

A SOCIAL REALIST STUDY OF EMPLOYABILITY DEVELOPMENT IN ENGINEERING EDUCATION

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Abstract

This qualitative case study of a course pairing offered to final-year electrical engineering students at the University of Cape Town in 2015 was undertaken in order to better understand the ways in which participation in undergraduate courses can prepare engineering students for the workplace. The course pairing consisted of *New Venture Planning* and *Professional Communication Studies*. While the former aimed to expose students to the knowledge relating to starting a new business, the latter focused on teaching students how to create written and oral texts to support such an endeavour.

Using Roy Bhaskar's critical realism as a theoretical underlabourer, the study develops understandings regarding the generative mechanisms at work during the two courses. In support of this, the study posits an understanding of employability that moves beyond the acquisition of discrete workplace skills. Rather, employability is conceptualised as discursive transformation, with students being deemed "work-ready" when they develop discursive identities as engineers.

Data generation took place by means of focus group and individual interviews, ethnographic observation and documentary research. Margaret Archer's social realist tools – in particular, analytical dualism and the morphogenetic framework – were used to trace the students' transformations over the course pairing. It was argued that those students who developed discursive identities of engineers were those who, in Archer's terms, emerged as social actors at the end of the course pairing. Two characteristics of the courses were found to enable this transformation: those parts that promoted deepened understanding of what the role of "engineer" entailed and the parts that provided spaces for students to develop their own personal identities.

The findings of the study indicated that discursive identities as engineers were more likely to be developed through the group work and spaces for reflection engendered by the courses than as a result of the formal curriculum. The implications of the research are that, while a focus on employability in engineering education is valid and productive, this needs to be supported by opportunities for authentic learning experiences which afford students the opportunity to engage in learning that promotes real-life application of knowledge.

Table of Contents

Abstract	i
Table of Contents	iii
List of Illustrations	vii
Figuresvii	
Tables vii	
Acronyms.....	ix
Acknowledgements	xi
1. Introduction.....	1
1.1. Background to the research.....	1
1.2. Research context	5
1.3. Research questions	7
1.4. Value of this study	8
1.5. Scope and limitations of this study	11
1.6. Thesis roadmap.....	12
2. Theoretical and conceptual framework	16
2.1. Ontology and epistemology	18
2.1.1. Bhaskar's critical realism.....	19
2.2. Employability.....	24
2.2.1. Employability as possession.....	25
2.2.2. Employability as positioning	29
2.2.3. Employability as processual	30
2.3. Reframing employability skills transfer	31
2.4. Perspectives on discourse	33
2.4.1. D/discourse and identity	35
2.4.2. Agency within discourse	37
2.5. Social realism	38
2.5.1. Analytical dualism	39
2.5.2. The morphogenesis of agency	45
2.5.3. Appropriateness of social realism.....	47
2.6. Conclusion.....	50
3. Research design	52
3.1. Research questions	52
3.2. Research methods.....	56
3.2.1. Generating data.....	58
3.2.2. Data analysis.....	67
3.3. Validity.....	75
3.3.1. Researcher bias.....	76
3.3.2. Reactivity.....	77

3.3.3. Lack of response variability.....	77
3.3.4. Summary: approach to validity.....	78
3.4. Ethics.....	79
3.5. Researcher reflexivity.....	81
3.6. Conclusion.....	84
4. Context of the study	85
4.1. Higher education in South Africa.....	87
4.1.1. Higher education during apartheid.....	87
4.1.2. The post-apartheid higher education system.....	88
4.1.3. The University of Cape Town.....	91
4.2. Engineering education.....	93
4.2.1. A historical perspective.....	93
4.2.2. Key issues in contemporary engineering education.....	95
4.2.3. Engineering education in South Africa.....	98
4.2.4. Engineering education at the University of Cape Town.....	103
4.3. Purposes of higher education.....	105
4.4. Conclusion.....	111
5. The case study courses	112
5.1. New Venture Planning.....	113
5.1.1. Curriculum.....	115
5.1.2. Assessment.....	117
5.1.3. Pedagogy.....	120
5.2. The Professional Communication Studies course.....	121
5.2.1. Curriculum.....	122
5.2.2. Assessment.....	124
5.2.3. Pedagogy.....	128
5.3. Conclusion.....	130
6. The macro-context of the New Venture Planning/Professional Communication Studies course pairing	132
6.1. Structural emergent properties.....	133
6.1.1. ECSA and industry.....	135
6.1.2. ECSA and higher education.....	137
6.1.3. Higher education and industry.....	139
6.1.4. Situational logics at T1 emanating from the structural emergent properties.....	142
6.2. Cultural emergent properties.....	145
6.2.1. Senior students and professionals in training.....	146
6.2.2. Elements of the “new engineer”.....	150
6.2.3. Situational logics at T1 emanating from the cultural emergent properties.....	155
6.3. Implications of the situational logics.....	156
6.4. Reintroducing the people.....	157
6.4.1. Double morphogenesis.....	158
6.4.2. Triple morphogenesis.....	160
6.5. Conclusion.....	163

7. The social interaction phase: structure and culture.....	164
7.1. Structural emergent properties.....	165
7.1.1 The Engineering and the Built Environment Faculty	166
7.1.2 The Electrical Engineering Department and the Professional Communication Studies Department	173
7.1.3 Situational logics arising from the relationship between the structural emergent properties.....	176
7.2 Cultural emergent properties.....	178
7.2.1 “Entrepreneur of the self” discourse	182
7.2.2 Discourse of “inevitability”	188
7.2.3 “One-size-fits-all” discourse	196
7.2.4 Situational logics arising from the relationship between the cultural emergent properties.....	201
7.3 Conclusion.....	202
8. The social interaction phases: agency	205
8.1. Paul: “Sometimes you just need to stand out”	209
8.2. Yasin: “As a group, we knew we’d make it eventually somehow”	214
8.3. Angela: “Right now, there isn’t really much time to learn about yourself”	219
8.4. Vuyo: “How is it going to affect my family and my social life after I graduate?”.....	224
8.5. Ravi: “I’m learning about ... everything that I want to learn about”	229
8.6. Faith: “I don’t know how many people came to varsity sure that they want to be engineers in the end”	233
8.7. Mike: “I may be a bit older and grumpier than a lot of the other people”	238
8.8. Conclusion.....	243
9. Conclusion	251
9.1. Responses to research questions.....	252
9.1.1. The structural and cultural emergent properties that operated at UCT and in the New Venture Planning/Professional Communication Studies course pairing	253
9.1.2. The pedagogic characteristics of the New Venture Planning/Professional Communication Studies course pairing that conditioned the development of discursive identities for the students.....	254
9.1.3. The constraints and enablements that students encountered in the development of discursive identities as engineers during the New Venture Planning/Professional Communication Studies pairing	255
9.2. Ways in which participation in an undergraduate course pairing prepares electrical engineering students for the workplace.....	256
9.3. Implications of the findings	259
9.3.1. The Engineering Council of South Africa	260
9.3.2. The Electrical Engineering Department at the University of Cape Town....	261
9.3.3. The discipline of engineering education	264
9.4. Not conclusions, but beginnings	267
References.....	271

Appendix 1: Engineering Council of South Africa Exit-level Outcomes	292
Appendix 2: Participants in each focus group interview	297
Appendix 3: Focus group interview guide	300
Appendix 4: Individual interview guide	303
Appendix 5: Nvivo coding categories T1-T4	305
Appendix 6: NVivo hierarchy charts for T1-T4	313
Appendix 7: Research consent form	314
Appendix 8: University of Cape Town ethics clearance	317
Appendix 9: Rhodes University ethics clearance	320

List of Illustrations

Figures

Figure 1: Maxwell's model of research design	17
Figure 2: The basic morphogenetic/static cycle (Archer, 1995: 157)	41
Figure 3: The emergence of personal and social identity (Archer, 2000: 269) ..	46
Figure 4: Three-dimensional conception of discourse (Fairclough, 1992: 73)...	74
Figure 5: Example of a PCS poster	125
Figure 6: Macro structures at T1.....	134
Figure 7: Relationships between the SEPs	142
Figure 8: Extract from the NVP course handout.....	189
Figure 9: Extract from the PCS course handout.....	196
Figure 10: The acquisition of social identity (Archer, 2000: 295).....	207

Tables

Table 1: Critical realist ontology.....	21
Table 2: The three domains	21
Table 3: Configurations of SEPs and CEPs and their situational logics	42
Table 4: Features of ethnography as social research as embodied in my participant observation	62
Table 5: Documentary data.....	67
Table 6: Students featured in the vignettes in Chapter 8.....	71
Table 7: Documents used for discourse analysis.....	73
Table 8: Some documents that have shaped the South African higher education sector.....	90
Table 9: 10 ECSA exit-level outcomes (ECSA, 2012: 4-6).....	100
Table 10: Undergraduate programmes offered by the UCT Department of Electrical Engineering.....	104

Table 11: Outline of the NVP course.....	116
Table 12: Mark breakdown for NVP.....	118
Table 13: Business plan sections and content.....	119
Table 14: Mark breakdown for business plan components.....	120
Table 15: Outline of the PCS course.....	123
Table 16: Mark breakdown for PCS.....	124
Table 17: Extract from the NVP handout	169
Table 18: Extract from the PCS course handout.....	171
Table 19: Condensed NVP course schedule.....	190

Acronyms

ANC:	African National Congress
CAQDAS:	Computer-assisted qualitative data analysis software
CEP:	Cultural Emergent Property
CESA:	Consulting Engineers South Africa
CHE:	Council on Higher Education
CR:	Critical Realism
CREE:	Centre for Research in Engineering and Science Education
CS:	Cultural System
DA:	Discourse Analysis
EBE:	Engineering and the Built Environment
ECSA:	Engineering Council of South Africa
ED:	Engineering Design
EIRC:	Ethics in Research Committee
ELO:	Exit-level Outcome
FOSS:	Free and Open-Source Software
GEAR:	Growth, Employment and Redistribution
HBU:	Historically Black University
HEI:	Higher Education Institution
HOD:	Head of Department
HWU:	Historically White University
IoT:	Internet of Things
MOOC:	Massive Open Online Courses
MoU:	Memorandum of Understanding
NQF:	National Qualifications Framework
NVP:	New Venture Planning
OHS:	Occupational Health and Safety
PAS:	Professional, Administrative and Support
PCS:	Professional Communication Studies

PEP:	Personal Emergent Property
QS:	Quacquarelli Symonds
RDP:	Reconstruction and Development Programme
SAICE:	South African Institution of Civil Engineering
SASEE:	South African Society of Engineering Education
SEP:	Structural Emergent Property
SR:	Social Realism
UCT:	University of Cape Town

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1. Introduction

1.1. Background to the research

One of the main purposes of the post-school system is to prepare workers for the labour market, or to enable individuals to earn sustainable livelihoods through self-employment or establishing a company or cooperative. Everyone should be able to make a living for themselves and contribute skills to a developing economy.

(DHET, 2013: 8)

The quote above is drawn from the South African Department of Higher Education and Training's (DHET) latest White Paper for Post-School Education and Training, which is a statement of the government's policy with regards to the higher education sector. The policy contains a strong declaration that links higher education, the labour market and "skills". There is nothing unfamiliar about this linkage or the oft-repeated criticism of university education in South Africa that it places insufficient emphasis on skills. Headlines such as "Students give it their best, but in the end employers find they are still not good enough" (Mungai, 2015) and "Employers lament lack of soft skills in graduates" (Nguyen, 2016) are common features in the popular media and imply that there is a mismatch between the demands of the labour market and the graduates who are produced by higher education institutions (HEIs). The "vocabulary of skills" (Fairclough, 1992: 209) implicit in this criticism of HEIs plays a key role in the commodification of educational discourse through its implication that the truly vital aspects of the education process (that is, the skills themselves) can be neatly divided into discrete units, to be bought and sold as goods on the educational market.

The skills discourse therefore raises issues concerning the relationships between various stakeholders in higher education, such as HEIs, employers, graduates and students. The concept of "employability skills" has also proved a useful catch-all

term that encompasses a myriad subtle, elusive and often intangible qualities and skills that employers demand of their workers. These may be general (e.g. “good communication skills”) or specific (e.g. “report writing”). They may refer to something that an individual can do (e.g. “proficiency with PowerPoint”) or the kind of person who someone is (a “good team player”). They situate a potential employee within a given work context by defining the qualities that that individual should exhibit in order to fit in (e.g. “works well under pressure”) and, in this way, serve to establish the boundaries for an industry, thus defining who is welcomed and who is barred from entry. For example, the fact that South African employers demonstrate a preference for graduates who can speak and write fluently in English (Baldry, 2016) may effectively exclude a large proportion of graduates who are second- or third-language English speakers from the workplace.

These issues related to the skills discourse have become entrenched in the discussion regarding graduate unemployment in South Africa, which was one of the issues brought to the fore in the wake of the national student protests that occurred in 2015, 2016 and 2017 (Langa, 2017; Pennington, Mokose, Smath & Kawanu et al., 2017). While there is some contention concerning the perceived (as opposed to the actual) rates of graduate unemployment in the country (Baldry, 2016; van Broekhuizen, 2016), photographs of graduates holding up signs on which they begged for jobs at traffic lights highlighted the severity of this issue for many young South Africans. (See, for example, Madibogo, 2016, and Genever, 2016). Investigations into the reasons behind the high rate of graduate unemployment have identified a number of different issues, which have gone on to become part of the national debate concerning higher education in South Africa. The fact that students are perceived as not possessing the requisite employability skills features highly in this regard.

It is in this context, in which the “skills project” has generally been regarded as unsatisfactory, that my personal involvement in higher education began. For nearly a decade, I have been a part-time lecturer at the Professional

Communication Studies (PCS) Department, which is located within the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town (UCT). The objective of the PCS Department is to assist senior undergraduate students to develop the written and oral communication skills that they will require in the engineering industry. In addition, the Department teaches “soft” skills such as teamwork, negotiation skills and leadership development – essentially all the employability skills that pundits claim that new graduates entering the industry lack. Our courses are very practical, as they require students to develop skills through presentations and the creation of texts similar to those that would be encountered in the industry, such as reports, business plans and posters. Small class sizes allow for the inclusion of interactive pedagogies such as discussions, role-play exercises and simulations of professional environments. I have always found teaching in this department to be personally stimulating and invigorating, and I have relished the connections that I have made with engineering students and the opportunity to be part of their educational journeys. Likewise, student feedback regarding our courses is almost universally positive: For example, following the PCS course that forms part of the case study reported on in this dissertation, some student comments included “it has given me confidence and insight of communication in the working environment”; “the detail that was required in the assignment forced us to learn a lot about the business industry”; and “[the course] gave me a better understanding of the real world” (Department of Professional Communication Studies, UCT, 2015a).

Yet, despite my enjoyment of my job and the positive responses from students, I have, over the years, experienced a growing sense of discomfort with my subject. This started with small issues – for example, noting the advantage that students who were first-language English speakers had when writing reports under test conditions – and grew to the point that I was questioning the very *raison d’être* of the PCS Department. Who was I, as a Humanities graduate with no EBE industry experience, to be telling engineers-in-training how they needed to behave in the workplace? In attempting to develop the same employability skills

in all of our students, was our Department simply feeding a giant labour-market system, with no regard to nurturing students' individuality? Finally, was the concept of developing students' workplace skills while they were still enrolled at university even possible, given the vast differences that exist between the academic and industry contexts?

This PhD study emerged in response to my personal struggle to reconcile these complex intellectual, and often emotional, challenges to my practical work as an educator. I was spurred on by the following words of Foucault (1973: 22):

We must question those ready-made syntheses, those groupings that we normally accept before any examination, those links whose validity is recognised from the outset; we must oust those forms and obscure forces by which we usually link the discourse of one man with that of another; they must be driven out from the darkness in which they reign.

Thus, while undertaking this research, my objective was to drive my taken-for-granted beliefs concerning what I taught "out from the darkness" in order to examine them and thereby "make the familiar strange" (Mercer, 2007: 7). I knew that the only way in which I could begin to understand how (and, indeed, whether) what I did every day – teaching employability skills to engineering students – actually had an impact on them was to disrupt my practice with new modes of thinking about issues such as skills development, the labour market and the purposes of higher education. During my PhD journey, I identified tools that could support me in this pursuit; these were the theoretical frameworks offered by critical realism (CR) and social realism (SR). My initial unfamiliarity with these tools and the "messy" process of working out how best to apply them to the teaching context with which I was so familiar were invaluable in helping me to develop new ways of understanding the relationship that exists between higher education and industry and the role that employability skills initiatives play in facilitating this relationship.

The central argument that I make in this research is that, while a focus on workplace readiness in engineering education is valid and productive, it needs to

be underpinned by a conceptualisation of employability not as the acquisition of a set of discrete, decontextualised skills, but rather as a process of identity development. When students are given opportunities to experiment with their burgeoning identities as professionals, particularly through authentic learning activities, this can lead to the development of their discursive identities as engineers, which promotes workplace readiness. This conclusion emerged from close study of a course pairing offered to fourth-year electrical engineering students at UCT in 2015, which is described in greater detail in the following section.

1.2. Research context

The course pairing that I used as a case study was comprised of the New Venture Planning (NVP) and the Professional Communication Studies (PCS) courses. These ran in tandem, with students registered for both concurrently. In NVP, students worked together in small groups in order to develop a concept for an electrical engineering-related product or process that could become a viable money-maker. This then became their “new venture,” which they worked on in both courses during the semester. The NVP course content focussed on all the aspects of developing an engineering-related entrepreneurial concept, including market assessment, financial projections and issues concerning health and safety. Students who participated in the PCS course employed the same new venture product/process and worked in the same groups to develop relevant industry-style texts. These included a summary of a business plan, a poster that targeted potential investors and a group presentation to be delivered to potential funders. The NVP/PCS course pairing was chosen as a focus for this study because of the explicit goal of developing students’ employability skills featured in both courses. For the NVP course, the focus was on business-related skills, while the PCS course emphasised written and oral communication skills and issues associated with group dynamics, leadership and negotiation skills.

It is worth noting that the inclusion of these kinds of skills in engineering programmes in South Africa is a requirement for accreditation by the Engineering Council of South Africa (ECSA), which specifies the exit-level outcomes (ELOs) that students graduating from these programmes must exhibit in its “Qualification Standards” document. At the time of writing, the Electrical Engineer Department at UCT was guided by Revision 3 of the Qualification Standards for Bachelor of Science in Engineering (BSc[Eng])/Bachelors of Engineering [BEng]) (ECSA, 2012), which consists of 10 ELOs.¹ (The full document can be found in Appendix 1.) This document includes a reference to the importance of a focus on “complementary knowledge” within an engineering programme. In addition, it directly mentions the kinds of employability skills that were taught in the NVP/PCS course pairing in several of the ELOs, including the following:

- **ELO5:** Engineering methods, skills and tools, including information technology;
- **ELO 6:** Professional and technical communication;
- **ELO 8:** Individual, team and multidisciplinary working;
- **ELO 9:** Independent learning activity; and
- **ELO 10:** Engineering professionalism.

The importance of ECSA accreditation for a South African engineering programme cannot be overstated: Accreditation means that the graduates of a programme will be eligible to register as professional engineers with ECSA once they have gained sufficient experience, which confers a host of employment and lifestyle benefits. Furthermore, ECSA is a signatory to the Washington Accord, an international agreement that allows graduates from certain countries to work globally. Losing accreditation would most likely signal the death knell for an engineering programme, since students would almost certainly prefer to study at institutions that offer accredited programmes. As such, it is in the best interests

¹ A subsequent revision to ECSA’s Qualification Standards was published in 2014, which consists of 11 ELOs.

of any engineering department to fulfil ECSA's ELO requirements, and this explains the necessity of including material such as that addressed in the NVP and PCS courses in electrical engineering degrees. However, a danger exists that, in ensuring that all of ECSA's ELOs are covered in an engineering programme, those planning curricula may adopt a check-list mentality, simply slotting ELOs into a programme in order to be able to "tick them off", without critically engaging with issues concerning what is being taught, how it is being taught and best practice in this regard. This PhD research project arose in response to this ad hoc approach; it represents a bid to better understand the potential impact of employability skills initiatives such as the NVP/PCS course pairing.

1.3. Research questions

The main research question that guides this study is therefore as follows:

In what ways can participation in an undergraduate course pairing prepare electrical engineering students for the workplace?

The research sub-questions are as follows:

- What structural and cultural emergent properties operate at UCT and in the NVP/PCS pairing?
- What are the pedagogic characteristics of the NVP/PCS pairing that condition the development of discursive identities for the students?
- What are the constraints and enablements that students encounter in the development of discursive identities as engineers during the NVP/PCS pairing?

1.4. Value of this study

As stated in Section 1.1 above, this study arose out of a personal desire to better understand the impact of the PCS courses that I have taught for nearly a decade on students. To this end, using Bhaskar's (1975) critical realism (CR) as a meta-theoretical framework provided me with a method of looking beneath the surface of my experiences or, in other words, adding ontological depth to my understanding of what my students and I experienced during PCS courses. This was a result of Bhaskar's (1975) exhortation that researchers look beyond the domains of the empirical and the actual to the domain of the real in order to learn more about the mechanisms that underpin interactions in the social world. Further, the tools offered by social realist Margaret Archer (1995, 2000, 2003), including the morphogenetic cycle and analytical dualism, provided me with a framework with which I could develop analytical histories of emergence that took into consideration the impact of structure, culture and agency in the conditioning, interaction and elaboration phases of the NVP/PCS course pairing. Thus, the processes with which I engaged in in order to produce this dissertation – from the literature study and engagement with policy to student interviews and immersion in theory – all led me to far richer understandings of the concept of work-readiness in general and the impacts of the NVP and PCS courses on the students more specifically. This has certainly influenced me as a practitioner, and I have seen how the *manner* in which I teach and *what* I teach has transformed as my personal practice has become grounded in research backed up by theoretical rigour.

However, the purpose of a PhD study is not solely to fill gaps in a researcher's personal knowledge. According to Rhodes University's "Guide for Masters and Doctoral Students", a PhD dissertation must show that a student "has made a substantial and original contribution to knowledge in the discipline" (2016: 5). There are several ways in which this dissertation fulfils this requirement; one of these relates to the research approach that I have adopted in this study. Given that many engineering educators originally hail from engineering faculties, there

is often a natural bent in engineering education research towards the more quantitative methods that are ubiquitous in these fields (Borrego, Douglas & Amelink, 2009). While these can be valuable in terms of reducing the causes of outcomes to specific sets of variables, qualitative studies such as the this are equally essential in order to provide deeper insight into the explanations *behind* the data. For example, while administering a Likert-scale survey to students enrolled in the NVP/PCS course pairing could have determined whether they found value in the courses and their responses to different aspects of the courses' content, I believe that it is only through in-depth personal engagements, such as the two sets of interviews and my on-going engagement with students over the course of a semester that I carried out in my research process, that these responses can be contextualised. Moreover, by applying the theoretical frameworks described above, I have been able to develop rich explanatory narratives of emergence. These provide answers to the core CR question (Easton, 2010: 121), namely "what caused those events to happen?" and, through highlighting the generative mechanisms behind the NVP/PCS course pairing, I have been able to develop an understanding of employability skills initiatives in higher education that has a broader scope than that afforded by UCT's Electrical Engineering Department.

While it is my personal hope that the findings of this study might be used to develop innovative approaches to supporting engineering students as they prepare to move from university to industry, it is clear that this is more than just an idealistic aspiration. Rather, this dissertation and the knowledge developed concerning workplace readiness, employability, skills development, engineering education and professionalism also fulfil a current research demand in South Africa. The DHET's "Research agenda: 2017-2020", which sets out the most pressing research needs of the Department, specifically mentions "Skills planning: analysis of skills needs" (DHET, 2017: 11) as one of its focus areas. The fifth key theme under this focus area is as follows:

5. Employability (What is employability? How is the notion of employability reflected in existing DHET policy and legislation? What kinds of knowledge, skills and attributes of new graduates are employers looking for? What must Education and Training Institutions do to improve employability?)

(DHET, 2017: 12)

The question of employability is at the very core of this study's conceptual framework, and, as such, it informs choices concerning methods and analysis and, as a result, the findings of the research. My study, therefore, is directly in accordance with the DHET's research foci. Furthermore, the topic of my dissertation is also aligned to ECSA's call for regular studies regarding the effectiveness of the engineering programmes offered by universities in meeting its objectives (ECSA, 2014a: 4). The results of these studies should, according to ECSA, be used to improve programme design, delivery and resourcing; in addition, they should be used for the purposes of staff development and student support where necessary.

Finally, this thesis rests on a conceptual repositioning of the concept of employability from a set of isolated skills to part of a larger process of engineering identity development. While this may have been a theoretical shift, engineering education scholarship has shown that developing richer understandings of how engineering students develop professional identities can potentially yield very positive and tangible contributions, since engineering identity (or lack thereof) is often a mediator for other important educational issues. For example, Tonso (2014: 267) shows that the strength of students' identification with engineering can be critical in terms of their persistence, with those who experience a lack thereof often migrating to other fields of study. Similarly, graduates who leave higher education strongly identifying as engineers may be more likely to remain in the industry once they enter the workplace (Eliot & Turns, 2011). Given the shortfall in the numbers of engineers in South Africa – according to ECSA's website, in South Africa, one engineer services 3,166 people, compared to Brazil's 227 and Malaysia's 543 per engineer (ECSA, n.d.) – research

that could potentially lead to a greater number of students and graduates desiring to remain in the engineering profession could ultimately be for the public good, as engineers are vital for infrastructure development and subsequent economic growth. While my study deals with a single case study, there is a focus throughout on how the development of discursive identities as engineers does/does not take place for the participants, and these findings will hopefully (as discussed previously) be used to develop more effective engineering education initiatives.

1.5. Scope and limitations of this study

Since this dissertation presents a case study, it is naturally bounded in that its location in a particular context (in this case, the Electrical Engineering Department of UCT's EBE Faculty) means that its findings cannot represent the state of employability development in other engineering contexts within the field of higher education. This is especially the case given that my analysis focuses on the structural and cultural context of this research, in accordance with Archer's (1995) realist social theory. For this reason, I acknowledge that the conclusions drawn from the study, as well as the recommendations made in Chapter 9, will not necessarily be directly applicable to other engineering programmes, even those located within South Africa. Nevertheless, at least some of the generative mechanisms that are identified in this dissertation as having underpinned the NVP/PCS course pairing might be familiar to readers, and my hope is that those who are situated in different contexts will be able to engage with my content in ways applicable to them.

Furthermore, this research into higher education is situated against the backdrop of student protests across South Africa. It was in the second half of 2015, just after I had completed my fieldwork, that the #RhodesMustFall movement, which saw students demand the removal of a statue of Cecil John Rhodes prominently located on campus, arose at UCT. This movement spread to other campuses in South Africa, and sparked further student activism, including

the #FeesMustFall movement, which includes as a core demand free decolonised education for all. This means that current debates and discussions around higher education – or what Gee (2014: 46) calls “society’s conversations” – are dominated by a focus on the issues associated with these movements, such as identity politics, racial inequalities on campuses, lack of institutional transformation and demand for curricula that reflect South African and African ontology and epistemology. While this dissertation neither deals explicitly with the trajectory of these movements nor directly with the issues that they have sparked, to not incorporate them in this discussion would be to ignore important structural and cultural contexts that impact on the ways in which agency (and, more specifically, engineering identity) is able to transform. As such, where doing so is relevant, I have made references to #FeesMustFall. This is particularly the case in Chapter 7, where the focus on cultural emergent properties (CEPs) in the NVP/PCS course pairing turns to a discussion of neoliberalism.

Finally, while the engineering sciences are a key aspect of the Electrical Engineering curriculum, thereby likely also impacting identity formation amongst students, the focus of this study is limited to the two case study courses: NVP and the PCS course.

1.6. Thesis roadmap

Following this introduction, I provide an overview of the theoretical and conceptual framework adopted for this research in Chapter 2. The chapter begins by outlining the ontological and epistemological underpinnings of the study, with specific reference to Bhaskar’s (1975) CR. Thereafter, it moves to a discussion of various approaches to employability, leading to a justification of my rejection of the notion of the “simple” transfer of employability skills. The focus of the chapter then shifts to the concept of discourse, linking it to both identity and the enactment of agency. This leads to a discussion of Archer’s (1995) realist social theory, with specific focus on analytical dualism, the morphogenesis of agency and the relevance of applying Archer’s theories within a higher education

context. A discussion of some criticisms of CR and SR is then followed by a conclusion, which outlines how these elements come together in this study.

Chapter 3 deals with the research design I adopted for this study. It begins by identifying my research questions and provides an explanation of my choice to utilise a qualitative case study methodology. Thereafter, it shifts to a discussion of the research methods employed, including data generation and analysis, and, while the focus is on how these procedures were carried out, there is also reference to their appropriateness given the CR and SR underpinnings of this research. The subsequent focus on validity is intended to indicate my acknowledgement of the ways in which my findings “might be wrong” (Maxwell, 2013: 123) and the strategies that I implemented in order to address these. This is followed by a description of a number of additional ethical issues. Finally, the section on Researcher Reflexivity is an outline of my position within the research site and the ways in which this may have impacted my findings.

In Chapter 4, I present a contextual overview of this study.² This chapter begins with a brief discussion of the history of higher education in South Africa that outlines the shifts that occurred because of, and subsequent to, the end of apartheid. Thereafter, the chapter’s focus moves to the field of engineering education, offering a historical perspective on its genesis and highlighting some key contemporary issues in the field, before narrowing the discussion to engineering education in South Africa. The final section of this chapter considers some core debates concerning the purposes of higher education. These are relevant to the study because they provide background to the goals of employability initiatives such as the NVP/PCS course pairing.

² The reason I chose to include this content *after* the chapter on the theoretical and conceptual framework is because I believed it was necessary for the reader to have a firm base of understanding of the SR concept of analytical dualism, and specifically “structure” and “culture”, before engaging with the macro-environment in which my research is located. The result of this is that the reader is able to engage with the contextual information concerning the NVP/PVS course pairing fully aware of the significance of the context to the SR analysis that follows in later chapters.

Chapter 5 presents an overview of the NVP/PCS course pairing. Both courses are described in detail, including aspects of their curricula, modes of assessment and pedagogy. In addition, the motivation behind presenting the two courses together as a pairing is also addressed. The purpose of this chapter is to provide relevant context, thus ensuring that the reader is equipped with the knowledge of the two courses required to understand the analysis that follows in the subsequent chapters.

The application of Archer's morphogenetic cycle begins in Chapter 6, which presents an overview of the structural and cultural emergent properties (SEPs and CEPs) at the start of the NVP/PCS course pairing, which, in Archer's terms, is Time 1 (T1) of the morphogenetic cycle. It identifies the agents at this socio-cultural conditioning stage and suggests how this context has been shaped by double and triple morphogenesis in previous morphogenetic cycles. This chapter answers the first research sub-question of this dissertation, which relates to the SEPs and CEPs operating at UCT and the NVP/PCS pairing from a macro-societal perspective.

Chapter 7 moves to the following stage of the morphogenetic cycle, T2-T3, which Archer describes as the "interaction" phase. Again, the analytical categories of SEPs and CEPs are used in order to analyse what occurred during the course pairing or, in Archer's terms, the situational logics that arose from the relationships between SEPs and CEPs. This is vital for the purposes of this study in that it describes the effect of cultural and structural conditions on the agents, i.e. the individuals who participated in the NVP/PCS course pairing. In addition, this chapter answers the second research sub-question regarding the pedagogic characteristics of the NVP/PCS pairing that contributed to this conditioning of the development of discursive identity.

This sets the stage for Chapter 8, which answers the third research sub-question regarding the constraints and enablements that the students encountered in the

development of their discursive identities as engineers. It does so by focussing on the morphogenesis of agency in T2-T3. Seven student “vignettes” provide analytical narratives that offer in-depth discussions of how specific students mediated the structural and cultural conditioning discussed in the previous chapter. In doing so, it draws conclusions concerning the ways in which these students did/did not develop discursive identities as engineers.

Chapter 9 presents this study’s conclusions. This chapter begins with an overview of the answers to the research questions and shows how they relate to the existing perspectives on employability development. This is followed by a discussion of the implications of my research findings, as well as potential future directions for research into employability development within the field of engineering education.

2. Theoretical and conceptual framework

Sometimes it's necessary to go a long distance out of the way in order to come back a short distance correctly.

(Albee, 1962: 125–126)

The quote above is drawn from the play *The Zoo Story* (1958) by American playwright Edward Albee. In the context of the plot of this play, the “long distance” alludes to a situation in which the protagonist institutes a long-term plan in order to achieve a seemingly straightforward goal. This quote resonates with my experience as a PhD scholar examining my own site of teaching practice. The case study that I researched for this dissertation was only a “short distance” from me, given that the two courses I examined were located in the engineering department in which I teach and that the focus of my research – employability skills development in engineering education – was the very subject matter that I taught. Yet, as I came to learn, in order to understand a context that is only a “short distance” away in a manner that is both appropriate and in-depth, it is necessary to move a “long distance” away in terms of the conceptual skills and theories that are drawn on in order to develop meaning.

This is a fundamental stage in the process of “making the familiar strange”, which, as I stated in Section 1.1, was one of my main personal aims during the research process. As I engaged with the literature, the research generation process and my analysis, my emerging theoretical and conceptual framework led me to identify analytical tools that challenged me by presenting new ways of understanding my case study site. These new approaches ranged from fresh perspectives on concepts that I had always taken for granted, such as “employability” and “skills development”, to deeper epistemological and ontological theories that literally changed the manner in which I view the world. Most importantly, I came to realise that a strong theoretical and conceptual framework, based on a clearly articulated ontology and epistemology, was essential to all aspects of the research process. In this sense, I was heavily

influenced by Maxwell's (2013) interactive model of research design which is depicted in Figure 1 below:

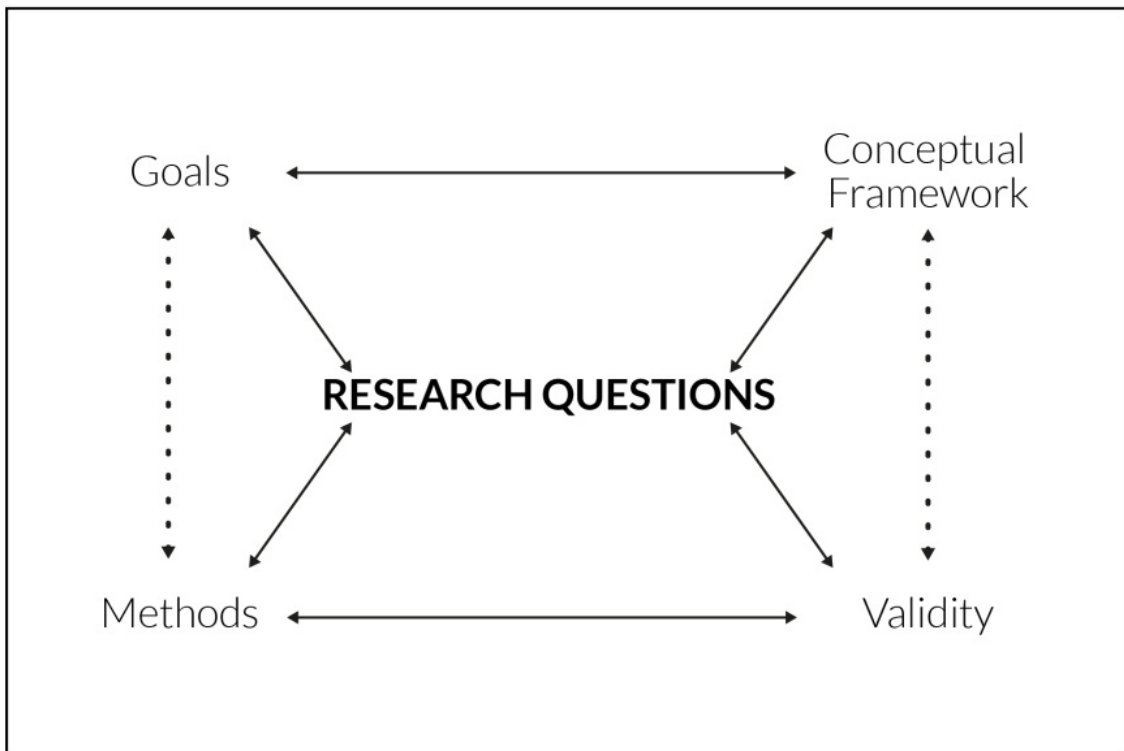


Figure 1: Maxwell's model of research design

In Figure 1 above, Maxwell (2013) presents what he calls a model *of* as well as *for* research in that it is not a prescriptive, step-by-step guide of how to go about conducting a study. Rather, through the linkages between different components of the research project (indicated by the bi-directional arrows), the model highlights how closely aligned these components should be. This chapter deals with the upper triangle of the model (the lower triangle is the focus of Chapter 3). The focus is on demonstrating how the theoretical and conceptual framework that is described in the remainder of this chapter is aligned with the goals of the study (as identified in the previous chapter) and the research questions. In this manner, while the theoretical perspectives outlined below may be, referring to Albee's quote above, a "long distance" away from the buzz of a PCS workshop, they are central in the findings that emerge from this research.

2.1. Ontology and epistemology

It is clear from the introduction above that, while conducting this study, I placed strong emphasis on the concept of alignment between the different elements of the research process. Part of the strategy that I adopted to achieve this was the development of a clear theoretical and conceptual framework. The development of this framework was iterative in that I moved back and forth between the elements of Maxwell's (2013) model (as depicted in Figure 1) and my developing theories in order to construct my formulation of what was taking place in the NVP/PCS course pairing. Part of this process entailed the use of Roy Bhaskar's critical realism (CR) as a theoretical underlabourer for the study. Bhaskar's CR posits clear explanations of ontology and epistemology, and these, along with Bhaskar's descriptions of transitive and intransitive objects of knowledge and the three domains of reality, empowered me to look beyond the surface of the context that I was so closely involved with by guiding my researcher's gaze to the emergent mechanisms that were active within this context.

While I, as a fledgling researcher, felt liberated by CR's explicit ontology, there is clearly a lack of consensus concerning the usefulness of this type of theory within the social sciences. For example, Tsilipakos (2012) argues that a reliance on ontology leads to nothing more than continuing confusion, as the questions of "what there is" and "what properly explains it" run together through the causal criterion of existence, resulting in conceptual perplexity. Likewise, Kemp (2005) argues that social scientists' search for generally accepted frameworks draws focus away from what he believes should be the main goal of research, namely empirical explanations and problem solving activities that can produce substantive theories of the social world. These perspectives clearly view a focus on ontology as a limiting factor for researchers. With specific reference to CR, Cruikshank (2004) goes so far as to call it a "hegemonic project" and a "dogmatic metaphysical claim". This, however, was not my experience; rather, for me, the affordance of CR lay in what Easton (2010: 119) deems CR's fundamental tenet: that causal language can be used to describe the world. Given that the goal of my

research was to better understand my practice as a PCS lecturer within an engineering department at a higher education institution (HEI), Bhaskar's ontology and epistemology provided me with a philosophical approach to developing explanations that are intellectually robust and coherent. I do acknowledge that there may be other philosophies that could also have provided me with a way "in" to this research project that maintained the alignment of the various aspects of Maxwell's (2013) model. However, my use of Bhaskar's CR was more reflective of Kemp's (2005: 185) statement that ontologies "...should be taken not as legislating the framework within which research must be conducted, but instead taken as possible inspiration for ways of thinking about research questions, which may turn out to be more or less productive". To this end, rather than superimposing Bhaskar's philosophies directly onto my research context, I moved back and forth (Carter & New, 2004: 28) between the data and realist social theory throughout the process of my research; thus, my research questions, data generation and analysis all informed *and* were informed by my conceptual framework. The elements of Bhaskar's CR that particularly contributed to this research project are outlined in the following section.

2.1.1. Bhaskar's critical realism

Critical realism (CR), a perspective most closely aligned with the philosophy of Roy Bhaskar (b.1944; d.2014), arose as a counter to the positivist thought that underpinned research in the sciences since the 1930s (Danermark, Ekström, Jakobsen & Karlsson, 2002: 4). Bhaskar argued that positivism is based on an empiricist ontology whereby statements about being can be reduced or analysed in terms of statements about knowledge; in other words, "ontological questions can always be transposed into epistemological terms" (Bhaskar, 1998: 28) or, as Danermark et al. (2002: 3) explain, what is is reduced to what we can know about it. Bhaskar terms this the "epistemic fallacy". Part of his criticism of the epistemic fallacy is the "concealed anthropocentricity" on which it depends, namely the view that, without human experience, the laws of science would cease to prevail.

Bhaskar's response to empiricism is manifold: First, he draws a distinction between *intransitive* and *transitive* objects of knowledge (Bhaskar, 1975: 21). Intransitive objects of knowledge, he explains, are things that are not produced by humans at all. Some examples that he offers are the specific gravity of mercury, the process of electrolysis and the mechanism of light propagation (Bhaskar, 1998: 16). These intransitive objects of knowledge are not changed by humans' knowledge of them and are independent of us. Transitive objects of knowledge, in contrast, relate to knowledge produced by humans, such as facts, theories, paradigms and models. Bhaskar (1998: 16) terms these transitive objects of knowledge the "raw materials of science" in that they form both the building blocks and the outcomes of the work of science. Thus, science creates knowledge about an intransitive object and this, in turn, becomes the raw material of future scientific work. Yet, no matter how much science deepens knowledge of an intransitive object, its product remains a transitive object (Collier, 1994: 51).

This distinction between the transitive process of knowledge creation and the independent intransitive objects of the knowledge that these processes produce provides scope for Bhaskar to develop a sociology of knowledge (Collier, 1994: 51). This is possible due to the notion that events are independent of experience and that a world of events could occur without human experiences thereof (Bhaskar, 1998: 24). This leads to the second key concept in Bhaskar's response to empiricism, which was integral to my study, namely his conception of the world as differentiated and consisting of three ontological domains: the domain of the actual, the domain of the empirical and the domain of the real (Bhaskar, 1975: 13). The CR ontology, as portrayed by Case (2013: 37), is illustrated in Table 1 below:

Table 1: Critical realist ontology

Level	Referring to
Empirical	Subject experiences
Actual	Object observations
Real	Mechanisms that underpin actual observations and empirical experiences

As is evident from the above table, Bhaskar's ontology takes into consideration the aforementioned distinction between the empirical (the subjective perceptions of individuals) and the actual (the objective world of events). This separation means that what occurs in the world is not the same as what is observed and that events transpire whether we experience them or not (Danermark et al., 2002: 20). However, it is in Bhaskar's third domain, the domain of the real, that the mechanisms that generate events are to be found. Bhaskar (1998: 34) emphasises that these generative mechanisms are independent of the events that they generate and endure even when they are not acting. He thus presents a depth ontology (in contrast to the "flat" ontology of empiricism) wherein "structures and mechanisms are real and distinct from the patterns of events that they generate; just as events are real and distinct from the experiences in which they are apprehended" (Bhaskar, 1998: 41). Nevertheless, the three domains overlap, as is evident in Table 2 below:

Table 2: The three domains

Level	Domain of Real	Domain of Actual	Domain of Empirical
Mechanisms	✓		
Events	✓	✓	
Experiences	✓	✓	✓

Bhaskar (1975) also distinguishes between closed and open systems. A closed system, which characterises the majority of the research conducted in the natural sciences, exists when generative mechanisms operate in isolation and independently of other mechanisms. In a closed system, no new emergent powers and mechanisms can develop, since the external conditions of the causal mechanism remain constant (Scott, 2005: 643). This creates the possibility of the production of regularity (Danermark et al., 2002: 67). The concept of an open system lies in contrast to the closed system exemplified by the experiments conducted in the natural sciences. In an open system, no constant conjunction of events prevail (Bhaskar, 1998: 25). This is because, in an open system, the generative mechanisms studied operate in complex interactions with other mechanisms (Danermark et al., 2002: 199), which either cooperate with or work against the mechanism in question. Thus, objects do not operate in a consistent manner, and the external conditions for the exercise of the causal mechanisms change (Scott, 2005: 643). This typifies human and social phenomena (Danermark et al., 2002: 39) and, as such, research in the social sciences usually takes place within an open system, as does the NVP/PCS course pairing that is the focus of this dissertation. Collier (1994: 121) links this to the concept of a stratified reality by explaining that the lower strata are closer to a closed system, as 'higher' level mechanisms are rooted in, and emergent from, more basal ones. Hence, he explains that "it is often possible to isolate a system from processes generated by 'higher' strata, but never possible to isolate one from those generated by 'lower' strata" (Collier, 1994: 121).

In open systems, a number of mechanisms are at play concurrently, bringing about a series of events that would not have been brought about by any subset of those mechanisms (Collier, 1994: 44). Thus, in considering methodology, scientific experimentation, which usually focuses on a single mechanism in isolation and records its effects (Bhaskar, 1998: 41), is inappropriate for studies in the social sciences. Danermark et al. (2002) also draw a distinction between the objects of natural and social science, respectively: Both are theoretically and/or ideologically conditioned and dependent on theories, since transitive

knowledge is always a social product. However, whereas “the objects of natural science are indeed socially defined but still naturally produced, the objects of social science are both socially defined and socially produced” (Danermark et al., 2002: 31). Yet, for both the natural and social sciences, according to CR, there is an objective reality.

Conceiving of the world according to Bhaskar’s three domains described above means that, for this research project, I had to reject the view that variables can mirror facts and that correlations between variables represent causal relations (Cruickshank, 2003: 2). Rather, variables are considered to always be conceptual interpretations and correlations are descriptions (since they are the effects of underlying causal processes). In addition, Scott (2005: 643) emphasises that educational research takes place within an open system, as the objects that it deals with, such as individual behaviours, the relations that exist between individuals and the structural properties of systems, change across time in different settings. This reflects the dynamic nature of the higher education sector in which my study is located, influenced as it is by various levels of staff, students, national and institutional policies, labour market trends, social demographics, and so on.

This epistemological and ontological framework had several implications for my study: First, since all research is transitive and produced by humans and is therefore inevitably fallible, my responsibility as a researcher was not to attempt to seek absolute knowledge but rather to strive to develop superior interpretations of reality (Cruickshank, 2003: 2). Second, the fact that this study is located within the open system of society had methodological implications since scientific experimentation of the kind that occurs in the closed systems of the natural sciences were not possible. Instead, I utilised a wide variety of data-generating sources (these are outlined in Chapter 3). Finally, in seeking to avoid the epistemic fallacy, it was essential that I did not merely report on the case study courses and the ways in which the interview participants described them; rather, I also had to consider the mechanisms in the domain of the real.

This affected my choices regarding data analysis, which are also further discussed in Chapter 3.

It is clear from this brief introduction to the theoretical framework that underpins this study that there are a number of ways in which CR is critical: First, since one of the tenets of CR is the fallibility of transitive human knowledge when describing reality, any attempt to explain the world cannot be justified in any absolute sense and is always open to critique (Scott, 2005: 635). Second, CR is critical because the concepts that inform it can only be developed via a critical dialogue with alternative social ontologies (Cruickshank, 2003: 3). Finally, Cruickshank (2003: 3) emphasises that CR is also critical in a political sense; this is because CR research moves beyond empirical facts to deeper domains, which leads to a focus on values. In doing so, it is able to develop critiques of the social, political and economic relations that give rise to inequality and exploitation. This was particularly important for me given that the South African higher education system is so fundamentally tied to issues of the country's complex past, present and future. The South African higher education sector is a meeting point for a host of social issues within the country, such as transformation, discrimination and poverty (these are discussed further in Chapter 4); as such, I felt strongly that the meta-theory that I adopted for the purposes of this PhD should have the capacity to yield critical insights.

2.2. Employability

The previous section demonstrated how CR influenced my research process, both in terms of defining a meta-theoretical approach and concerning the methodology that I chose to adopt. The chapter now moves towards an explication of the key theoretical concepts that inform this study. In CR terms, these are the transitive objects of knowledge that form the building blocks of the study and provide lenses through which one can begin to understand the mechanisms at play within the deeper domains of reality.

One of the core concepts that I deal with in this study is “employability”. Holmes (2013: 538) explains that, irrespective of geographical or socio-economic context, individuals enter and progress through higher education as students and, should they complete their courses of study, exit as graduates. They then progress to their post-graduation lives, during the course of which it is expected that they will assume influential roles in society, the economy and/or the political sphere. Thus, the manner in which higher education institutions prepare students for their post-graduation lives is of concern to a variety of stakeholders. It is in this context that the concept of employability emerges, although, as will become clear, it is a notion that has been much problematised.

Boden and Nedeva (2010: 42) trace the changing nature of the term “employability”: In the early twentieth century, they explain, debates concerning employability related to the economic value of education or how education related to the labour market. By the early twenty-first century, however, the focus had shifted to personal skills and knowledge. The authors outline how this was articulated in two ways: First, employability was understood as an individual gaining and retaining fulfilling work. According to this conception, a graduate is viewed as employable if she is able to secure a job. However, the second approach to understanding employability delved more directly into what it is that enables her to appeal to a range of potential employers. This may be in terms of skills, achievements or attributes. Holmes (2013) outlines three perspectives on employability: possession, positioning and processual.

2.2.1. Employability as possession

The understanding described above, wherein employability is viewed as a characteristic of individuals who have graduated from HEIs (Holmes, 2013: 542), is in accordance with the first of Holmes’s perspectives, which views employability as the possession of particular skills or attributes. Hinchcliffe and Jolly (2011: 566) refer to this as the “list approach to employability”. According to this perspective, skills that are not specific to any particular subject area or

career path are generic, apply generally to the workplace and are common to both general and vocational education are included in the education process in order to enhance a graduate's likelihood of becoming employed and ability to function in a job.³ Examples of these kinds of skills include communication skills, technological proficiency, teamwork and the ability to select and evaluate information.

The objective of developing these so-called employability skills in higher education is that newly employed graduates will be able to “hit the ground running” when they begin their careers. Tomlinson (2012: 412) outlines how policy has responded to this notion of enhancing graduate employability through the development of particular skills, with Griesel and Parker (2009: 4) highlighting the Mayer Report (1992) and the Finn Report (1991) from Australia, the Dearing Report (1996) from the United Kingdom and the Secretary's Commission on Achieving Necessary Skills (2000) from the United States as examples of publications that identify skills that are seen as essential features of employability. In South Africa, the seven critical cross-field education and training outcomes (or critical outcomes) describe the generic qualities identified in the National Qualifications Framework for development in students within the country's education and training systems (SAQA, 2000). These are as follows: identify and solve problems using critical and creative thinking; work effectively with others; organise and manage oneself and one's activities; collect, analyse, organise and evaluate information; communicate effectively; use science and technology effectively and critically; and demonstrate an understanding of the world as a set of related systems. In addition, concern for generic skills is also evident in local engineering education, with the Engineering Council of South Africa (ECSA) having stipulated that particular employability skills must be integrated into engineering curricula for accreditation. These have been worked

³ I acknowledge that the nomenclature of these skills is contested. They are also known as core, generic, transferable or, for the purposes of this study, employability skills (Harvey, 2000; Gedye, Fender & Chalkley, 2004; Mason, Williams & Cranmer, 2009; Oria, 2012).

into a set of exit-level outcomes (ELOs), which were referred to in Section 1.2 and are further discussed in Chapter 4.

Mason, Williams and Cranmer (2009: 2) outline some of the ways in which these types of employability skills are included in higher education curricula. These include modifying existing course content, introducing new courses and teaching methods and offering work experience initiatives to students. They also make a distinction between embedding the desired skills into discipline courses and offering standalone courses that “bolt on” to traditional academic programmes. NVP and PCS, the courses that are the focus of this study, are examples of “bolt-on” courses, as they stand apart from the rest of the (more technically orientated) electrical engineering curriculum. However, examples of other initiatives are also evident within UCT’s EBE Faculty: For example, during their undergraduate studies, all electrical engineering students are required to complete two sets of six-week practical modules involving vacation work or practical training in industry, after which they submit reports outlining the skills and knowledge that they have gained through their experiences. Another example is the communication training strand that runs throughout the chemical engineering curriculum: Here, students learn employability skills by applying them to their technical knowledge. For example, after performing a certain experiment, they are required to deliver a short formal presentation regarding their findings and are assessed on both their technical knowledge and their presentation skills.

Holmes (2013: 543) identifies a number of problems with the conception of employability as the possession of skills. First, he notes that, although there are many lists of desirable skills and attributes, there are no shared, mutually agreed-upon understandings of these skills (Holmes, 2013: 544). For example, Bennett, Dunne and Carré (2000) provide a list of common synonyms for these kinds of skills: key, core, generic, process, common, work- or employment-related and soft. However, they also emphasise the ambiguities that exist concerning these terms. The question thus arises whether all skills are potentially transferable to a variety of settings or whether such transferability is limited to skills of a

particular nature. Are core skills core to particular disciplines or core to an individual's generic functioning within an industry? Another question concerns whether specific skills have the same meaning for all stakeholders. With reference to my PCS teaching context, while it may be desirable for engineering graduates to have good communication skills, the specifics of what this entails will differ in different industries and will change over time. For example, a freelance engineering consultant will need to communicate in a different manner to a chemical technician.

Another issue with employability being understood as the possession of skills is related to the methodology utilised in research concerning these employability skills. Holmes (2013: 546) explains how the majority of studies in this sphere consist of surveys administered to various stakeholders, such as academics, students, graduates and/or employers, that gather data concerning the perceptions of the respondents with regards to which skills are deemed important. This focus on perceptions means that it is not possible to develop any sort of objective approach to measuring these skills, thus preventing the development of any unequivocal criteria for employment (from the perspective of both graduates and employers) or even clear definitions of the core terms used. For example, Knight and Yorke (2003: 7) argue that the term "skills" is not sufficient to capture the diverse social practices that employers have associated with employability; the authors instead argue that these encompass a complex set of learning achievements including understanding, skills, self-theories and metacognition.

The final problem with the perspective of employability as graduates' possession of skills is that it fails to explain labour outcomes (Holmes, 2013: 546). Thus, while a civil engineering graduate may have had opportunities to develop communication skills, teamwork and negotiation skills over the course of her⁴

⁴ While I am cognisant of the issues surrounding lack of equitable gender representation in both engineering higher education and the engineering industry, for the purpose of this dissertation, I have decided to alternate between male and female personal pronouns when referring to engineering students in general. My use of both female and male pronouns is an attempt to

studies as a result of ECSA's requirements, she may not be able to find employment because of shrinkages to the construction sector that occur due to a weakened economy. This, however, in no way reflects on her mastery of the relevant skills (Mason, Williams & Cranmer, 2009: 23). This is particularly pertinent in the context of graduate oversupply, which has been a result of the massification of higher education globally (Tomlinson, 2012: 425). Graduates in the job market are expected to constantly maintain their own employability (Tomlinson, 2012: 413); however, their efforts to do so may have less of an impact on whether or not they are able to find employment than the vagaries of the international markets and their impacts on the economy and, more specifically, the labour market.

2.2.2. Employability as positioning

The second perspective on employability that Holmes (2013) presents is that of employability as social positioning. According to this conception, education reinforces social stratification and social positioning by reinforcing existing patterns in terms of how advantage and disadvantages are distributed within a society. Holmes (2013: 547) cites studies that show that, even though massification of higher education means that more graduates are entering the workplace, preference is still given by employers to those who are in possession of cultural capital, which he defines as "a form of wealth arising from control over knowledge, ideas, symbols, etc." (Holmes, 2013: 547), of the dominant class. This includes the modes of language, sets of values and practices of the privileged. According to this understanding, elite positions are awarded to those who already have the necessary cultural capital as a result of their elite backgrounds. Hager and Hodkinson (2009: 632) define cultural capital as knowing how to succeed in a particular field. To this end, those from a disadvantaged background or those with less cultural capital thus have little hope of finding employment,

interrupt the perception of male hegemony in this discipline and a means of acknowledging the participation of female students in engineering programmes, both at UCT and South African HEIs and abroad.

leading Holmes to refer to this perspective as the “counsel of despair” (Holmes, 2013: 548).

However, this perspective does not take into account individual agency. Over time, through the actions graduates may take in their interaction with others, they are able to improve their chances of gaining employment. Employability is thus conceived as an evolving process, leading to Holmes’s (2013) third and final perspective.

2.2.3. Employability as processual

In the two preceding sections, I highlighted some of the problems associated with the possession and positioning perspectives on employability. This, then, brings me to the notion of employability as processual, which is the perspective that I adopted during the formulation of my conceptual framework. According to this perspective, graduation from higher education does not mark an end point by which time graduates should have acquired all of the skills required to gain suitable employment; rather, a process takes place during, through and after higher education that Holmes (2013: 549) refers to as an “identity project”. Employability thus consists of more than simply attaining decontextualised skills; rather, it embodies a process of *becoming* a graduate and acting in ways that lead others to ascribe to one the identity of a person who is worthy of being employed. This entails the integration of academic abilities with personal, interpersonal and behavioural attributes (Tomlinson, 2012: 421). Hinchcliffe and Jolly (2011: 564) further develop this concept of employability by shifting their focus from skills and performance to practice and identity. They consider graduate identity as consisting of four strands: values, intellect, performance and engagement, with the precise mix thereof varying across different employment contexts. Graduate identity, they argue, is the cultural capital acquired prior to entering an organisation (Hinchcliffe & Jolly, 2011: 581), with skills being inseparable from the identity of an individual.

This approach to employability was more appropriate for the purposes of my study because it is based on the notion of “learning as becoming”. In moving beyond the vagueness of employability as possession and the lack of agency inherent in the view of employability as positioning, the notion of employability as processual offered me an opportunity to make the students themselves the focus of my research. This was because it challenged the notion of “learning transfer” as the neat, neutral, unproblematic attainment of individualised skills; rather, the focus on transformed identity necessitated research into the ways in which the students’ identities were/were not impacted by the NVP/PCS course pairing. This reframing of employability skills transfer is discussed in the following section.

2.3. Reframing employability skills transfer

Bridges (1993: 50) states that, while it may be interesting to identify which transferable employability skills should be taught in higher education, it is more intriguing to identify

...what is involved in the transferring of skills or what it is that enables someone with some knowledge, learning, understanding or skill gained in one cognitive domain and/or social context to adapt, modify or extend it in such a way as to be able to apply it in another.

While his discussion shifts the area of focus from the skills to be taught to how knowledge is generalised across social contexts, he still draws on the “transfer metaphor” to explain how learning occurs. This metaphor invokes the idea of transporting something from one place to another. This harkens back to Holmes’s (2013) perspective of employability as possession, according to which employability skills, such as the report-writing or oral presentation skills that are taught in PCS, are acquired by our engineering students in higher education and carried over to industry, where they are applied. The “transfer metaphor” is enduring because, as Billet (2013: 6) explains, developing adaptable learning is central to the purposes of educational institutions. Beach (1999: 105) calls this

the “functionalist epistemology of public education tasked with preparing all students to be productive members of a society viewed as static, neutral and hermitic”.

Hager and Hodkinson (2009: 622–623) specify the three basic assumptions that underlie the transfer metaphor of learning: First, what is learnt is a product, a thing or substance that is independent of the learner. Second, learning involves movement of this thing or substance from place to place. Finally, what is learnt is independent of and separate from the context in which it is learnt. These assumptions are so widespread in conceptions of education, they argue, that the transfer metaphor has come to be dubbed the “common-sense account of learning” (Hager & Hodkinson, 2009: 622). However, I agree with the authors who caution against the uncritical adoption of this metaphor, as it presents an overly simplistic notion of learning, which should more accurately be viewed as an on-going, complex set of processes rather than as a series of discrete acquisition events (Hager & Hodkinson, 2009: 620). In a similar vein, Beach (2003: 41) conceives of learning as “the continuity and transformation of knowledge across various forms of social organisation involving multiple interrelated processes rather than a single analysis of transfer”. Moreover, Fenwick (2013) notes that the transfer metaphor is problematic because it assumes that spaces and places (for example, HEIs and workplaces) remain static and stable while an individual moves between them. It thus ignores the “continuous dynamics through which space is open, relational and multiple, socially produced and productive of social relations” (Fenwick, 2013: 361), flattening out the journeys that individuals actually trace as they transition *from*, *between* and *to* new contexts.

Hager and Hodkinson (2009) present two alternative metaphors that they believe better embody the process of learning: The first is learning as participation in human practice (Hager & Hodkinson, 2009: 626). According to this metaphor, people learn by participating in contextually and culturally grounded activities. The second, which is the metaphor which has the greatest

resonance for me, is the metaphor of *learning as transformation or reconstruction* (Hager & Hodkinson, 2009: 628). This invokes the image of learning resulting in the transformation of a learner and/or her environment. Here, learning is reconceptualised from the unidirectional procedure of the transfer metaphor to one that involves changes in both individuals and organisations, as well as changes in their relations to each other. The implication of this is that, when I teach students to write business proposals for new engineering ventures, it is more than just a decontextualised application of skill; rather, it represents “the construction of new knowledge identities, ways of knowing, and new positioning of oneself in the world” (Beach, 2003: 42).

There is a clear link between the metaphor of learning as becoming and Holmes’s (2013) perspective of employability as the process of identity development, as both are underpinned by the concept of transformation in the individual over and beyond the acquisition of decontextualised skills. One way of understanding this transformation within the particular context of engineering education is by conceiving of it as the acquisition of an entirely new Discourse (Gee, 2008), a topic that is discussed in more detail in the following section.

2.4. Perspectives on discourse

Various traditions of discourse theory exist in fields as diverse as the social sciences, health sciences and business studies (Bacchi, 2005: 199). This “intellectual popularity” (Sawyer, 2002: 434) means that the term “discourse” is used in multiple ways, which are often conflicting and confusing. At its simplest, discourse can be defined as a sequence of sentences (Gee, 2014: 18). Sawyer offers a similar definition of discourse as being “any unit of language larger than a sentence” (2002: 434). He goes on, however, to explain that this represents the standard usage of the term, which is often portrayed as established and unproblematic. However, the manner in which “discourse” is used in contemporary cultural studies reflects a broader usage of the term. This broader usage (the meaning of which is often attributed to Foucault, 2002: 424) is more

encompassing of the concept of language-in-use. Moving beyond the level of grammar, it incorporates the use of language in context and the meanings that are manifested in linguistic form through texts of various kinds. Discourses, as understood in the Foucaultian manner, thus move beyond the realm of an individual activity to suggest a form of social practice (Fairclough, 1992: 63), as they provide a way of focusing on how issues are given a particular meaning within a particular social setting (Bacchi, 2005: 199).

Despite the multiple understandings of the concept of discourse that exist, Bacchi (2000: 46) pushes against attempting to develop an absolute definition of this term. This is because discourse is at work within definitions, delineating what counts as “knowledge”. Therefore, she explains, definitions require scrutiny, not replication, and it is more valuable to identify the role(s) that this term is expected to play in intellectual practices (Bacchi, 2005: 199). Within my study, the concept of discourse provides a theoretical tool with which I attempt to achieve two particular goals: The first is methodological, as discourse is utilised in the analysis of relevant texts, such as policy documents concerning South African higher education and engineering education, in order to better understand the context of this study. The second is more conceptual: To this end, discourse is used as a means of understanding the identity transformation that is implied by the concept of employability, as discussed in the previous section.

Fairclough (1992: 64) explains that there is a dialectical relationship between discourse and society: Discourse is both shaped and constrained by social structure *and* is socially constitutive in that it constructs the world in meaning. He identifies three aspects of the constructive effects of discourse: First, it constructs social identities or “types of self” (Fairclough, 1992: 64). Second, it constructs social relationships between people. Finally, it contributes to constructing systems of knowledge and belief. This third role corresponds to Bacchi’s (2005: 206) conception of discourses as institutionally supported and culturally influenced conceptual and interpretive schemas that influence the

understanding of an issue. Discourses, in this understanding, do not emerge from the free play of ideas in people's heads (Fairclough, 1992: 66) but rather from a social practice that is firmly rooted in and oriented to real, material social structures. Thus, in the context of this research, discourses provided me with a means of approaching the first goal mentioned above, namely that of critically analysing content relevant to the NVP/PCS course pairing in order to learn more about context. This is further discussed in the section concerning discourse analysis (DA) in Chapter 3. It is, however, to the first socially constitutive activity of discourse mentioned above (that of constructing social identities) that this section now turns.

2.4.1. D/discourse and identity

According to Gee (2014: 20), different approaches to analysing discourse tend to foreground various elements, such as the information provided from content or the actions that occur as a result thereof. He offers an approach that foregrounds identity. This is thus a useful tool for the exploration of how transformation can occur in individual students as a result of the learning process or, in the case of my study, the identity development that constitutes employability. Just as Fairclough (1992) emphasises the dialectical nature of the relationship that exists between discourses and society, so too does Gee (2014: 20), who states that, when humans speak or write, we simultaneously *say* something, *do* something to/in the world and *are* something. Identity thus becomes performance. Gee (2014: 24–25) distinguishes between “small d discourse” and “big D Discourse” to show how humans communicate within this performance. “Small d discourse”, he explains, is interactive identity-based communication using language, while “Big D Discourse” is interactive identity-based communication using language and “everything else at human disposal” (Gee, 2014: 24). Discourse is comprised of distinctive ways of speaking/listening and writing/reading, coupled with distinctive ways of acting, interacting, valuing, feeling, dressing, thinking and believing, so as to enact specific socially recognisable identities (Gee, 2008: 155). Discourse is thus about how an

individual is recognised as being a specific kind of person at a specific time and in a specific place.

Gee explains that Discourses are about recognising and being recognised as “certain sorts of *whos* doing certain sorts of *whats*” (2008: 156). There is an endless array of Discourses in the world, for example those of paediatricians, police officers, stay-at-home mothers, gang members and, for this study, electrical engineering students and professionals. He goes on to distinguish between primary and secondary Discourses (2008: 156–157): A person’s primary Discourse is the initial Discourse into which he is born and provides an enduring sense of self and way of being as an “everyday person”. As we are socialised, we acquire additional Discourses beyond our primary Discourse. Gee refers to these as secondary Discourses. These are formed through association and interactions with institutions beyond the family, such as schools, workplaces and businesses. Each person is simultaneously a member of many socially and historically defined Discourses, and these may be compatible or in conflict with one another.

As there are so many secondary Discourses at our disposal, Gee (2008: 169–171) turns his attention to how people become members of various Discourses. To do so, he draws a distinction between learning and acquisition, setting these up as two poles on a continuum, with mixed cases in between. Learning, he explains, involves conscious knowledge gained through teaching or reflection involving explanation and analysis. In contrast, acquisition is a process whereby something is acquired without explicit teaching, e.g. through exposure to models, trial and error and practice within social groups. Discourses can only be mastered through acquisition, not through the overt instruction associated with learning. This involves enculturation into social practices through supported interactions with individuals who have already mastered a particular Discourse.

The implication of Gee’s D/discourse theory is that humans are seen as the meeting point of many different, sometimes conflicting, Discourses. For example,

in the context of my research, the study participants are not just engineering students but also sons, daughters, artists, rappers, entrepreneurs and activists, to name but a few different Discourses. Thus, Gee's theory explains how it is possible to take on different secondary Discourses and, in this manner, to evolve and change. Since Discourses include saying, doing and valuing (Gee, 2008: 181), such a change is more than superficial. This links to the concepts of learning as becoming and of employability as identity development and transformation discussed previously in this chapter. The transformation from student to professional is aligned to the mastery of the secondary Discourse of engineering. Allie et al. (2009: 361) understand this as the "certain ways of using language, acting, interacting, behaving, believing, using tools, sign systems, and so forth, which characterise a particular community". This concept of community is fundamental; by taking on a discursive identity (Brown, Reveles & Kelly, 2005: 783), individuals use a particular discourse, knowing that it will signal their membership of particular communities. This, in turn, connects to Fairclough's second constructive function of discourse mentioned above, namely that that of constructing social relationships between people. The classroom, Allie et al. (2009) explain, presents an important space in which students can start to experiment with these new identities; the objective of this study is thus to discover to what extent this is possible within the NVP/PCS pairing.

2.4.2. Agency within discourse

This focus on D/discourses raises an inherent tension that exists within the concept of discourse, namely that of subject agency (Bacchi, 2005: 200). If discourses are institutionally supported and culturally influenced interpretive and conceptual schemas and signs, to what extent can we say that particular subjects are primarily discourse users or, instead, that we are constituted in and by discourse? A similar issue arises when considering Gee's notion of secondary Discourses if one understands these as being pre-existing, static cultural models that humans have no choice but to adhere to. Gee (2008: 187), however, is adamant that "people are used by Discourses and they, in turn, use Discourses as

agents in their own right”. Similarly, Bacchi (2005: 207) confirms that people use discourses (through active deployment of language) and discourses use people. Focusing particularly on identity construction, Stapleton and Wilson (2004: 48) explain that identities are simultaneously shaped by prevailing discourses and locally negotiated to produce specific versions of one’s self. Applying this concept to my research meant that I needed to identify a tool that could assist me to understand the agency that the students enacted in the development of their discursive identities as engineers. This entailed examining the cultural and structural constraints and enablements that the students encountered while enrolled in the NVP/PCS courses in a bid to understand how they affected their identity development. These concepts are explored in greater detail in the following section.

2.5. Social realism

The understanding of the learning process as encompassing the transformation of an individual was implicit in Holmes’s (2013) conceptualisation of employability as processual, in Hager and Hodkinson’s (2009) metaphor of learning as transformation/reconstruction and Gee’s (2014) theory of Discourse acquisition. Dall’Alba and Barnacle (2007) argue that higher education provides an important space in which this transformation can take place. They do so by calling for a turn away from a sole focus on epistemological concerns (that is, foundational, absolute knowledge) to the ontological implications of learning within higher education. According to this perspective, knowledge is not restricted to the realm of thoughts, ideas and concepts; rather, it is understood as embodied and enacted by the individual. Learning thus becomes the “development of embodied ways of knowing or, in other words, ways-of-being” (Dall’Alba & Barnacle, 2007: 683). The focus therefore expands from a higher education that is solely in the service of epistemology to one that includes an emphasis on ontology. No longer is it sufficient for students studying a particular profession to master new skills or concepts; instead, they need to transform as

individuals in order to become architects, teachers, doctors or, in this study, engineers.

This perspective is in accordance with that of Williams (2012), who acknowledges that learning encompasses both personal and social transformation, or what he refers to as ontological change. However, given that I adopted this expanded understanding of learning, in order to understand whether learning took place it was no longer simply enough to consider test scores or grade point averages. Instead, I needed to locate an analytical tool that could trace whether/how an individual underwent change over time. In this study, Margaret Archer's social realism (SR) provided a way to do this while also taking into consideration the impact of the structural and cultural contexts.

2.5.1. Analytical dualism

Archer uses the concepts of *structure*, *culture* and *agency* to investigate the relationship between the actions that people take and the contexts in which they find themselves. Fundamentally, these concepts provide an analytical framework with which to understand how structural and cultural powers⁵ impinge on agents and how agents use their own personal powers (agency) to act in particular ways in specific situations (Archer, 2003: 3). This, she suggests, represents a means by which social theory can confront the "vexatious fact of society" (Archer, 1995: 1), which is the problem of the relationship that exists between a society and its human components or, as she puts it, the "parts" and the "people".

Archer argues against theories that explain the relationship between the "parts" and the "people" using upwards, downwards or central conflation. Upwards

⁵ Thorough discussion of the differences between structure and culture is provided in Chapter 6. However, for the purpose of the present chapter, the distinction between these concepts is that while structure deals with the distributions, roles, institutional structures and social systems that are primarily dependent on material resources (Archer, 1995: 175-176), culture consists of doctrines, theories and beliefs (Archer, 1995: 196-197).

conflation views society as an aggregate of individuals, downwards conflation views individuals as being determined by society and central conflation views the two as inseparable because they mutually constitute one another (Archer, 1995: 80). Instead, she proposes the methodology of analytical dualism (Archer, 1995: 66) as a means by which structure and agency can be linked, rather than conflated. This methodology is built on two premises: First, the social world is stratified and the emergent properties of structures (which here encompass both structure and culture) and agents are irreducible to one another. Second, structure and agents are temporally distinguishable. According to this understanding, while structure, culture and agency constantly overlap, intertwine and influence one another, it is possible to analytically separate them for research purposes. This offers a means of examining them independently in order to understand any changes, before bringing them back together in order to develop explanations of how they impinge on one another. For the purposes of this study, this means that I could analytically separate the agents (the electrical engineering students) and the structural and cultural context (the NVP and PCS courses offered within UCT's EBE Faculty).

As a means to operationalise analytical dualism, Archer advances the morphogenetic cycle. According to the cycle, structural emergent properties (SEPs), cultural emergent properties (CEPs) and agents' personal emergent properties (PEPs) interact continuously and either elaborate/change or preserve/maintain a system's form, state or structure (Archer, 1995). Archer terms the former scenario "morphogenesis" and the latter "morphostasis". Figure 2 below depicts the stages of the morphogenetic cycle. ("T" represents a given time.)

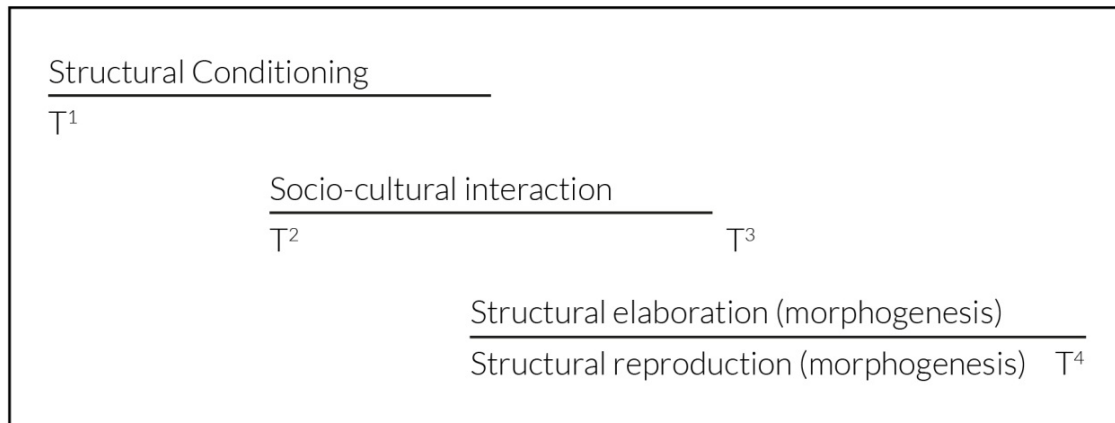


Figure 2: The basic morphogenetic/static cycle (Archer, 1995: 157)

Structure, culture and agency each have their own morphogenetic cycles, which are continuously operative in society and are always interrelated because they intersect in the middle element (Archer, 1995: 192). T1 is the context of structural, cultural or socio-cultural conditioning, which is considered to be the emergent consequences of previous actions (Archer, 1995: 90). T2-T3 is the social, socio-cultural and group interaction, which is structurally conditioned but not structurally determined, since human agents will ultimately decide how/when to act in a certain situation. T4 represents the state of the system at the end of a period of social or socio-cultural interaction. The cycle is then repeated, with T4 becoming T1 for the next morphogenetic cycle.

According to Archer (1995: 194), the explanations provided by the morphogenetic approach take the form of “analytical histories of emergence for the practical issue under investigation”. Through examination of the interplays within and between T1-T4, the periods of change or stability that may have occurred over a given time are portrayed, which Hoel (2010: 43) calls a “historical model of social reality”. The development of this model begins at T1, with an analysis of the relationships that exist between the SEPs and CEPs in a given context. According to Archer (1995), understanding these relationships provides insight into the “situational logics” at play or, in other words, the ways in which the structural and cultural contexts condition agents’ behaviour. That is to say that, given a particular set of SEPs and/or CEPs, humans are likely to behave in a

particular manner that will either lead to morphogenesis or morphostasis. Archer (1995: 216) defines four configurations of SEPs and CEPs and suggests the likely situational logics and morphogenetic/static effects that could arise from them. These configurations are shown in Table 3 below:

Table 3: Configurations of SEPs and CEPs and their situational logics

<i>Level</i>	<i>Relationship</i>	<i>Situational logic</i>	<i>Morphogenesis/stasis</i>
SEP	Necessary complementarities	Protection	Morphostasis
CEP	Concomitant complementarities	Ideational systemisation	Morphostasis
SEP	Necessary incompatibilities	Containment and compromise	Morphogenesis
CEP	Constraining contradictions	Ideational syncretism	Morphogenesis
SEP	Contingent incompatibilities	Elimination	Morphostasis
CEP	Competitive contradictions	Choice (and elimination)	Morphostasis
SEP	Contingent compatibilities	Pure opportunism	Morphogenesis
CEP	Contingent complementarities	Opportunity	Morphogenesis

Table 3 above shows that the different combinations of SEPs and CEPs condition human behaviour in analogous ways. For both SEPs and CEPs, the relationships identified by Archer (1995) are based on two factors: whether they are necessarily/contingently related to one another and whether they are complementary/incompatible.

Necessarily related SEPs and CEPs are those that are internally related and need one another to exist, while contingent relations imply that SEPs and CEPs are only related because of context (Lockett, 2012: 341; Case et al., 2017: 281). For

example, a university and its administrative department would be necessarily related, while two separate HEIs would be contingently related. Complementary SEPs and CEPs are those that are compatible, while incompatibility refers to those that are contradictory, which may lead to tensions (Luckett, 2012: 341; Case et al., 2017: 281). For example, should the university and its administrative department mentioned above work together productively, it would reflect a complementary relationship, whereas, if they espoused fundamentally different and irreconcilable perspectives on the way in which work should be carried out, they would be incompatible. The language that Archer uses to define these configurations differs, but she notes that both structure and culture supply directional guidance for agency in exactly the same manner (Archer, 1995: 229). The only difference is that, whereas the configurations of SEPs refer to the relationships that exist between social institutions, the configurations of CEPs refer to the different theories/beliefs that agents hold concurrently.

With regard to SEPs, “necessary complementarities” are mutually reinforcing and invoking. As such, a situational logic of protection arises because all parties involved have something to lose should the relationship between them be disrupted. “Necessary incompatibilities” contain a potential for change (through a situational logic of containment and compromise) because the necessary relationship that may exist between the SEPs/CEPs means that any radical change will lead to negative repercussions for all, which results in the need for coexistence through (often uneasy) compromises. “Contingent incompatibilities” lead to a situational logic of elimination, since the fact that the SEPs are incompatible and that there is no necessary relationship between them means that great gains are frequently associated with eliminating a contradictory SEP. Finally, “contingent compatibilities” entail a situational logic of pure opportunism, given that there is no restriction on the possibilities in terms of transformation and change since the SEPs are not necessarily related and are compatible with one another, meaning there is no competition/clash over available resources.

A similar set of configurations exists for CEPs. “Concomitant complementarities” are different ideas that are necessarily related and complementary to one another. These present no problems for agents, since the ideas are mutually reinforcing, and therefore lead to a situational logic of ideational systemisation, which Archer (1995: 236) states “stimulates nothing beyond cultural embroidery”. In a context such as this, the result is often reduced likelihood of agential morphogenesis, given the densely consolidated nature of societal discourses that exist. “Constraining contradictions” refer to a site of cultural tension, in which there are two (or more) ideas that are incompatible but necessarily related, meaning that an individual must find ways to manage them concurrently. Because of this, a situational logic of ideational syncretism (that is, an attempt to sink differences and effect union between contradictory elements) exists within this configuration. “Competitive contradictions” are ideas that are fundamentally incompatible, to the point that it is impossible to hold both simultaneously. This leads to a situational logic of choice in that agents need to decide which idea they will commit to and which they will eliminate. Finally, “contingent complementarities” are ideas that are not necessarily related but are compatible. This means that they can coexist, giving agents the freedom to determine which idea(s) they wish to commit to and in which combinations. This leads to a situational logic of opportunity, as agents can adopt and/or adapt various CEPs as they choose.

Archer is clear that these various configurations of SEPs and CEPs and the tendencies they condition towards morphogenesis or morphostasis do not act as “hydraulic pressures” on agents: The fact that we live in an open society means that people are capable of “resisting, repudiating, suspending or circumventing” (Archer, 1995: 195) the situational logics. However, they do present the researcher with a means of understanding how the “parts” (structure and culture) impact on the “people” (the agents). For the purpose of my research, I needed to discover a way of analytically separating the NVP/PCS course pairing from the context in which the courses took place. This was especially necessary given my enlarged definition of employability, which shifted from the

accumulation of isolated skills to the development of an engineering identity. Focussing on the situational logics of the SEPs and CEPs at T1 provided me with a means of understanding what it was about the “parts” that conditioned students’ transformations (or lack thereof). In Archer’s terms, this is the morphogenesis of agency.

2.5.2. *The morphogenesis of agency*

In order to trace how individuals transform over time, Archer proposes that humans consist of three irreducible, emergent strata: persons, social agents and social actors. Every individual, she explains, is born with a “continuous sense of self” (Archer, 2000: 255) that emerges early in life and serves as an anchor for the agent and actor that emerge over time, continually informing us that the things that happen in the world and the things that we make happen all pertain to the same person. Agency (which Archer, 1995: 257, uses in the plural to denote a group or collectivity) emerges as a result of *double morphogenesis* (1995: 247), which is based on the concept that agency has the potential to lead to the elaboration of structure and culture and may itself be elaborated upon at the same time. Archer distinguishes between two forms of agency to demonstrate how this elaboration takes place: The first, primary agency, refers to the collectivities into which we are born. This involuntary placement sees us assigned positions in relation to society’s distribution of resources. If primary agents are able to collectively transform themselves in seeking to transform society by organising for collective action, they become corporate agents. Corporate agents are groupings with shared vested interests (Archer, 2000: 265). Not all primary agents become corporate agents, but those who do have the potential to shape the social context for all agents. This is because, when there is a plurality of corporate agents working on influencing social structure in different directions, the structural and cultural landscape is reshaped (Archer, 1995: 264).

Part of this reshaping involves corporate agents extending the array of available social roles through organising for collective action, articulating shared interests and generating social movements. When agents find roles they feel they can invest themselves in, they become social actors; Archer (1995: 255) calls this process *triple morphogenesis*. I would argue that this provides a point of connection with Gee's (2014) theory of Discourse acquisition, as the roles that are made available by the social actions of corporate agents can be conceptualised as Gee's (2014) "big-D" secondary Discourses. This is so because, like Discourses, Archer (2000: 283) explains that these roles have emergent properties that cannot be reduced to the characteristics of their occupants. In identifying with particular roles (or Discourses) and choosing to actively personify them, actors also acquire their social identities. Personal identity, on the other hand, refers to the precise and unique balance that we strike between concerns in the natural order (our physical well-being), the practical order (our performative achievements) and the social order (our self-worth) (Archer, 2000: 11).

Archer (2000: 296) calls an individual who has managed to attain both a social and personal identity a "successful subject". This means that such a person has located a satisfying role which, once weighed against concerns in the natural, practical and social order, she is prepared to invest herself in. Figure 3 below depicts the morphogenesis of personal and social identity.

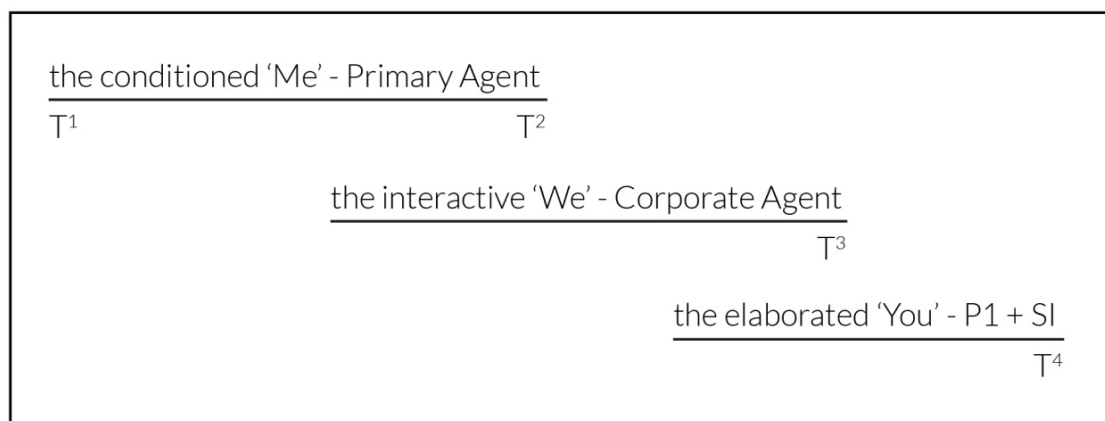


Figure 3: The emergence of personal and social identity (Archer, 2000: 269)

2.5.3. Appropriateness of social realism

The affordances of Archer's tools of analytical dualism and the morphogenetic framework provide a means of tracking the transformations (or lack thereof) of students over a particular time without neglecting the effects of context. This is appropriate given my conceptualisation adopted throughout this study of learning as entailing changes in the individual. Social realism (SR) offers a means of accounting for both the impact of context on the actions of students as well as the actions themselves or, as Archer (2000: 315) puts it, "the confluence of causal powers – those of external reality and our own which emerge from our relations with it". This focus on both the "parts" and the "people" provided me with a space in which to develop rich explanations of how the students negotiated the constraints and enablements of the NVP/PCS course pairing in the findings of this study. Ashwin (2008: 152) explains that an explicit focus on structure and agency can improve the quality of explanations offered in research in teaching and learning in higher education by focussing on both individuals' intentions and on the ways in which they are structured by institutions and wider social structures. This was my aim in attempting to understand how participation in the NVP/PCS course pairing prepared electrical engineering students for the workplace.

At a macro-level, triple morphogenesis can be seen at play in the interactions that occur between students, the university and wider society. Individuals enter university at T1 as primary agents, with their unique persons having been conditioned by their life experiences to date. During their time at university, between T2-T3, their active status as students means they may become corporate agents who work together to achieve various ends. This occurs in different ways within the university; some of the spheres in which it is evident are in peer groups, social movements, tutorial groups and classes. Through these groups, students transform the structure and culture of the university space. For example, the #RhodesMustFall, #FeesMustFall and allied activist movements that emerged in 2015 (as discussed in Section 1.5 in Chapter 1) had concrete

effects on universities in South Africa, including achieving a zero increase in fees in 2016 and the in-sourcing of campus workers.⁶ Changing the landscape results in the creation of new roles (or Secondary Discourses) for students to occupy, both within the university and outside of it. When/if they embody these roles, they emerge at the end of their time at university (at T4) as social actors, who have achieved synthesis of their social and personal identities. There is thus a transformation in the students over their time at university as their different strata emerge.

At the more micro-level of engineering education, morphogenesis can also be used as a means of tracking how the students considered in this research develop over the course of their studies. They enter the BSc degree in Engineering at T1 as diverse individuals from a variety of different backgrounds that have conditioned them in particular ways and become primary agents due to their general status as members of a body of students. Over the course of their programmes, from T2-T3, they may become corporate agents through participating in various collectivities, for example working in groups to complete particular courses and projects. The goal is that, when they graduate from the degree programme at T4, they do so as social actors, embodying the role of “professional engineers” in balance with their concerns in the three orders (natural, practical and social). Case (2015: 850) highlights this synthesis of personal and social identity as the end goal of higher education, as this results in a student who “formulates ultimate concerns and enacts projects towards that end; also a student who occupies that role in a way which gives expression to their personal identity”.

It is important to note, however, that there are a number of strong critiques of Archer’s SR theories. For example, Cruikshank (2010: 580) argues that the concepts Archer uses (specifically, agency, structure and culture) are too

⁶ This was in response to one of the main demands underpinning the protest movement, which was that campus workers (such as cleaners, catering staff and security), who were previously managed by external labour brokers, should be hired as full-time university staff. This would result in better remuneration and other benefits for the workers.

“elastic” to be theoretically useful in that any data can be read into them. His argument is that, because they are so generic, they cannot offer any novel explanatory insights that do not already exist and, as such, his contention is that SR theory is often simply *invoked* as opposed to actually *justified* in the research context. Kemp (2005) raises another issue with Archer’s categories of “structure” and “culture” through his assertion that, while the use of her morphogenetic cycle requires an analytical separation between structure and culture, the difference between these concepts is never made explicit, which often leads to confusion. This was something that I experienced when undertaking my analysis; in particular, it was difficult to understand whether “curriculum” was an example of a “structure” (in that, in the higher education context, it is determined by institutions) or “culture” (in that a curriculum is always influenced by particular beliefs and theories). In fact, the case could even be made that a “curriculum”, which is a manifestation of choices made by humans (for example, course designers, lecturers and members of professional accreditation bodies), is an example of agency. This links to one of King’s (1999) main critiques of Archer’s SR, namely that her “structure” and “culture” categories are fundamentally flawed in that both of them can, in every case, be reduced to the actions of other people. Thus, according to King, what occurs between T2-T3 is not a complex intertwining of structure, culture and agency, but simply individuals interacting with one another and, in this way, changing social conditions.

These critiques are clearly expressed and justified, but, for me, the value of Archer’s SR framework lies particularly in its potential for *practical social theorising*. Archer’s morphogenetic cycle provided me with a tool that not only impacted the manner in which I understood my data conceptually but also influenced my entire research process. Analytical dualism and the morphogenetic cycle were crucial in terms of formulating my research questions. They framed my data collection process, as I was aware that the NVP/PCS course pairing that I was observing was T2-T3 and that, when I was interviewing students and attending lectures, my focus needed to be on structure and agency

and their interactions. Archer's concepts were also a vital part of my data analysis, as they provided me with a way of organising my findings and identifying and creating explanatory links. In this manner, Archer's SR was a unifying force throughout my research process and, indeed, in this resultant dissertation. For this reason, while I acknowledge the critiques of Archer's work, I believe that it was appropriate for the purposes of my research. Carter and New (2004: 35) state that realism allows a "modest concept of objectivity" that, while providing provisional answers to some research questions, also throws up a fresh set of questions. They believe that this is the hallmark of any fruitful research approach, and, to this end, I believe that the choice of SR was justified for this study.

2.6. Conclusion

This chapter opened with a quote explaining that it is sometimes necessary to take a long detour in order to reach the correct destination. Now, having traced the theoretical and conceptual framework that underpins my study, I have finally arrived back at the context, which is only a short distance away from my location as a researcher: the NVP/PCS course pairing. As mentioned previously, this study took as T1 the start of the NVP/PCS course pairing in the first semester of 2015, while T2-T3 spanned the period over which the courses ran (from mid-February to mid-May) and T4 was the end point of the research. Analytical dualism allowed me to consider structure, culture and agency separately over this time to determine if/how transformation occurred within these domains. Both NVP and PCS differed from the more technical subjects taught in the electrical engineering curriculum in that they both explicitly aimed to prepare students for the workplace. The enlarged concept of employability that I adopted in this study meant that, instead of understanding work-readiness as the attainment of decontextualised skills, I viewed it as a process of identity development. This alternate conceptualisation was supported by the metaphor of learning as transformation (Hager & Hodkinson, 2009), which, according to Gee (2014), sees a student's transformation to a professional through higher

education as representing the mastery of a secondary Discourse - in this case, of engineering.

The adoption of a CR framework for this research meant that the focus shifted beyond describing what I observed during the NVP/PCS pairing (the empirical domain) or what students described during interviews (the actual domain). Instead, the focus was on the generative mechanisms at play in the domain of the real. The analytical tools offered by Archer's SR (i.e. analytical dualism and the morphogenetic framework) provided a means by which I could provide explanations due to their focus on identifying systems of mechanisms that give rise to observed social phenomena (Case, 2015: 848). These, concepts therefore, underpinned the conceptual foundation of this study; as such, they also influenced both the data generation process and the analysis. They did so by providing a way for me to track how students did/did not transform over the course of the NVP/PCS pairing, or, in other words, how they developed (or failed to develop) engineering identities. Using this approach, it became possible to develop understandings of how the two courses prepared students for the workplace.

3. Research design

Research is formalised curiosity. It is poking and prying with a purpose.
(Hurston, 1942: 182)

The quote above, from novelist and civil rights activist Zora Neale Hurston's autobiography *Dust Tracks on a Road* presents a fundamentally human perspective on the act of research. While all humans - even babies and toddlers - engage in some curious prodding and poking on occasion, Hurston characterises research as formalised and purposeful. Once the conceptual framework of my PhD had started to take shape, I felt empowered to design a research methodology that directly related to the goals of my research and my research questions. In addition, a concern for trustworthiness ensured, to expand on Hurston's above metaphor, that I was poking and prying the correct people/objects in the correct way. My emphasis on achieving alignment between these different aspects was strongly influenced by Maxwell's (2013) interactive model of research design, which was depicted in Figure 1 in Chapter 2. This chapter, which focuses on research design, deals particularly with the bottom triangle of the model, specifically the use of methods (including data generation and analysis) and validity. The chapter ends with a discussion of my impact on my research or, in other words, an examination of researcher reflexivity.

3.1. Research questions

My research design was intended to address the following research questions:

Central question

In what ways can participation in an undergraduate course pairing prepare electrical engineering students for the workplace?

Sub-questions

What structural and cultural emergent properties operate at UCT and in the NVP/PCS pairing?

What are the pedagogic characteristics of the NVP/PCS pairing that condition the development of discursive identities for the students?

What are the constraints and enablements that students encounter in the development of discursive identities as engineers during the NVP/PCS pairing?

Approach to research

I decided to adopt a qualitative approach to my research. As mentioned in Section 1.4, there is a natural inclination towards quantitative research in engineering education (Koro-Ljungberg & Douglas, 2008; Borrego, Douglas & Amelink, 2009). This could be due to the fact that engineering educators are often trained in the engineering discipline, wherein quantitative methods related to positivist frameworks are more the norm. I agree that there is certainly a place for quantitative research in engineering education, particularly given its ability to determine trends and correlations (Kelly & Bowe, 2011). Over the course of my research process for this this dissertation, for example, a number of quantitative studies were of use in helping me to better understand the current contextual trends within the field of engineering education. For example, the Engineering Council of South Africa's (ECSA) National Engineering Skills Survey (Edu-surveys, 2013) provided me with an overview of the current state of the engineering industry in South Africa, with particular focus on factors such as demographics (gender, age and race), qualifications and the current state of employment.

Yet, as Case and Light (2014: 547) explain, widening the scope of research approaches in a discipline such as engineering education expands both the kinds

of research questions that can be addressed and the potential findings that can be obtained. To this end, and in line with my conceptual framework, I decided that a qualitative approach to research would more adequately allow me to achieve my research goals of developing an explanatory critique of employability skills development and, on a more personal level, adding depth to my own understanding of the impact of the NVP/PCS course pairing. This was because, in my opinion, only qualitative research methodologies could provide me with the means to better understand the generative mechanisms at work in Bhaskar's (1975) domain of the real (see Section 2.1.). Similarly, my choice to use Archer's (1995) morphogenesis of agency (see Section 2.5.2) as a means of tracking whether/how students developed engineering identities meant that I needed to draw on research methods that enabled me to generate understandings of how students' agency is conditioned by structural and cultural factors. Riley, Slaton and Pawley (2014: 348) explain that qualitative methods are particularly useful for this type of examination of the experiences of a small number of individuals because they have, at their heart, the deep exploration of stories. This ties back to the Hurston (1942) quote with which this chapter opened, since seeking out other people's stories via poking and prying is an entirely natural activity for humans. However, in contrast to the criticisms that people sometimes raise with regards to qualitative research – e.g. that it is too subjective or too limited in sample size – it is my contention that a well-designed qualitative approach that is aligned with the research questions and conceptual framework of a study can be invaluable in adding to the body of knowledge in a particular discipline. This is particularly the case for educational research, which operates at the confluence of many complex social, demographic, pedagogical and epistemological issues. In this sort of context, the “thick descriptions” (Cousin, 2013: 133) enabled by qualitative research can yield important insights.

Within this qualitative approach to research, I decided to utilise a case study approach. The reason for this choice was that, to better understand how concepts such as “employability skills development” and “skills transfer” (as described in Sections 2.2 and 2.3) are enacted, I needed to examine them in a

real-life higher education context. A case study approach to research afforded me a means of doing so, given that it involves a distinct, single instance of a class of phenomena (Case & Light, 2014: 537) that is specially selected in order to advance the understanding of the object of interest. Thus, I chose the New Venture Planning (NVP)/Professional Communication Studies (PCS) course pairing offered to electrical engineering students enrolled in the Engineering and the Built Environment (EBE) Faculty at the University of Cape Town (UCT) as a case study site given the explicit focus in both courses on promoting the workplace readiness of engineering students.

One of the affordances of a case study approach to research is that it presents an opportunity to observe effects in real contexts. Given its use of social realism (SR) as a theoretical tool, this was appropriate for my study, as SR seeks to unpack the relationships between the actions that people take and the contexts in which they find themselves. In my case, the NVP/PCS course pairing provided a bounded site in which I could apply Archer's analytical dualism to separate structure, culture and agency and then bring them back together again in order to develop a rich understanding of the ways in which students develop discursive identities as engineers. A case study approach is also well suited to a critical realist (CR) framework because it provides a contained site for the examination of all three of Bhaskar's ontological domains; in fact, Easton (2010) argues that case study research is ideally suited for CR studies, given the opportunity it offers for comprehensive and in-depth examination of the causal powers involved in a phenomenon.

Yet it is this very intense focus on one research site that forms the basis of one of the most common critiques of case study research, namely the perspective that a case study cannot contribute to scientific development because it is impossible to generalise on the basis of an individual case (Flyvbjerg, 2005; Ruddin, 2006). According to this view, given that my dissertation focuses only on the NVP/PCS course pairing, it is impossible for it to deliver any new insights that, on the one hand, indicate how employability skills development occurs in other contexts

and, on the other hand, could be used to improve other, similar initiatives in different engineering education contexts. In response to this, Flyvbjerg (2005) questions the very notion of generalisability as the main source of scientific progress, arguing that this perspective draws attention away from other equally vital processes of knowledge accumulation. However, with reference to whether or not the findings that emerge from case study research can be generalised, Ruddin (2006) argues that there is a direct link between generalisation and validity, explaining that to argue that one's analysis of a case is valid is implicitly to claim that the analysis holds for cases of the same sort. For this reason, my research design included careful consideration of issues associated with validity (see Section 3.3).

Another advantage of a case study approach that made it appropriate for my research was the flexibility that it offers in terms of the methods used for data generation. Hyett, Kenny and Dickson-Swift (2014: 2) describe this as the availability to a case study researcher of "a palette of methods", meaning that a researcher can determine which methods to employ to best make use of naturally occurring sources of knowledge, such as people or observations of interactions. This was supported by Sayer's (2000) assertion that CR is compatible with a wide range of research methods and that particular choices should therefore depend on the nature of the object of study and what one wishes to learn about it. More information regarding the research methods that I employed for this study is provided below.

3.2. Research methods

While a comprehensive focus on the NVP/PCS course pairing is provided in Chapter 5, some background information is needed at this point to provide a basis for understanding the description of the data generating methods and analysis that follow. The NVP and PCS courses operated as a pair because they shared a joint project: In NVP, students were introduced to concepts associated with starting an entrepreneurial venture, and the major assessment of the course

was the development, in small groups, of a business plan for a new venture conceived of by the students. In PCS, the students worked in these same groups and used this same new venture in the creation of industry-like texts, including a poster, a group presentation aimed at investors and a summary of a business plan. The NVP lectures, which were held twice a week for 45 minutes, were delivered to the full cohort of 148 fourth-year electrical engineering students, 130 of whom were male and 18 of whom were female. For the one hour and 45 minute PCS lectures, which were delivered once weekly, however, students were split into four classes of around 35 students each.

One of my early methodological choices concerned how best to engage with the PCS course. This was an issue, given that there were four classes running concurrently, which meant I would necessarily have to restrict my data generation as a result of the fact that I could not be in all of the classes at once. I decided to attend lectures run by Helen. This decision was less influenced by Helen's qualities as a lecturer than by the demographic makeup of the students in her class. PCS classes are generated randomly, and, in 2015, the result was that in the other lecturers' classes, there was hardly any diversity in terms of race, gender and age. For example, in one class, there were no female students; in the other class, there were only four black⁷ students, all of whom were male. Helen's class, with its nine females, two mature students⁸ and wider racial spread, provided the greatest variety in terms of demographic diversity. This was something that I deemed important since I wanted to have access to a wide spectrum of student stories to add richness to my research. The manner in which I engaged with these students in the generating of data is discussed in the next sections.

⁷ While acknowledging the constructed and contested nature of racial classification, for the purposes of this dissertation, the South African racial classifications of black, white and coloured are utilised.

⁸ UCT defines "mature students" as all those who are aged 23 or older (UCT, n.d.).

3.2.1. Generating data

Focus group interviews

At the outset of the NVP/PCS course pairing, at the start of the first semester of 2015, I conducted six focus group interviews with students from Helen's class. Since I was attending Helen's PCS lectures, I knew that they would be the students with whom I would forge relationships with over the course of the term. I believed that there was much benefit to be gained from becoming acquainted with this smaller sample of students more intimately over the course of the semester, as building trust with them over time would mean that they would be more likely to share their experiences and opinions openly with me. Six of the seven groups in Helen's class accepted my invitation to participate in the interviews. The number of participants in each interview varied from three to four, depending on student availability and willingness to be involved. I conducted the interviews myself, and they were both filmed and recorded using a dictaphone. (See Appendix 2 for further details on the interview groups). I transcribed the recordings of the interviews myself so as to gain an initial impression of my data.

My decision to conduct focus group interviews at the beginning of my research was based on two main factors: First, given that it was my first time occupying the role of "observer" of a PCS course (as opposed to lecturer) and given my lack of familiarity with the NVP course, I wanted to utilise a method that would allow me to access a wider range of perspectives at the start of my research process so as to ensure that my early formulations concerning the structural and cultural contexts in which the students operated were as broad as possible. Focus group interviews promote access to "intersubjective experience", which Kelly (2006: 304) defines as the experience that is shared by a community of people. I developed an initial interview guide for the focus group interviews, which was subsequently refined by input from my supervisors and colleagues prior to the interviews. In the context of my research, the goal of the focus group interviews

was to allow me to gain insight into the experience of being an electrical engineering student. As such, the questions dealt more generally with the students' perceptions of aspects of the electrical engineering degree, for example the skills and knowledge that are the focus of the course, students' concerns for the future, and motivating factors (see Appendix 3 for the full interview guide). While the questions provided a general structure for the conversation, the semi-structured nature of the interviews meant that the conversations often turned in unexpected directions; this I saw as adding richness to my findings. The participants shared their motivations for studying electrical engineering and their goals for the future. They outlined the skills and knowledge that they had developed over the course of their studies and some of the concerns that they faced as they prepared to enter the professional world. In addition, they were asked to reflect on their understanding of the concept of "workplace readiness".

The second reason that I chose to conduct focus group interviews was due to their synergistic nature (Finch & Lewis, 2003). This refers to the manner in which, during focus group interviews, data is generated by the interactions that occur between group members. People listen to one another, reflect, refine their ideas and engage with one another and, as this happens, the responses offered move to a deeper and more considered level. This was borne out in practice since, during the focus group interviews that I conducted, the students interacted with one another in a manner that deepened their descriptions of being agents in T1 of Archer's morphogenetic cycle (see Section 2.5.1), which marked the period immediately prior to the start of the NVP/PCS course pairing. As the students shared their experiences as engineers-in-training, it was possible to begin to understand how they had used and continued to use their personal powers to negotiate the structural and cultural contexts that they faced.

Both the focus group interviews and the individual interviews discussed below were conducted in English, despite the fact that some of the students were not English first-language speakers. In making this decision, I was cognisant of the

issues around choice of language in qualitative interviewing. For example, Welch and Piekkari (2006) argue that interviewing in one's home language results in responses that are more subtle and nuanced, thus adding to the richness of data that is generated. In addition, they suggest that accuracy and authenticity may be compromised when interviewees are forced to use a language with which they are not familiar. Finally, in a South African context specifically, the dominance of English represents a powerful hegemony which this thesis discusses in other places (see sections 6.1.3 and 7.2.3). Despite these arguments, however, my decision to interview in English was driven by several factors. First, since my interviewees were fourth year students at an English-medium university, I felt I could assume a certain level of English proficiency. Second, for the focus group interviews in particular, some of the groups were made up of students who spoke different home languages, with English being the only common denominator language that could facilitate communication between the group. Lastly, I wanted to conduct the interviews myself in order to get to know the interviewees and immerse myself in the data from the start of the process, and English provided a means to achieve this.

Ethnographic observation

In order to generate data concerning the T2-T3 phase of the morphogenetic cycle that is the focus of my research, I observed both the NVP and PCS lectures during the first semester of 2015. My aim was to develop an understanding of the constraints and enablements that students were faced with in the process of developing engineering identities, as per my third research sub-question. Kelly (2006: 310) distinguishes between structured and unstructured observation: He characterises the latter as impressionistic, using continuous time sampling and being naturalistic. These qualities embodied my observations of the two courses. Since my field notes were based on my observations, they followed the duration of the lectures, and they emerged from the interactions that occurred. I used these notes to draw up researcher memos in which I attempted to capture what occurred during the lectures "from the inside out" (Kelly, 2006: 313). This allowed me to begin formulating my own knowledge of what took place during

the NVP/PCS course pairing in two of Bhaskar's ontological domains. Recording my objective observations of the two courses, such as how the lecturers taught and the ways in which students responded to group activities in PCS, represented my engagement with the domain of the actual. My opinions regarding these activities, such as which pedagogical methods I thought were most effective, related to knowledge within the domain of the empirical. While this observation did not, therefore, generate knowledge on the domain of the real, it was a useful opportunity for me to begin developing my nascent theories intended to explain the impact of this course pairing on the students.

Participant observation, such as I carried out during the NVP/PCS course pairing, is one of the data generation methods within the broader category of ethnographic research (Case & Light, 2014). Column 1 in Table 4 below presents the features that Hammersley (1993) identifies as central to the application of ethnography in social research. Column 2 indicates how these features were embodied by my observations of the NVP/PCS course pairing:

Table 4: Features of ethnography as social research as embodied in my participant observation

Features of ethnography as social research	My observation of the NVP/PCS course pairing
Empirical data are systematically selected for the research purpose.	The course pairing was selected for observation because of its explicit focus on the development of employability skills.
The data come from “real world” contexts.	I observed the actual NVP and PCS lectures.
Data are gathered from a range of sources.	I observed the lectures and engaged in informal conversations with students (individually and in pairs/groups) and lecturers.
The approach to data collection and interpretation is flexible and dynamic.	I took opportunities to generate data wherever they arose. For example, when the students were showing their PCS posters (see section 5.2.2 in chapter 5) I took the opportunity to hold brief impromptu group interviews with some groups.
The focus is a single setting or a relatively small-scale group.	My study focussed only on the two courses comprising the case study pairing.
The analysis involves interpretation.	While observing the course pairing, my identity as a lecturer and student coloured the interpretations I began developing. This is discussed further in section 3.4 below.

Lillis (2008), however, emphasises the difference between ethnography as method and as methodology. The former entails “talk”, in the form of the researcher interacting with participants in order to discover their perspectives on the phenomenon in question. In contrast, the latter involves “multiple data sources and sustained involvement in contexts of production” (Lillis, 2008: 355), allowing the researcher to explore a complex phenomenon dynamically. My observations of the courses went beyond ethnography as a method, as they entailed more than simply discussing the research issues with the participants; rather, I was able to observe the students and lecturers over the course of the

semester and engage with the curriculum and the pedagogy of NVP and PCS, all of which contributed to the development of the “thick description”, which, as discussed in Section 3.1 above, was one of the main reasons behind my choice to adopt a qualitative research approach.

Individual interviews

Following the conclusion of the NVP/PCS course pairing, I conducted in-depth semi-structured interviews with eleven of the students who had participated in the initial focus group interviews. The objective of these interviews was to gain an understanding of the students’ experiences of, in Archer’s terms, T2-T3 of the morphogenetic cycle, which is the interaction phase. While related data could have been generated via a survey administered to students or another set of focus group interviews, my decision to conduct individual interviews was informed by Brinkmann’s (2013) extension of the concept of interviewing beyond being simply another empirical method. Instead, he suggests that qualitative interviews can be understood as a mode of knowing and a fundamental ontology of persons. With regards to the former, he explains that the certainty of our social knowledge is a matter of conversation between persons, rather than a matter of interaction with a nonhuman reality. Thus, given CR’s fundamental basis in the concept of knowledge as “real” (as discussed in Section 2.1), I believed that the interactions that occurred between interviewer and interviewee would provide rich access to the students’ social knowledge concerning the NVP/PCS course pairing. Furthermore, the connection identified by Brinkmann (2013: 151) between interviews and human ontology emphasises the way in which human reality itself may be understood as conversational. This is because, as he puts it, cultures are constantly produced, reproduced and revised in dialogues among their members. In planning my data-generating strategy, it was my belief that the act of conducting individual interviews would harness this very real process of “meaning making”, thus adding depth to the data that was obtained concerning the students’ experiences of the NVP/PCS course pairing.

The interview questions focussed on the students' experiences of the NVP and PCS courses and, similar to the questions for the focus group interviews, were refined following expert review. In this set of interviews, in contrast to the focus group interviews, participants were asked to reflect on particular moments of NVP and the PCS course, the skills and knowledge that they did or did not develop and any shifts that occurred in terms of their understandings of their own discursive identities as professional engineers. (See Appendix 4 for the full interview schedule.) In addition, I included a question concerning whether/how students felt that they had changed over the course of the course pairing. While I was aware that whatever answer the students gave me would be on the empirical domain of Bhaskar's ontology of knowledge and therefore not necessarily representative of the generative mechanisms at work during the courses, I believed that the students' answers would provide insight into how they had mediated the structural and cultural conditioning in T2-T3. The interviews took place in an office in the PCS Department at UCT, and each took between one and two-and-a-half hours. As was the case in the focus group interviews, I recorded and transcribed these sessions myself.

The sampling methods used to identify participants in these interviews were both purposive and convenience sampling. In terms of the former, I specifically selected students who were diverse in terms of age, social background, race, country of origin and gender in order to obtain access to a full range of perspectives and experiences. In addition, when students had stood out in the focus group interviews as having the potential to make a unique contribution to my research, I approached them to participate in the individual interviews. For example, during the focus group interviews, I discovered that one of the interviewees was already running his own engineering-related business. It struck me that his perspectives on the NVP/PCS course pairing's efforts to prepare students for the workplace could be particularly interesting, since he was already operating as a professional. As such, he was one of the students whom I approached to participate in an individual interview. In finalising my sample, I

was aware of the possibility that the students whom I had invited to participate in individual interviews could potentially share perceptions of the NVP/PCS course pairing that were inaccurate or did not reflect what had actually occurred during the courses. However, I was guided by the CR perspective that opinions and perceptions are real (even if they subsequently transpire to be “false”) since they have real effects on the world (Danermark et al., 2002: 36). As such, the method of conducting individual interviews would support my development of explanatory critique in this study.

Qu and Dumay (2011: 240) identify some of the common critiques of the use of individual interviews as a research method. These include problems of representation, the nature of language, the inseparability of the researcher and knowledge and the problems associated with writing. Interestingly, Brinkmann (2013) argues that these sorts of issues arise because researchers equate interviews with everyday conversations; therefore, they do not adequately prepare by ensuring that the choice of individual interview is aligned to the goals of the research, the conceptual framework, the research questions, and choices regarding validity, as per Maxwell’s (2013) interactive model of research design (Figure 1) referred to in the introduction to this chapter. As discussed previously, individual interviews were appropriate for my study because they allowed me to better understand the impact of the NVP/PCS course pairing on the students (my research goal), and they were appropriate for CR and SR research, albeit with the acknowledgement that the data generated would necessarily concern the domains of the empirical and actual. Issues regarding validity and, in particular, the manner in which my identity as a PCS lecturer may have impacted the data-generating process, are discussed in Section 3.3 below.

Documentary research

Collecting and analysing key documents and policies were vital steps in my data-generating process, given May’s (2011: 191) contention that documents are “the sedimentations of social practice” that both inform the decisions that people

make and constitute readings of social events. Engaging with these documents thus aided my research on two levels: First, they provided critical insight into the context in which the students were operating as agents, thus supporting my understanding of the conditioning effects of structure and culture throughout the morphogenetic cycle. Second, as examples of discourse themselves, these documents were important sources for the analysis that allowed me to develop (tentative) theories concerning what was taking place in Bhaskar's domain of the actual. This is because, as Bacchi (2009: ix) explains, policy documents are "cultural products", which means that, by asking questions about their sources and operations, it is possible to develop insights into power and governing within specific contexts and the implications thereof for those who are governed. As such, many of the documents provided knowledge that was vital to this study's findings concerning the generative mechanisms underpinning the NVP/PCS course pairing (see Section 3.2.2).

Table 5 below presents the main documents and policies that were drawn on in this study. The reason for my focus on these particular documents was that they were created by institutions that are an integral part of the structural context of this research. The South African Qualifications Authority (SAQA), the national Department of Higher Education and Training (DHET), ECSA and UCT have all asserted structural influence on the NVP/PCS course content (this represents a key focus of both Chapters 6 and 7).

Table 5: Documentary data

<i>Document</i>	<i>Organisation</i>	<i>Year</i>
The National Qualifications Framework and Curriculum Development	SAQA	2000
White Paper for Post-School Education and Training	DHET	2013
Background to Accreditation of Engineering Education Programmes	ECSA	2014
Criteria for accreditation of engineering programmes meeting stage 1 requirements	ECSA	2014
Qualification standard for Bachelor of Science in Engineering (BSc(Eng))/ Bachelors of Engineering (BEng): NQF Level 8	ECSA	2012
The Strategic Plan for the University of Cape Town 2010-2014	UCT	2009
UCT EBE Strategic Plan 2014-2018	Faculty of Engineering and the Built Environment, UCT	2014

In addition to the institutional documents and policies identified above, I also drew on texts specifically related to the NVP/PCS course pairing, which included both handouts from the courses and the EBE Faculty prospectus for 2015. In addition, I also referred to the CVs and e-portfolios that the students created as part of the PCS course (see Section 5.2.2) for additional information about each student.

3.2.2. Data analysis

As mentioned previously, the analysis of the obtained data started during the interviews, participant observation and the documentary research that I carried out and continued throughout the entire fieldwork stage. This is congruent with Maxwell's (2013) assertion that the analysis of data in qualitative research

should be conducted simultaneously with data collection, since this allows the research to progressively focus the interviews and observations on the themes that emerge and to test emerging conclusions. As such, it is perhaps a misrepresentation to present this section on “data analysis” as entirely separate from the previous section on data generation, since it suggests a chronological separation between the two that did not actually exist. However, according to Maxwell (2013), data analysis should influence and be influenced by the rest of a study’s designs; therefore, the focus of this section is on presenting a description of how I went about my data analysis, with the additional goal of demonstrating how this was in alignment with the other elements of my research design.

Coding and connecting

As I observed lectures, interacted with students and lecturers and transcribed both the focus group and the individual interviews myself, I was able to begin to discern certain themes that emerged during the data generation process. For example, noticing how student attendance at NVP lectures dropped over the course of the semester caused me to consider issues of student motivation and engagement. Themes such as these were valuable once I began the formal coding of the interview data. To facilitate this process, I decided to use the Nvivo computer-assisted qualitative data analysis software (CAQDAS). The affordance offered by CAQDAS is that it provides researchers with a means of storing, retrieving, coding and sorting data (Nudelman, 2017a: 350), and I was drawn to Nvivo because of its logical interface and user-friendliness. However, Terre Blanche, Durrheim and Kelly (2006: 325) note that, as useful as computer software can be during the process of data analysis, only humans, ultimately, can make creative associations between the different aspects of accounts or relate what people say to the context in which they operate. As such, I ensured that I used Nvivo as a tool to process and manage my data, not as a substitute for the “messy” work of engaging in an in-depth manner with the content of the student interviews.

I knew that, given the CR underpinning of my research, I needed to engage with the contents of the interview transcripts beyond the domains of the empirical and the actual. Coding represented a crucial step in accessing the generative mechanisms in the domain of the real. I therefore recognised the need to work with the data in a manner that moved beyond a reliance on the narratives presented by the students to focus on the categories that were emerging in and across the interviews. Coding facilitated this process by enabling the segmentation of the data into discrete units for examination, comparison and contrasting in order to allow me to begin developing answers to my research questions. My coding strategy was informed by the distinctions that Maxwell (2012: 111–113) draws between organisational, theoretical and substantive categories: Organisational categories are broad areas and issues that may be identified prior to the generation of data and can be understood as “bins” for sorting the data for further analysis. In my study, this included wide categories such as “electrical engineering degree in general”, “NVP course”, “PCS course” and “career goals”. These codes enabled me to organise my data and to start developing tentative understandings of the students’ experiences. I then utilised theoretical categories to ensure that the manner in which I was working with the data was aligned with the theory that I was using in my conceptual framework. In accordance with Archer’s analytical dualism, I coded for “structure”, “culture” and “agency”; this helped to deepen my knowledge of each of these elements, which was particularly crucial for the analyses presented in Chapters 6 and 7 which deal specifically with structural and cultural emergent properties, and Chapter 8 which focuses on agency. I also organised the data according to whether they related to T1, T2-T3 or T4 of the morphogenetic cycle⁹. Throughout these coding processes, I also developed substantive categories,

⁹ See Appendix 5 for examples of these coding categories and Appendix 6 for the hierarchical charts that show the most prominent themes for each of these stages of the morphogenetic cycle. Whilst the coding process I undertook was dynamic and involved a number of different organisational structures (including according to “structure”, “culture” and “agency” as described above) I have chosen to include these two as illustrative examples to indicate the themes that emerged from the data. For both appendices, the codes under T1 allude to the participants’ experiences as electrical engineering students. Those under T2-T3 relate specifically to NVP and the PCS course, both separately and as a pairing. Finally, T4 includes codes referring to the students’ concerns, plans and perceptions of the future.

which, according to Maxwell, are primarily descriptive and include descriptions of participants' concepts and beliefs. Some of the substantive categories that I used included "nearly quitting", "not coming to lectures" and "focus not on grades". A number of these substantive categories arose from my own ethnographic observation as discussed in section 3.2.1 above.

In addition to these coding strategies, I felt that it was necessary to utilise "connecting" analytical strategies (Maxwell, 2012). As opposed to breaking data up into chunks, decontextualising it and then recontextualising it according to predefined categories (as in coding), connecting analytical strategies focus on the "structure or significance of the narrative conveyed by the data" (Maxwell, 2012: 116). One way in which I did so was by creating narrative vignettes based on the accounts of seven different students. These drew on different aspects of the data relating to how the students did/did not develop discursive identities as engineers during the NVP/PCS course pairing. (These form the basis of Chapter 8.) My choice to include these seven vignettes was based on my assertion that these seven students' narratives provided the most pertinent examples of the ways in which students mediated structural and cultural constraints and enablements in the development of engineering identities. Because these seven student narratives were diverse in terms of factors including reasons for studying engineering, familiarity with engineering professionalism and opinions regarding the NVP/PCS course pairing, they represented a wide pool of experiences for analysis. Where I chose not to feature interviewees in vignettes (there were four individual interviewees whose individual narratives I did not include), this was because they did not appear to add anything substantially new or different to the discussion. This is in line with what Durrheim (2006: 50) terms "sampling to redundancy". Information regarding the seven students who were featured in the vignettes presented in Chapter 8 is provided in Table 6 below:

Table 6: Students featured in the vignettes in Chapter 8

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Mike	Male	27	White	South Africa	Electrical engineering
Ravi	Male	23	Coloured	South Africa	ECE
Paul	Male	24	Black	South Africa	Mechatronics
Vuyo	Male	23	Black	South Africa	Electrical engineering
Angela	Female	23	Black	Namibia	Mechatronics
Yasin	Male	23	Coloured	South Africa	Mechatronics
Faith	Female	24	Black	Kenya	ECE

In developing the narrative vignettes, I drew on each students' individual interview, input to the focus group interview and texts created in class, including CVs and eportfolios. I collated the codes that I had assigned to each of these texts and organised them in such a way that the narratives that feature in Chapter 8 emerged. In this way, the codes were connected so as to "tell a story" about each of the seven students, with the ultimate goal of better understanding how they did/did not develop discursive identities as engineers during the NVP/PCS course pairing

The other "connecting" analytical strategies that I used were the CR modes of inference of abduction and retroduction. These were employed in order to generate understandings of the emergent properties and powers operating in the domain of the real. "Abduction" is a method of inference whereby a phenomenon is interpreted and recontextualised in the frame of a new set of ideas, using creativity and imagination to give new meaning to already known phenomena (Danermark et al., 2002: 91). For example, once I had coded for the different stages of the morphogenetic cycle, I was then able to use abduction to trace developments in various domains from T1-T4 and to develop an understanding of how the various domains interacted with one another, resulting in either the morphogenesis or morphostasis of agency; this was the goal of my third research sub-question, as stated in Section 2.5.

“Retroduction” aims to identify what is basically characteristic and constitutive of a phenomenon by asking the question “What properties must exist for X to exist and be what X is?” (Danermark et al., 2002: 97). The strategies that have been suggested to facilitate this process, including counterfactual thinking, thought experiments, and focusing on extreme cases, were used at various stages of the data analysis in order to provide new ways of considering the data. For example, one of the vignettes I created dealt with a student who did *not* develop a discursive identity as an engineer over the course of the NVP/PCS course pairing (see Section 8.6). This was no surprise, since she had been ambivalent about whether she wanted to be an engineer even when she enrolled for her degree. However, utilising her case as an example presented a contrast to other students’ cases, and gaining a better understanding of how her experience differed from that of other students fed into my knowledge of the generative mechanisms at play during the NVP/PCS course pairing.

Discourse analysis (DA)

I chose to utilise DA as a tool for analysing the texts related to the NVP/PCS course pairing that the students had access to prior to the start of the semester. These were as follows:

Table 7: Documents used for discourse analysis

Course	Documents
NVP	EBE Faculty Undergraduate Handbook (faculty prospectus)
	NVP course handout (contains basic overview of course)
	NVP course timetable (outline of lecture schedule)
PCS	EBE Faculty Undergraduate Handbook
	PCS course handout
	PCS course materials (package of notes compiled for the students)

I focussed my discourse analysis on these documents because I wanted to better understand how the NVP/PCS course pairing reflected the notion of a professional engineer, as this was vital to my study. Since my main research question was directed towards how the courses prepared the students for the workplace, I needed to develop more nuanced understandings of the discourses at work in the portrayal of the engineering workplace. Furthermore, given that a core component of my conceptual framework rested on the re-conception of the development of workplace readiness from the attainment of individual skills to students' development of discursive identities as engineers (see Section 2.3), I needed to learn more about what, according to these two courses, this actually entailed. I realised that my aim of understanding the course pairing at Bhaskar's domain of the real could only be achieved if I moved beyond the content of the texts in order to examine the relationships between their form and function. As discussed in Section 2.4, there is a dialectical relationship between discourse and society in that discourse is both shaped and constrained by social structure and is socially constitutive in that it constructs the world in meaning (Fairclough, 1992: 64). Thus, DA could assist me to understand how the relationship between form and function in texts related to the social practices evident in the NVP/PCS course pairing and how these helped to perpetuate the very nature of these practices. In this way, DA allowed me to identify some of the generative

mechanisms that contributed to the course pairing. With reference to Archer’s analytical dualism, DA was particularly instrumental in facilitating my understanding of the cultural emergent properties (CEP) operating at T2-T3; these form the basis of Section 7.2.

My approach to DA was influenced by Fairclough’s (1992) three-dimensional conception of discourse, which is depicted in Figure 4 below:

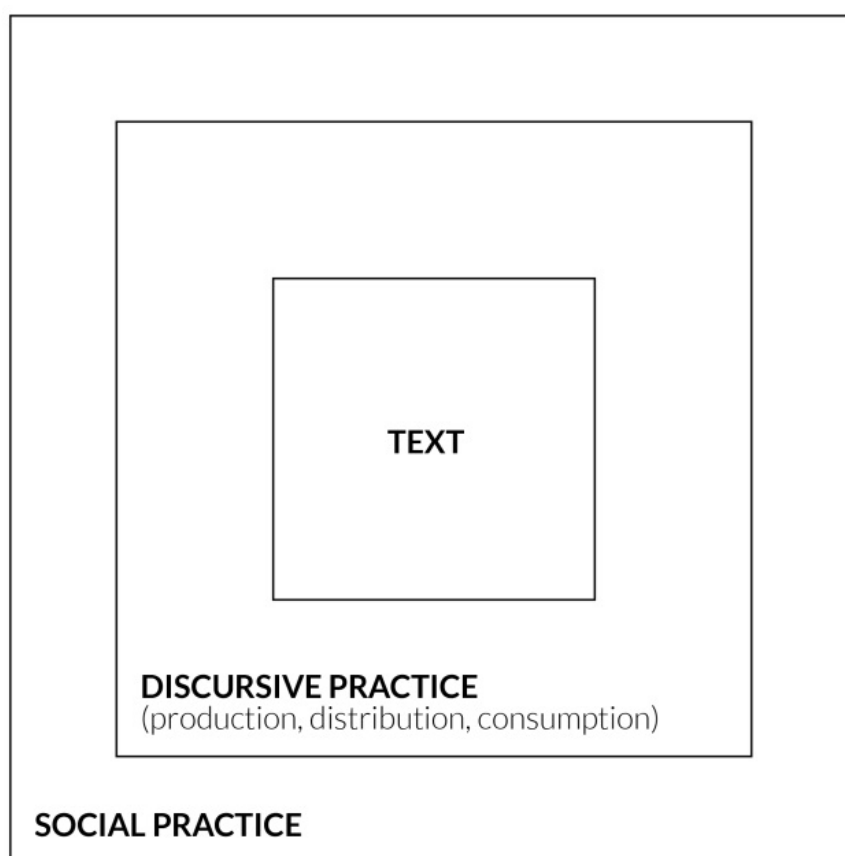


Figure 4: Three-dimensional conception of discourse (Fairclough, 1992: 73)

As is evident from Figure 4 above, Fairclough’s model requires that researchers engage with texts on three levels. While he does concede that the divisions between these levels are not sharp (Fairclough, 1992: 74), for the purposes of my analysis, I found the analytical distinction useful. At the first level, that of “discourse as text”, the focus of the analysis is the text itself; at this stage, analysis focuses on aspects such as vocabulary, grammar, cohesion, text structure, force, coherence and intertextuality. The second level is that of “discursive practice”; at

this stage, the researcher focuses on the processes whereby a text is produced, distributed and consumed. The final level, “discourse as social practice”, is focussed on unearthing the ideological issues that underpin a text, with specific reference to how power and hegemony are enacted. During the process of DA, I used Fairclough’s model to guide my analysis of each of the texts listed in Table 7. This allowed me to move back and forth between textual specificity and social relevance. For example, while my DA analysis of the description of the NVP course in the EBE Faculty Undergraduate Handbook included a close, word-by-word analysis of the text, it also yielded rich content concerning the implications of a focus on developing entrepreneurial skills in an undergraduate context and the philosophies that underpin such an endeavour, including neoliberalism.

3.3. Validity

Maxwell (2012, 2013) presents a realist approach to validity that is in accordance with the CR orientation of this study. He explains that the challenge for CR researchers with regards to validity is how, if they acknowledge that their understandings are their own fallible constructions (and not “objective” interpretations of real phenomena), “one can possibly have any basis for making validity judgements that go beyond procedures and attempt to engage with these real phenomena” (Maxwell, 2012: 130–131). His answer to this lies in understanding the validity of an account in CR research as inherent, resting not on the methods used in a study, but in its relationship to the thing that it is intended to be an account of.

For this reason, validity threats in CR research can be understood as the answers to the question of “how might I be wrong?” (Maxwell, 2013: 123). Responding to this question involves moving beyond the general application of strategies such as member checking, returning interview scripts and triangulation, which Maxwell (2013: 123) likens to “magic charms that are intended to drive away evil”. Cousin (2013: 126) makes a similar point when she states that, while such strategies are helpful in demonstrating carefulness and trustworthiness, they

need to be decoupled from the belief that they will “contribute towards getting at a truth in ‘objective’ ways”. Instead, Maxwell urges researchers to be clear about the threats that may arise in their specific studies and how they plan to deal with these. Thus, some of the key validity threats that arose during the various phases of my study and my responses thereto follow below.

3.3.1. *Researcher bias*

Throughout Section 3.2, I attempted to make explicit the rationale behind choices such as those concerning which documents I used in my research and which students I interviewed. Despite these explanations, I am aware that these choices were, to an extent, an enactment of researcher bias. While I presumed to approach this study as a neutral researcher, these decisions undoubtedly affected the findings outlined in Chapters 6-9 and my conclusions in Chapter 9. I am also aware that my use of DA meant that certain data stood out to me as important for my study and that my choices concerning which themes to pursue further were also an enactment of researcher bias. The first way I managed this bias was by including clear explanations of my unfolding theories throughout this dissertation as well as maintaining clear alignment with my conceptual framework. May (2011: 171) explains that, regarding ethnographic research in particular, “our own cultural equipment is thereby used reflexively to understand social action in context”, and my responsibility as a researcher was to enact and articulate this reflexivity. The second way in which I managed my researcher bias was through my attempts to ensure that there was alignment throughout the various elements of the research process, as per Maxwell’s (2013) interactive model of research design (Figure 1). My hope was that aligning the research methods, the conceptual framework and the data analysis strategy would result in a level of integrity that contributed to the overall validity of the findings and conclusions.

3.3.2. Reactivity

As described in Section 3.2 above, my methods of data generation included interviews and ethnographic observation. Another validity threat to my research, therefore, was reactivity. This, according to Maxwell (2013: 124), refers to how I may have influenced the setting or the individuals studied. In particular, my status as a PCS lecturer had the potential to influence how willing students were to be open with me during interviews and how naturally they would act as I observed their interactions during lectures, particularly in the PCS course, given that there was much small-group work during the sessions. As a way of dealing with this, I made a particular effort to be open and honest with the students from the start of the NVP/PCS pairing about who I am and what I was attempting to achieve with this study. In the first NVP lecture, which the majority of the fourth-year electrical engineering students attended, I introduced myself to the class, described the study's parameters and made myself available for any questions that the students may have had. I also made an effort to attend every NVP and PCS lecture so that the students would become comfortable in my presence. This seemed effective since, when the time came to conduct the individual interviews at the end of the course pairing, I had already established relationships with most of the students. In addition, I had purposely not taught this cohort of students the previous year, when they were in third year (PCS also runs a course for third-year engineering students), so that they would be less likely to relate to me as a lecturer than they would have had they been my students. Finally, at the start of every interview, I reminded the students of the measures I would be taking to ensure their confidentiality (see Section 3.4).

3.3.3. Lack of response variability

Another issue that could have threatened the validity of my findings was the fact that one of my main research methods was focus group interviews, in which a lack of variability may have arisen in the responses provided by students. This could have occurred if the students felt reluctant to share their (potentially

personal) experiences of being electrical engineering students with a group of individuals with whom they were not fully comfortable. In addition, group dynamics may result in one individual being dominant in the discussion, thus silencing potential alternative voices from the group. This would have been detrimental to the validity of my research because it would have limited the scope of the insights that I was able to develop concerning how the students, as agents, navigated the constraints and enablements conditioned by structure and culture (my third research sub-question), as well as their conceptions of their identities as agents at T1 of the morphogenetic cycle. One of the ways in which I addressed this was by being flexible when conducting the interviews and changing tack depending on the dynamics of particular groups. In addition, the fact that I conducted six focus group interviews provide me with an opportunity to compare the kinds of responses that I received, thereby alleviating the validity threat that comes with a reliance on a single data source.

3.3.4. Summary: approach to validity

This section discussed three potential validity threats to my research, as well as the measures that I implemented in order to allay them. However, it bears reiteration that CR's assertion that there is an objective reality but that all research is produced by humans and is therefore inevitably fallible (Cruickshank, 2003) meant that my focus in terms of validity also needed to include the credibility of my interpretations and the conclusions that I drew from the study (Maxwell, 2012). For example, I knew that my analysis of T2-T3 of the morphogenetic cycle would need to include reference to the curriculum taught in the NVP and PCS courses. However, as Ramsden (2003: 67) notes, there are multiple understandings of curriculum, including the manifest one defined by staff (the formal curriculum) and a latent one defined by students' perceptions (the hidden curriculum). The implication of this for my analysis could have been that I focused only on the first, resulting in my findings being compromised and therefore lacking credibility.

As a means of countering this, I ensured that I generated data from multiple sources, as outlined in Section 3.2.1 above. However, Sayer (2000) urges CR researchers to abandon naïve ideas regarding the existence of “some simple formula for discovering the truth”; instead, the validity of interpretation should be assessed in terms of the actual context and purposes of the interpretation’s use. To this end, I was influenced by Archer’s (1995: 344) argument that practical realist social theorising *cannot* result in a single explanatory “grand narrative” or what she refers to as a “master-key to human development”, given that the causal mechanisms at work in Bhaskar’s domain of the real are always contingent, meaning that the effects of agency will always be unpredictable. Critical realist research, therefore, does not suppose that knowledge mirrors the world, but rather that it interprets it in such a manner that the expectations and practices that it informs are intelligible and reliable (Sayer, 2000). Thus, for Sayer (2000), validity relates to the “practical adequacy” of research findings within a specific context, which he describes as “a matter of adding to the range of interpretations, thereby enriching an on-going creative conversation”. It is my belief that the strong theoretical and conceptual framework underpinning my research and the coherent research design described in this chapter provide the basis for a valuable examination of the development of employability skills in engineering higher education.

3.4. Ethics

Throughout the research process, I was committed to autonomy and respect for the dignity of my study participants, which Wassenaar (2006: 66–67) emphasises as the core philosophical principles that underlie ethical research. To adhere to these principles, I ensured that voluntary informed consent was provided by all participants. This involved the initial briefing delivered to the entire NVP class mentioned in Section 3.3.2 above, where, in addition to sharing the aims of this research, I ensured that the participants understood that they were free to decline or withdraw at any point after the study started. I also formalised an agreement in writing by means of a consent form (see Appendix 7).

Moreover, I protected the confidentiality of the individuals who participated in the study through the use of pseudonyms. One complexity related to this was that, because I used focus group interviews in the data-generation phase, I could not ensure that all participants treated each other's input as confidential. However, I began each focus group and individual interview by reiterating issues concerning privacy and confidentiality, so my hope is that the participants adhered to privacy requirements. I was also aware that the fact that the focus groups were filmed may have been of concern to certain participants. Some ethical issues around filming include the threat to anonymity that a film presents, as well as the possibility that the integrity of an interview is compromised by either the interviewer or interviewee feeling pressured to "perform for the camera" (Kelly, 2006: 298). To counter these potential issues, Saunders, Kitzinger and Kitzinger (2014) suggest that explicit negotiation with research participants should be part of the process. To this end, I was clear both on the consent form and in the initial briefings delivered before the interviews that the films were for data-capturing purposes only and would be deleted after a period of five years.

One particularly ethically challenging issue that I needed to deal with was my role as a PCS lecturer. During the data-generating process, I was aware that the students may have thought that, because I was a lecturer in the PCS department, they would need to respond positively regarding the PCS course. They may have believed that I would share any negative feedback with their lecturers (my colleagues) and that doing so may have impacted the results that they received for the course. To avoid this perception, I assured the students that I would not be present in any staff discussions regarding the NVP/PCS course pairing. In addition, I excused myself from any departmental meetings in which individual students would be discussed in order to ensure that I would not have the opportunity to engage in any conversations that could potentially have influenced how their lecturers related to or assessed the students.

Since I was conducting research with UCT students, it was necessary for me to obtain ethical clearance from the university. This clearance needed to be obtained from two parties: the Executive Director of Student Affairs at the university, and the EBE Ethics in Research Committee (EiRC). Both of these applications for ethics clearance were granted, and the relevant documentation can be found in Appendix 8. In addition, the Education Higher Degrees Committee at Rhodes University granted my request for ethics clearance for this study as part of the proposal acceptance process. The relevant documentation can be found in Appendix 9.

3.5. Researcher reflexivity

Throughout this chapter, I use the first-person pronouns “I”, “me” and “my” to describe the choices that I made and the actions that I took with regards to research design. This grammatical choice was intentional in that I wished to represent my agency as a researcher. This signifies my acknowledgement of my position in relation to my research site and topic and my understanding of a researcher as, in Cousin’s terms (2013: 127), a “self-conscious, theoretically and emotionally invested” actor, as opposed to an “objective, truth-finding” one. (This links to the discussion in the previous section concerning CR’s understanding of research as produced by humans and therefore inevitably fallible.) This conception of a researcher as a self-conscious author and, as such, as *part* of the data, leads to the requirements of researcher reflexivity, which is the process of self-reflection whereby a researcher considers how her identity, beliefs, experiences and opinions may impact the data, findings and conclusions of a study. Cousin (2013: 127) identifies some typical reflexive questions:

What perspective am I bringing to the inquiry? What insights does it afford?
What alternative lens might be useful? What were the limits and scope of my inquiry? How was I positioned?

The personal journey that led me to my PhD dissertation topic is described in some depth in Section 1.1. This account should help the reader to understand

how my personal, academic and professional fields of interest intersected at the point where I decided to focus on the ways in which the NVP/PCS course pairing prepared engineering students for the workplace. This being the case, however, I soon became aware that the most obvious aspect of my identity that I needed to be aware of during my research process was my status as an “insider” in the research environment. At the time of my fieldwork, I had already been working as a contract lecturer in the PCS Department for seven years, and I was therefore very familiar with its curriculum, teaching materials, pedagogy and lecturing staff. Such a level of familiarity is often emphasised as being problematic for researchers, as it could mean that they may be “more likely to take things for granted, develop myopia, and assume their own perspective is far more widespread than it actually is” (Mercer, 2007: 6).

The practical actions that I described in Sections 3.3.1-3.3.3 were, in part, implemented as a means of avoiding these sorts of issues. In addition, the inclusion of the NVP course in my study contributed to “making the familiar strange” (Mercer, 2007: 7), since this was an unfamiliar space for me, both literally (I had little knowledge of the nature, pedagogy and content of the course) and in a disciplinary sense (I had no experience of being a professional engineer). Furthermore, while I may have been an insider because I worked at PCS, other aspects of my identity, such as my age, gender and ethnicity, located me as an outsider among my research participants, who were all students.

However, the entire notion that an insider perspective on a research site is “some kind of virus which contaminates the research” (Cousin, 2013: 127) is also subject to critique. Trowler (2011: 2) explains that an insider researcher is more “culturally literate” in the research site, and this was certainly the case for me. My familiarity with the PCS Department and, indeed, the EBE Faculty at UCT, added depth to my interpretations with regard to identifying causal mechanisms, particularly concerning curriculum and institutional culture. Another benefit of insider research is increased credibility and rapport with research participants (Mercer, 2007: 7), and I feel certain that, because I was a member of the UCT

“community”, the students felt more able to openly share with me; this was because I could recognise the contexts that they described and relate to their experiences at the university. Thus, both of these positive aspects of conducting insider research helped me formulate richer explanations of my data.

Finally, as my study progressed, I realised that my emerging critique of the NVP/PCS course pairing could lead to a clash between my dual roles as member of staff in the EBE Faculty and as a PhD student/researcher. This is a common dilemma for those conducting insider research within their own organisations (Brannick & Coghlan, 2007; Trowler, 2016); as such, I felt it was important to find ways to respect the integrity of UCT whilst also maintaining that of my research. Since the study arose from my own practice as a lecturer, I felt that changing the name of the institution would be pointless, given that readers would be able to identify my institutional affiliation quite easily. However, I chose to use pseudonyms for the lecturers, so that my references to them would not be interpreted as evaluating their teaching practices.¹⁰ In addition, I have made it clear in this chapter that my study does not provide a mirror to reality but rather an interpretation thereof. Shay, Ashwin and Case (2009: 375) explain that the use of different approaches in higher education research can result in new perspectives that strengthen the field studied in terms of its diversity. My expectation, therefore, is not that my conclusions will override other perspectives on the NVP/PCS course pairing; rather, my hope is that they will be recognised as valuable in contributing to a new approach to conceptualising employability development in engineering education, particularly given that universities are sites of on-going knowledge development and that the EBE Faculty at UCT will have to continue to find ways of incorporating ECSA requirements into its programmes in the years to come.

¹⁰ When the lecturers use their academic titles, I incorporated these into the pseudonyms.

3.6. Conclusion

This chapter began with a quote from Zora Neale Hurston's autobiography that characterised research as "formalised curiosity". The goal of this chapter was to explore the decisions that were involved in the process of formalisation. This included choices concerning the overall approach to the research, the methods used for gathering data and analysis and considerations regarding validity and researcher reflexivity. Throughout the chapter, I have drawn links between the choices that I made concerning these issues and the CR and SR underpinnings of the study, the goal of which was to highlight the alignment between the different elements of Maxwell's (2013) interactive model of research.

Later in her autobiography, Hurston (1942: 184) writes that "My search for knowledge of things took me into many strange places and adventures". While I was obviously familiar with UCT and had a broad understanding of the higher education sector, I soon realised that there was much about the context of my research that I needed to investigate further in order to be able to develop richer explanations. This included historical perspectives on higher education in South Africa, approaches to engineering education and wider debates concerning the purposes of higher education, all of which served to inform the interpretations that I developed of the impact of the NVP/PCS course pairing. This contextual information forms the basis of the following chapter.

4. Context of the study

In my younger years, I was, at intervals, set on being a writer, innovator of sorts, social scientist, physical scientist, and mathematician. It turned out that I would not pursue any one of these careers, but, at least to some extent, all of them. The Engineering method, I found, has as its cornerstone the careful synthesising of knowledge from a wide variety of disciplines; and the extraction, from this crock pot of contradicting and colliding ideas, a creative solution.

(Werner, student e-portfolio, 2015)

The quote above was taken from one of the e-portfolios created for the Professional Communication Studies (PCS) course that forms one part of the course pairing that is the focus of this dissertation. Students were required to create a website intended to showcase their skills, experience and CVs to potential employers (see Section 5.2.2). Many students also chose to include in their e-portfolios a testimonial in which they described their personal connections to engineering; the opening quote by Werner is an example of this.

What is significant about this quote is that Werner views engineering as a meeting-point of many different disciplines, ontologies and skills. To him, choosing to become an engineer did not come at the price of the exclusion of many of his interests; rather, it provided him with a career in which this diversity would allow him to thrive. This view is echoed in the vision statement of the Engineering and the Built Environment (EBE) Faculty at the University of Cape Town (UCT), which is “the desire to foster strong analytical skills, practical ingenuity and creativity, good communication and high ethical standards and professionalism, as well as the ability to be lifelong learners” (EBE, n.d.). Thus, the study of engineering is seen as involving more than the development of technical skills; rather, it also incorporates modes of thinking (ingenuity and creativity), approaches to professionalism (including ethics) and the employability skills (including communication) that are at the heart of this dissertation. This view of contemporary engineering education as having to incorporate these diverse elements is a common theme in scholarship in the field (Conlon, 2008; Galloway,

2008; Jordan, Carlile & Stack, 2008; Froyd, Johnson & Rabb, 2012). In addition, given the current rate of technological development globally (including a rise in automation and artificial intelligence), it is impossible to predict exactly what the role of an engineer will be in twenty, or even ten, years' time. For this reason, Tryggvason and Apelian (2006: 16) write that they are only modestly exaggerating when they define the "engineer of the 21st century" as a professional who

- Knows everything;
- Can do anything;
- Works with anybody, anywhere; and
- Imagines and can make his/her imagination a reality.

The challenge for contemporary engineering higher education, then, lies in how it might educate engineers-in-training in such a fashion that they possess the capabilities required to enact all these roles. Understanding these contextual challenges forms the basis of the content of this chapter. As a means of situating the course pairing considered in this case study and highlighting the genesis of some of the current issues in the local higher education sector, this chapter begins with a brief historical overview of the higher education sector in South Africa. Thereafter, the chapter shifts to a discussion of engineering education, both globally and locally, with a particular focus on UCT. Trends and changes are discussed in a bid to establish a foundation for understanding how the NVP/PCS course pairing fits in with current views on engineering pedagogy. Finally, the chapter ends by expanding to consider the wider debate regarding the purposes of higher education; this topic is addressed in order to emphasise the cultural conceptions concerning the role of universities. The objective of the chapter is to situate the NVP/PCS course pairing within its structural and cultural context and thereby to lay the foundation for the analysis that follows in subsequent chapters.

4.1. Higher education in South Africa

4.1.1. Higher education during apartheid

The foundations of South Africa's higher education system can be located in the establishment of the South African College in Cape Town in 1829 (Maharajh, Motala & Scerri, 2011: 197). While the College's initial intake was small, demand soon grew, and a number of similar colleges were established. Following the establishment of the Union of South Africa in 1910, 1916 saw the government pass Acts 12, 13 and 14, which resulted in the establishment of the University of South Africa (UNISA), the University of Stellenbosch and the University of Cape Town (UCT), respectively. Between 1918 and 1951, six more colleges became fully fledged universities (Maharajh et al., 2011: 198). The establishment of these universities reflected the developing needs of industry and the economy at the time (Sehoole, 2006). As the focus of economic expansion shifted from agriculture and stockbreeding to mining and industry in the late 19th century, the need for skilled labour to expand these new industries increased.

From the time of their establishment, racial segregation was a defining factor of these institutions, with privileged access being granted to whites. While there was no law prohibiting the admission of black students to universities prior to apartheid, access was extremely limited, with strict segregation in areas such as sports, accommodation, social activities and, in some cases, academic matters (Reddy, 2004: 13; Maharajh et al.). This had both structural and cultural implications, given that it affected the nature of these institutions in terms of enrolment and epistemology. When, following its electoral victory, the National Party came to power in 1948, entrenching apartheid as the system of governance, the percentage of black students enrolled at universities was 4.8 percent (Reddy, 2004: 10).

The 1959 Extension of Higher Education Act prohibited established universities from accepting black students, except with special permission from a cabinet member. Black students were forced to attend the newly established institutions that would come to be referred to as historically black universities (HBUs). Only under exceptional circumstances, for example a specific course not being available at a HBU, could a black student attend a historically white university (HWU) (Akoojee & Nkomo, 2007: 389). The HBUs were intended to “legitimate, reproduce and constitute” (Reddy, 2004: 10) the government’s classifications of race and ethnicity, thus entrenching the culture of division and the prejudice of apartheid. Thus, for example, the University of Zululand was created for Zulu and Swazi speakers and the universities of the Western Cape (UWC) and Durban-Westville for coloured people and Indians. Student numbers at the HBUs soared between 1960 and 1968, with numbers increasing by 83 percent at the University of the North, Zululand and UWC between these years (Reddy, 2004: 16). The repressive and conservative cultures at the HBUs ultimately led to mounting student unrest and, by the 1980s, the sector was a “vibrant terrain of conflict with the apartheid state” (Reddy, 2004: 19). When the first democratically elected government came to power in 1994, it inherited a higher education sector that was fractured along a number of structural lines, including racial, linguistic and geographic, and by type of institution (i.e. university or technikon¹¹) (Bozalek & Boughey, 2012: 692).

4.1.2. The post-apartheid higher education system

The post-apartheid government embarked on a programme of reforming the education system that was underpinned by the values of social justice, human rights and democracy for all enshrined in the country’s new Constitution. This represented a significant cultural shift. Moreover, the new education system needed to take into consideration the changing global environment and evolving

¹¹ Before 2002, there was a distinction in the South African higher education sector between universities and “technikons”, which were vocationally based higher education institutions.

systems of trade, finance, and technologies (Maharajh et al., 2011: 199). In terms of the structural context of higher education, policy since 1994 has focussed on the development of a single, coherent system intended to cater for all South Africans and to contribute to the economic and social needs of the country (Bozalek & Boughey, 2012: 692). Selected key documents related to the higher education sector, their years of publication and core content are outlined in Table 8 below.

Table 8: Some documents that have shaped the South African higher education sector

Date	Document	Core content
1995	South African Qualifications Authority Act	Established a National Qualifications Framework that focussed on learning outcomes as benchmarks to be reached on all levels of the education system.
1997	White Paper on Higher Education Transformation	Aimed to redress some inequalities of systemic apartheid through higher education. Placed higher education within the broader context of the Reconstruction and Development Programme in South Africa at the time affirming its potential impact on “political democratisation, economic reconstruction and development and redistributive social policies aimed at equity” (DHET, 1997). Introduced the concept of a “single national coordinated system” as a way to overcome the fragmentation of the sector.
2001	National Plan for Higher Education in South Africa	Outlined the framework and mechanisms for implementing the White Paper. This included the restructuring of the system, reducing the number of institutions via mergers and the establishment of new institutional and organisational forms. Identified three institutional “types”: traditional universities, universities of technology and ‘comprehensive’ universities.
2001	Report of a Working Group (Department of Education)	Made recommendations regarding the principles established in the National Plan. Called for the reduction in the number of higher education institutions from 36 to 21 through mergers and incorporations and outlined the form that the restructured institutions must take.
2013	White Paper for Post-Secondary Education and Training	Followed the establishment of the Department of Higher Education and Training (DHET) as distinct from the Department of Basic Education. Set out a vision for what the higher education system will look like by 2030, with a specific focus on a single, coordinated post-school education and training system, emphasising expanded access, improved quality and increased diversity of provision.

The list above is not exhaustive, yet it does highlight some of the key shifts that have occurred in the sector from the end of apartheid to the present. Clearly, steps have been taken at a national level to address both the structural and cultural fragmentation in higher education that was the legacy of the apartheid system, for example institutional mergers. How effectively this change has been implemented and the ways in which it has impacted the equity of the system as a whole are subjects of on-going debate as South Africa enters its second decade of democracy (Govinder, Zondo & Makgoba, 2013; Sehoole, 2013; Booie, Vincent & Liccardo, 2017). For example, the current funding formula, which assigns greater funding based on graduation rates and research output, means that all universities compete for funding in the same manner (Bozalek & Boughey, 2012: 676); however, this does not take into consideration universities' specific contexts, including whether they have established research traditions and whether the basic education system has adequately prepared students to advance in the system.

4.1.3. The University of Cape Town

Within this system, UCT, where this study is located, consistently ranks amongst the top universities in Africa according to various global ranking systems, including the Quacquarelli Symonds (QS) World University Rankings, the Times Higher Education World University Rankings and the Academic Ranking of World Universities. In 2016, student enrolment at UCT stood at 29,074 students. Of this total, 18,421 were undergraduates and 10,653 postgraduates (UCT, 2016b). The University consists of six faculties (Humanities, Commerce, Law, Engineering and the Built Environment, Health Sciences and Science) and the Centre for Higher Education Development, which is a cross-faculty structure. In terms of demographics, according to the latest available figures, of the South African students at UCT, 34 percent were white, 28 percent were black, 16 percent were coloured, 8 percent were Indian and 14 percent were undisclosed (UCT, 2016a). These figures are out of synch with national demographics in a

country in which black Africans make up nearly 80 percent of the population (Statistics South Africa, 2012: 21).

Developing strategies intended to effectively redress these types of complexities is at the heart of transformation discussions at UCT and other South African universities, in particular the HWUs. Debates regarding structural and cultural issues such as staff diversity, student admissions, curricula, language of instruction and learning and institutional leadership have been brought to wider societal attention by the #FeesMustFall student protests which occurred at South African universities in 2015, 2016 and 2017 (Lange, 2017; Pennington et al., 2017). These protests have at their core the demand for free decolonial education for all (see Section 1.5). One of the results of #FeesMustFall and allied protest movements has been intense scrutiny of the higher education sector by different societal spheres, including the media and national politics. Responses to the mid-November 2017 release of the Heher Commission Report concerning the possibility of free tertiary education, which was requested by President Zuma, served to highlight the lack of consensus regarding the way forward for the South African higher education sector, as well as the conflicting demands from various stakeholders, including the universities, government, students, academic staff, economists and representatives from industry. The higher education sector in South Africa is therefore clearly in a state of flux, and the way forward is unpredictable.

The purpose of this section has been to provide historical background concerning the factors that have contributed to the development of the higher education sector in South Africa. One of the main issues that has emerged from this discussion revolves around how contemporary higher education institutions (HEIs) reflect and deal with the post-apartheid context in South Africa. In some cases, this relates to structural issues, such as the fact that HBUs are less resourced than HWUs. However, in many cases, the legacy of apartheid manifests in questions that are directly related to teaching and learning: For example, what should be taught at a contemporary South African university?

How can a university cater for students who have had inequitable access to quality basic education? Should a South African university's emphasis be on contributing to national economic growth or on social justice? These sorts of questions are challenging because of the divergent cultural conceptions that underpin the higher education sector as a whole in South Africa. However, it is also possible to identify their manifestations in particular disciplines: Engineering education is a case in point, particularly as it operates at a unique intersection between science and the economy, which adds complexity to the academic project. These engineering education-related issues are the focus of the next section, which begins with an overview of the history of engineering education.

4.2. Engineering education

4.2.1. *A historical perspective*

Seely (2005: 115) notes the link between the development of engineering as an industry and the means used to induct new individuals into the field at various historical stages; he locates the emergence of engineering as a profession at around the time of the Industrial Revolution. At this time, advances in manufacturing processes and the concomitant technological and economic progress were carried out by individuals from a wide range of backgrounds, including businessmen, entrepreneurs, craftsmen and scientists. These were the "early engineers" (Case, 2013: 76), who were very much defined by what they could do, as opposed to formal credentials. One became an engineer through hands-on apprenticeship, for example, at a machine shop, on a factory floor or on a building site (Tryggvason & Apelian, 2006: 15). Harwood (2006: 55) refers to this as "shop culture", whereby the older elite of the profession, who had themselves been trained in this manner, downplayed the necessity of formal education for engineers.

The shift from this method of training to “school culture” (Harwood, 2006: 55) that occurred in the mid- to late nineteenth century was influenced by the emergence of a more science-based engineering industry. Where engineering practice once relied on common-sense, hands-on approaches, newly emergent electrical and chemical technologies required engineers to be grounded in basic science and mathematics (Grimson, 2002: 32). In addition, Seely (2005: 116) explains that leaders in the engineering profession at this time had “an acute sensitivity to their lack of social position” in relation to other professions, particularly the sciences. A more formal approach to education was viewed as a means of acquiring prestige.

Thus, engineering education as we know it today began to emerge; Harwood (2006: 55) refers to this as the “academisation” of engineering education. In both the United States and Europe, there was a clear shift towards more organised, comprehensive approaches to training engineers, although this manifested in different ways. In the US, engineering programmes were largely offered in universities, while in Europe (and particularly in Germany) engineering colleges which were independent of the university system, were established (Case, 2013: 76). While these contexts differed, there emerged a similar tension in terms of maintaining a balance between hands-on knowledge and theoretical and scientific understanding (Froyd et al., 2012: 1345). This relationship between practice and theory within engineering curricula continues to be debated today and is discussed in the following section.

Another significant feature of the engineering profession that Seely (2005: 122) considers as having affected the education of engineers is its close relationship to large corporations. He explains that, while most professions, including medicine and law, define their professional identities in ways that emphasise their independence from particular stakeholders, engineering has historically placed emphasis on loyalty and service to employers, thus aligning itself with the interests of corporate capital (Case, 2013: 77). As a result, a focus of engineering education became the preparation of students for the business environment,

and, as this terrain has shifted over time, so too has the emphasis of engineering educators (Seely, 2005: 123). For example, in the 1920s, with the growth of technological innovation and big business, the inclusion of courses in accounting and management in engineering curricula became prevalent. After World War II and the Cold War, elements of the humanities were strengthened in engineering curricula as a means of steering students away from communism. More recently, with the acknowledgement of the role of environmental responsibility held by corporations, sustainability and environmentalism have been incorporated into engineering curricula (Grimson, 2002).

4.2.2. Key issues in contemporary engineering education

The brief historical survey above demonstrates how the features of the engineering industry at any given time have affected the format and content of engineering education. The enduring nature of this industry-education relationship continues to be evident in key issues currently facing engineering schools, departments and curricula around the world. Publications with titles such as “Educating engineers: designing for the future of the field” (Sheppard, Macatangay, Colby & Sullivan, 2009), “The 21st-century engineer: a proposal for engineering education reform” (Galloway, 2008) and “Educating the engineer of 2020: adapting engineering education to the new century” (National Academy of Engineering of the National Academies, 2005) indicate that engineering educators and policy makers are looking to the future in order to ensure that the education system is able to produce appropriately trained engineers in numbers sufficient to meet the needs of a technologically, socially and economically developing world.

Sheppard et al. (2009: 1) view engineering as a profession that is focussed on the solving of problems: Engineers must apply their knowledge to the solution of problems for the good of society. However, they argue that recent rapid changes in technology (which are often brought about by engineering itself) have shifted the nature of problem analysis and solving from the linear conception that

existed in previous, more stable systems to a “network, web, or system understanding” (Sheppard et al., 2009: 4) of engineering work. This results in new requirements for engineers. Whereas, in the past, they could approach a given problem in a neutral, objective fashion, today’s more complex, intermeshed systems require an insider’s perspective that is able to take into account factors such as sustainability, impact of the economy, and social issues when approaching a problem to be solved. Barnett (2000: 415) refers to this context of conceptual overload resulting from a multiplicity of frameworks as “supercomplexity”. While the fundamental engineering processes, such as design and development, remain the same, the domains of application in today’s supercomplex world are quickly increasing in scope (National Academy of Engineering of the National Academies, 2005).

Thus, the argument is made that, as the engineering profession evolves, so too do engineering education systems need to change in order to ensure that the engineers being trained today are able to meet new challenges. Critiques of this conception of higher education needing to adapt to the needs of industry do exist (Kruss, 2004; Dill, 2005; Calhoun, 2006), as it relies on a particular understanding of the purposes of higher education. (This is discussed in Section 4.3 below.) Nevertheless, many of the current key issues in engineering education focus on how best to ensure that engineering curricula and pedagogy are appropriate and relevant for societal needs, both today and in the future.

One of these core debates relates to determining the ideal balance between theory and practice in engineering curricula. As mentioned previously, this debate is almost as old as engineering education itself, although Case (2013: 80) does emphasise that the nature of the theoretical knowledge and practical skills involved has changed enormously. Harwood’s (2006: 54) explanation for this on-going tension between theory and practice is that engineering educators face a “socially structured ambivalence”, since they have to equip students to draw on systematic bodies of fundamental knowledge and to solve practical problems. This leaves them “stuck betwixt and between” (Harwood, 2006: 69) two

powerful groups – science and the economy – and, in aligning with one group or the other, they tend to emphasise either the practical or the theoretical. In terms of higher education, the repercussions of this decision relate to choices regarding both curriculum and pedagogy.

Other challenges currently facing engineering education involve issues of *quantity* and *quality*. These relate to whether sufficient numbers of engineers are graduating worldwide and whether those who are entering the workforce are equipped to carry out work at the required levels. The former involves the consideration of issues of demography. For example, in some contexts, improvements in healthcare continue to lead to an increase in life expectancy, which contributes to an aging population; this, in turn, leads to greater demands on health care, a diminished labour force and increased political instability (National Academy of Engineering of the National Academies, 2005: 9). On the other hand, the “youth bulges” in some developing countries sees a large proportion of young people unable to find employment, which could lead to social and political unrest and an increased need for military services. In either scenario, the growth of populations creates greater demand for public works programmes, which rely on engineers. It is necessary to take into consideration these types of demographic factors when determining how many engineers are required to meet a society’s needs.

With regards to quality, issues regarding whether engineering graduates are able to effectively carry out the work required of them once in industry remain key. This is especially relevant given that, unlike law or medicine (which require students to undertake postgraduate study before they enter the workplace), the standard four-year undergraduate engineering degree enables graduates to enter the workplace as professionals (Sheppard et al., 2009: 8). This has led to many debates in engineering education today concerning curriculum and pedagogy (Galloway, 2008; Grasso & Burkins, 2010; Froyd et al., 2012). With regards to the latter, Froyd et al. (2012) discuss examples of how education, learning and social-behavioural sciences research are currently being

incorporated into engineering education. This includes a focus on developing learning outcomes, encouraging increased student engagement, an integrated approach to course and programme design and the acknowledgement of the importance of fostering a broader range of knowledge, skills and attributes on the part of engineering graduates.

4.2.3. Engineering education in South Africa

While engineering education in South Africa faces the key issues discussed above, there are several factors that make the context and experience in this country unique. Core to these is the structure of the educational options available. As has been mentioned in previous chapters, according to the Engineering Profession Act, No. 46 of 2000, tertiary engineering education in South Africa is accredited by the Engineering Council of South Africa (ECSA); the Act empowers ECSA to conduct accreditation visits in order to evaluate educational programmes (ECSA, 2014b). These programmes must meet the requirements of the profession and must be aligned with the objectives of the National Qualification Framework (NQF), which aims to create a single integrated national framework for learning achievements and to facilitate access to, and mobility and progression within, education, training and career paths (South Africa, 2008: 6). Currently, three professional engineering qualifications are accredited by ECSA:

- The four-year **BEng and BSc(Eng) degrees** are offered by traditional universities to prepare students to become professional engineers;
- The more practically orientated **National Diploma** is offered by the universities of technology to prepare students to become engineering technician; and
- The **BTech degree** is offered to students who have already completed a National Diploma. It is offered by the universities of technology and

comprehensive universities. It involves two semesters of additional academic work intended to prepare students to become engineering technologists.¹²

While many of the issues facing engineering education relate to all three of these qualifications, the focus of this study is on courses offered in the fourth year of a BSc in Electrical Engineering, and as such, the training of professional engineers is the focus of this section.

As part of its accreditation process, ECSA provides guidelines for the structure and content of Bachelor degree programmes. These must consist of a minimum of 560 credits and must have a coherent core comprised of mathematics, natural sciences and engineering fundamentals. Moreover, ECSA stipulates 10 exit-level outcomes (ELOs) that students must be able to demonstrate in order to graduate.¹³ These are summarised in Table 9 below:

¹² While the distinction between professional engineers, technologists and technicians is blurred in the workplace, with each category of registration often engaging in work across the boundary of another category, the difference relates to the nature of the engineering work that is done. Engineers innovate to create and find new applications for products, systems and procedures, while technologists ensure that established products, systems and procedures are applied effectively. The role of technicians is to select and apply very well-defined processes and procedures to the solution of practical engineering problems. Engineering teams in industry are made up of various combinations of these professionals, depending on the needs of different organisations (Harker, 2011).

¹³ As mentioned in Section 1.2, a subsequent revision of the ECSA Qualification Standard for Bsc(Eng)/BEng) in 2014 resulted in a shift to 11 ELOs. Since the 2012 version was the one that was utilised at the time of the case study course pairing, however, I have chosen to refer to it throughout this dissertation for the purposes of relevance and avoiding confusion.

Table 9: 10 ECSA exit-level outcomes (ECSA, 2012: 4–6)

Number	Document	Description
1	Problem solving	Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.
2	Application of scientific and engineering knowledge	Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality to solve complex engineering problems.
3	Engineering design	Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.
4	Investigations, experiments and data analysis	Demonstrate competence to design and conduct investigations and experiments.
5	Engineering methods, skills and tools, including information technology	Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.
6	Professional and technical communication	Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.
7	Impact of engineering activity	Demonstrate critical awareness of engineering activity on the social, industrial and physical environment.
8	Individual, team and multidisciplinary working	Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.
9	Independent learning ability	Demonstrate competence to engage in independent learning through well developed learning skills.
10	Engineering professionalism	Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

While ECSA stipulates these outcomes, it is up to engineering departments to determine how students achieve them, and, as such, it does not specify elements such as curriculum content, teaching methods or assessment tasks. Perhaps

spurred by the uncertainty that arises amongst those who design engineering programmes, the area of engineering education pedagogy has continued to grow in South Africa, as is evident through the efforts of organisations such as UCT's Centre for Research in Engineering Education (CREE) and the South African Society for Engineering Education (SASEE), which work to promote research and other academic activities (such as workshops, conferences and specific training initiatives) intended to improve the learning and teaching of engineering in South Africa.

One of the key concerns regarding engineering education in South Africa involves the shortage of engineers in the country, which has repercussions for key national challenges such as infrastructure development and private sector growth, as well as the job creation and poverty alleviation that can result from these. Systemic factors related to education and training in the country have contributed in various ways to this lack of engineers. For example, there are limited numbers of school leavers who are suitably qualified to manage the science and mathematics demands of an engineering degree (Fisher, 2011: 35). In addition, Hanrahan, Beute, Fraser, Gosling, Lawless and Jandrell (2006: 76) explain that there is generally inadequate funding for engineering higher education, which may result in decreasing academic staff numbers, cuts in equipment budget, and defensive measures being adopted by academic departments. These would influence quality of teaching and could impact the already low throughput figures. A 2007 study of students who entered South African higher education in 2000 showed that, by the end of 2004, only 30 percent had graduated. Fifty six percent had left their institutions without graduating, and 14 percent were still in the system (Scott, Yeld & Hendry, 2007a: 12). While the figures for engineering are more encouraging (these are discussed in greater detail below), Fisher (2011) indicates that they remain an area of concern.

High school leavers also demonstrate little interest in pursuing engineering as a career (Hanrahan et al., 2006: 72). This may be due to generally limited public

knowledge of engineering and/or perceptions concerning the poor remuneration offered in comparison to careers such as accountancy and medicine. Du Toit and Roodt (2009: 24) cite these lower levels of remuneration, as well as a perceived lack of glamour around engineering, as reasons why potential students may choose other fields of study. This could also account for why many young engineering graduates change industries once they enter the world of work.

Lack of access to higher education remains a challenge for most South African school leavers, and this inevitably affects the number of students who are able to achieve professional qualifications. The scholarship programmes offered by industry, which see students' university fees being paid in exchange for agreements to work for specific companies for a set period of time after graduation, have sought to redress this. However, when students from disadvantaged backgrounds are given access to engineering programmes at universities without creating an environment that supports and nurtures academic success, this can result in what Case (2006: 25) refers to as the "revolving door syndrome", whereby students fail courses, are unable to complete their degrees, and are thus excluded from the system. This is backed up by the available figures: In a comparative study of the four-year engineering degrees offered at five engineering faculties at South African universities, Fisher (2011: 25) shows that average completion rates in the minimum time ranged from just over 10 percent at two institutions, to a little over 30 percent at a third and around 40 to 45 percent at two others. Total completion rates ranged from a low of 35 percent to a high of over 60 percent. It is thus clear that throughput rates are a major area of concern for engineering education in South Africa. Furthermore, even when scholarship holders do graduate, this provides no assurance that they will remain in industry: Sithole (2006: 79) describes how some students use engineering bursaries as a way into higher education and then change careers as soon as they graduate in order to follow their real passions.

4.2.4. Engineering education at the University of Cape Town

Engineering education at UCT is offered through the EBE Faculty, which also encompasses the Departments of Architecture and Planning, Geomatics and Construction Economics and Management. Four-year BSc degrees are offered in chemical, civil, mechanical and electrical engineering. Each department also offers postgraduate degrees at the master's and PhD levels. In addition, certain departments offer diploma and honours programmes. In 2015 – the year in which the NVP/PCS course pairing addressed in this study was offered – there were approximately 4,380 students enrolled in the Faculty, 2972 of whom were undergraduate students (UCT, 2015). More in-depth information about the EBE Faculty, including staff complement and money earned from research, is included in Section 7.1.1.

This study focuses on two courses offered to fourth-year students in the Department of Electrical Engineering. Students undertaking a BSc in Electrical Engineering enrol in one of three programmes: electrical engineering, mechatronics engineering or electrical and computer engineering (Department of Electrical Engineering, UCT, n.d). The differences between these programmes are shown in Table 10 below:

Table 10: Undergraduate programmes offered by the UCT Department of Electrical Engineering

<i>Programme</i>	<i>Description</i>
Electrical Engineering	A comprehensive grounding in electrical engineering with the option to specialise in heavy current (including power generation, alternate energy, transmission and machines) or light current (including electronics and analogue circuitry).
Mechatronics Engineering	Theory and practices relating to the development of mechatronic systems (systems that combine mechanical engineering with light-current electrical engineering) including instrumentation and control.
Electrical and Computer engineering	Theory and practices relating to the development of mechatronic systems (systems that combine mechanical engineering with light-current electrical engineering) including instrumentation and control.

Certain courses offered in the Department of Electrical Engineering are taken by students enrolled in all three of these programmes. These include Engineering Mathematics, Engineering Statistics and Engineering Physics, as well as NVP and PCS, the two fourth-year courses on which this study focuses. However, each programme also contains more specialised courses.

The goal of this section has been to provide an introduction to the field of engineering education, both in a general sense and in the specific context of UCT. What has emerged through this discussion of historical and contemporary factors is that the engineering profession and higher education have always been in a dialectical relationship, given that changing conceptions of the engineer have affected the approaches adopted by higher education, while, at the same time, higher education has had an effect on conceptions of the engineer. As discussed in Section 2.3, my study entails reconceptualising workplace readiness from the accumulation of isolated skills by students to the development of discursive identities as engineers. The implication of the dialectical relationship described above is that any research concerning engineering identity cannot be properly

understood without consideration of the macro purposes of higher education. This follows in the next section.

4.3. Purposes of higher education

Barnett (1990: 80) argues that, “Whether we like it or not, higher education is bound up in, and is a key player in, the formation of modern society”. His reference to the fact that some people “may not like it” refers to the criticisms that abound regarding the contemporary higher education sector. As mentioned in Section 4.1.3 above, with specific reference to the South African context, the student protests that have become endemic within higher education over the past few years have brought this sector to the forefront of “society’s conversation” (Gee, 2014: 46), with the majority of stakeholders seemingly thoroughly disgruntled with the status quo, both in terms of the dominant structure and culture in the sector. Many students claim that universities still bear the legacy of apartheid and that the curricula and academic practices at HEIs are fundamentally discriminatory against black South Africans, thereby perpetuating social inequality (CMoloi, Makgoba & Ogutu Miruka, 2017). A 2014 study of South African academic staff showed that 34 percent of the academics in the sample were considering leaving their institutions, mainly for reasons of poor compensation (Theron, Barkhuizen & du Plessis, 2014). Industry stakeholders complain that graduates are ill-equipped to deal with workplace requirements (Mungai, 2015). Even the government has indicated its dissatisfaction with the sector through the passing of the Higher Education Amendment Bill in May 2016. The bill, which set fixed transformation goals and oversight mechanisms, gives the Minister of Higher Education greater power to intervene in HEIs.

While these examples combine to present an image of a sector that is clearly in flux, they do show the centrality of HEIs to contemporary societies. Beyond the epistemological (cultural) function of HEIs, which is dealt with later in this section, McArdle-Clinton (2008: 219–220) demonstrates how integral the

higher education sector is to society by speculating about the potential structural effects of a total shut-down of the sector, which include the loss of academic and administrative jobs; empty campuses; a concomitant lack of need for construction firms to bolster campus infrastructure; no demand for childcare options, given that parents who had been working at the HEIs would be unemployed; and young, underresourced and underprepared adults flooding the job market. While this is not to say that the societal purpose of HEIs is to be an employer, the scenario laid out above does demonstrate how intertwined the higher education sector is with the rest of society, both in terms of culture and structure.

However, while McArdle-Clinton's scenario is clearly hypothetical, a very real challenge to the higher education sector is posed by the focus on skilling students for the world of work (see Section 2.2). This reflects what Barnett (1990: 10–11) refers to as the “double undermining of higher education”: According to him, higher education is under attack epistemologically and sociologically. The epistemological undermining refers to the changing conception of what knowledge is. In modern society, an objective approach to knowledge and truth can no longer be taken for granted, which poses a challenge to higher education. The sociological undermining refers to shifting notions of what the relationship between the state and higher education should resemble. The challenge for contemporary higher education is to be able to clarify its purpose amidst these shifting spaces.

In terms of culture, the teaching of employability skills at a university can be viewed as part of both epistemological and sociological undermining. Epistemologically, it challenges traditional notions of what should be valued by the academy. For example, within professional programmes, Winberg, Engel-Hills, Garraway and Jacobs (2013: 103) draw a distinction between disciplinary knowledge and situated knowledge, with disciplinary knowledge forming the foundation for programmes and situated knowledge being the specific work practices related to the relevant professional context. They state that

universities need to provide students with a balance between these but go on to demonstrate that this can be challenging, not least because these two knowledge domains can be understood as separate and bounded, thus posing difficulties in terms of integration (Winberg et al., 2013: 111). The challenges associated with this difficulty in terms of integration are exacerbated by the rise of what McArdle-Clinton (2008) calls “capsule education”. According to this perspective, the current postmodern environment has had the epistemological effect of resulting in a lack of any legitimate grand narrative for lecturers to teach. Therefore, higher education has been reduced to the delivery of “pre-packaged capsules of information geared to examinations” (McArdle-Clinton, 2008: 207). The structure of UCT’s electrical engineering degree programmes (see Section 4.2.4) reflects this approach, since the knowledge deemed necessary for the students to acquire is divided into discrete courses, the majority of which only run for a semester before they are “written-off” via an exam. The NVP and PCS courses are examples of these semester-long offerings, and the challenge that arises from this would be whether this “capsule” approach to higher education can impact the development of a students’ identity, which is a core component of the conception of workplace readiness adopted in this study (see Section 2.3).

Sociologically, the question of what the relationship between higher education and society should look like remains an on-going debate. One view that has become increasingly common is what Trepanier (2013) terms the “economic utilitarian function” of higher education. This considers the fundamental purpose of HEIs as being the production of economically fruitful actors who are able to join the labour market structure and contribute to national growth. Collini (2012: 95) agrees that this is increasingly becoming the central purpose of higher education. His (somewhat cynical) proof of this involves removing references to “economic prosperity”, “growth”, “our economic competitiveness”, “wealth creation” and so on from the speeches delivered and articles written by politicians, academic administrators and business leaders concerning higher education. His suspicion is that not much will be left to support an argument regarding the value of HEIs and the activities that they pursue. It can be argued

that the notion of students having to develop employability skills such as those addressed in the NVP/PCS course pairing stems from this increasing “marketisation” of higher education (Nixon, 2008: 142). According to this perspective, everything that happens in HEIs must be justified by a defined financial worth (McArdle-Clinton, 2008: 209). This is due to the belief that producing graduates who are “work ready” means that they are, on the one hand, more likely to find paid employment quickly and, on the other hand, unlikely to need additional (and potentially costly) training once they are in industry. This understanding of the purpose of higher education draws on complex relationships between the relevant structural stakeholders, such as HEIs, professional bodies, graduates and employers. The nature of this relationship within the context of this study is discussed in Chapters 6 and 7.

Minogue (2005: 4) characterises the relationship between higher education and society as being “constantly in a state of conflict”, explaining that public discussion regarding universities normally focuses on the need to reform them. This was evident in the examples provided in the first paragraph of this section of the ways in which various stakeholders feel that the South African higher education sector is inadequate. Nevertheless, however this relationship is conceptualised, the acceptance that higher education is integrally related to modern society denotes a two-way relationship: As a key institution in modern society, HEIs will inevitably reflect societal change (Barnett, 1997: 37); however, they are simultaneously in a position to shape society through research, teaching and learning. For this reason, Barnett (1990: 159) contends that curricula oriented to “the worlds of action, of work and of the professions”, or what is understood in this study as developing workplace readiness, need not be opposed. According to him, developing work readiness can be understood as a legitimate goal of higher education. However, the notion of work readiness must not simply be drawn from the outside world and arbitrarily imposed upon the curriculum; rather, it must be placed in a framework of systematic intellectual exploration and should afford students opportunities for critical thinking.

With reference to engineering education in South Africa, ECSA stipulates the kinds of work readiness skills that engineering graduates must be able to demonstrate in its 10 ELOs (see Section 4.2.3). However, such stipulations often lead to a check-list mentality, where the emphasis in teaching and learning shifts from critical engagement to perfunctory adherence for the sake of compliance (see Section 1.2). This is inimical to developing critical thought on the part of students because, in these cases, discussions concerning employability are not proffered in a spirit of debate. Instead, the focus is on competence in terms of performance and not on developing students' capacity to critically reflect on the world in which they live and whether/how they may wish to change it. In addition, Fenwick (2013: 364) supports this view, explaining that the idea that higher education can be considered as a means of preparing students for the university-work transition draws from a normative understanding of transitions that does not enable students to "critically assess the material desires and cultural discourses binding them to these norms". Waghid (2008: 20) understands the development of this critical capacity as part of a university's civic role. Encouraging students to realise that there multiple ways of understanding the world, he argues, prepares them for participation as informed citizens in democratic societies. It is just this type of critical engagement with diverse societal cultures that the "capsule education" described above quashes.

Waghid (2008: 21-22) also considers other ways in which a university should play a civic role. These include the potential to expand life opportunities for graduates in terms of access to employment and the resultant rise in material resources, as well as engaging in research activities that contribute to the processes of democratisation. Nixon (2008) echoes this vision in a call for what he terms a "virtuous university", whereby the higher education sector should focus on building strong civic links, not just with business and industry as is the focus of the economic utilitarianism perspective described above, but with the non-profit sector. This feeds into another of higher education's purposes - civic formation (Trepanier, 2013). In this conception, HEIs have a key role to play in shaping students as responsible and active democratic citizens and leaders. This

was certainly a key mission of the post-apartheid higher education sector (as discussed in Section 4.1.2 above) and reflects the potential of higher education as a “public good”, a concept that has been debated by various researchers (Singh, 2001; Dill, 2005; Calhoun, 2006). Yet, while the contention that higher education should contribute positively to society seems straightforward, Singh (2001: 15) explains that the complexity concerning this notion is in part due to the questions of “which public” and “whose good” this function of higher education should serve. This is particularly contentious when considered in relation to Nixon’s (2008: 142) claim that HEIs have actively contributed to constructing the middle class and the dominance of consumerism and capitalism within society. Indeed, Section 7.2 shows how these neoliberal discourses are pervasive within the NVP/PCS course pairing, which raises the issue of whether the “good” promoted by higher education is limited to benefitting society’s elites.

Whether the purpose of higher education is seen to be promoting economic utilitarianism, civic formation or something else, the question remains of how the higher education sector, which is made up of bureaucratic structures, is able to respond to society’s needs. This raises the concept of “curriculum responsiveness”, which is the term coined by Moll (2004) to refer to how higher education curricula respond to both economic and non-economic imperatives. Seen through this perspective, the focus of the NVP/PCS course pairing on employability skills as a means of equipping students for the workplace could be seen as an aspect of higher education’s economic responsiveness, which refers to the ways in which institutions are preparing qualified workers to function in key sectors of the economy in order to increase economic productivity. For example, the qualifications, knowledge and skills demanded by the economy are being incorporated into the engineering curriculum, so UCT could be seen as simply fulfilling a need prescribed by industry and thereby, fundamentally, equipping its graduates to thrive once in industry. However, this notion of the role of the university as a driver of economic development recalls Barnett’s caution, described previously, against arbitrary impositions on the curriculum from the outside world. Kruss (2004: 674) also issues a strong warning in this

regard when she explains that “the danger inherent in contemporary calls for responsiveness is that the role of higher education becomes reduced solely to its economic purpose, ignoring the social, moral, cultural and intellectual purposes of education”. As is shown in Chapter 7, this seems to be evident from the impact of the ECSA ELOs, which I argue encourage passive participation in industry rather than critical innovation and boundary-crossing by graduates.

4.4. Conclusion

This leads back to the purpose of this thesis, which is to develop an understanding of the ways in which participation in an undergraduate course can prepare electrical engineering students for the workplace. This chapter began with a historical overview of higher education in South Africa; it then shifted to a focus on engineering education, both generally and in relation to location of my research, UCT. Finally, this chapter examined issues concerning the purpose of higher education, the objective of which was to highlight the contested nature of the philosophies that underpin the sector. The aim of this chapter was to introduce the reader to the context within which the NVP/PCS case study that is the focus of analysis for this study took place. While contextual understanding is always valuable, this is particularly important in a social realist analysis, given its emphasis on the structural and cultural context in which interaction occurs. This chapter opened with a quote by Werner, one of the students enrolled in the NVP/PCS course pairing, who described how he discovered, in engineering, a field of study that encompassed many aspects of his identity. The focus of my research, however, goes further by attempting to understand how the NVP/PCS course pairing impacted the *development* of discursive identities as engineers on the part of the students. The next chapter is vital for developing this understanding, as it presents an overview of the curricula, assessment methods and pedagogies of both of these courses.

5. The case study courses

This chapter provides an overview of the two courses that comprise the case study pairing that is the focus of this study: the New Venture Planning (NVP) and Professional Communication Studies (PCS) courses offered to fourth-year electrical engineering students at the University of Cape Town (UCT). It therefore represents, in the context of this study, a “zooming in” from the more macro social and philosophical contexts of engineering higher education discussed in the previous chapter to the specifics of these two courses. As is demonstrated in this chapter, the foci of the courses differ; however, they are linked through the group project that they share, as well as their explicit aims of preparing students for the workplace. Both courses also fall under the Engineering Council of South Africa (ECSA's) category of “complementary knowledge”. ECSA, which is responsible for accrediting engineering programmes, stipulates that of the total 560 credits that make up an engineering programme, 56 must be allocated to complementary knowledge areas (ECSA, 2012: 3). The NVP/PCS course pairing, therefore, is an important component of the electrical engineering degree programme not only because of the content of these courses but because it also plays a vital role in the fulfilment of accreditation requirements.

Of course, the notion of accreditation is contested, as are the disciplinary divisions that define what constitutes core engineering and what is categorised as complementary knowledge. However, the purpose of this chapter is not to offer analysis – that is the focus of the remaining chapters of this dissertation – but rather to provide a description of the curricula, assessment strategies and pedagogies of the courses. Thus, while the content that follows does not answer my research question concerning the ways in which participation in an undergraduate course pairing prepares electrical engineering students for the workplace, it does perform the vital role of defining the bounds of the case study that I use to examine these issues. Moreover, given that this is a critical realist

(CR) study that is underpinned by Bhaskar's (1975) "depth ontology" (see Section 2.1.1), the function of this chapter is to describe what happened during the two courses in the domains of the empirical (subjective experiences) and the actual (objective observations). Only in the subsequent chapters, once I begin working with Archer's (1995) social realist (SR) tools of morphogenesis and analytical dualism (as described in Section 2.5), does the analysis shift to the domain of the real. With this in mind, this chapter begins with a description of the NVP course.

5.1. New Venture Planning

The NVP course is offered annually in the first semester of the fourth year of the electrical engineering degree. The aim of the NVP course is to equip students with the business skills required to start entrepreneurial ventures. To do so, it traces the process of planning from product concept and description to market assessment, industrial analysis, marketing, financial feasibility and developing business plans. At the beginning of the course, students form groups of five or six individuals with whom they work throughout the semester. Each group comes up with an idea for an engineering-related product or process that could plausibly be introduced to the market as a "new venture". In 2015, the year in which this research was conducted, the students were required to pick their idea under the umbrella concept of "the Internet of things"¹⁴ (IoT).

The venture that the students developed as a group had to satisfy the following criteria:

- It must initially be based in South Africa but may consider external markets;
- It must sell a technological product or service, not including a transport information product, a home security, parking or tracking solution;

¹⁴ The "Internet of Things" is a term used to describe physical objects, such as devices, buildings, vehicles or other items that use network connectivity to collect and exchange data.

- It should include an “Internet of things” concept that adds significant value to the product;
- At the end of five years, the company should employ at least six people and turn over at least R5 million per annum and generate a dividend to shareholders of at least 15 percent of their investment per annum; and
- Students may plan on an initial investment of R250,000 from personal connections (termed “friends, family and fools”) but must raise any additional capital required.

The students were given 10 days from the start of the course to complete an initial concept proposal in their groups. This three-page or 1,500-word document needed to provide an overview of each group’s preferred concept that clearly described the product or service, defined the intended market and outlined the value proposition and intended distribution channels. Groups were also required to provide a rough competitor analysis, budget and timeline. In addition to this, each group had to submit three back-up ideas, each in the form of a single paragraph of half a page in length describing the business concept.

The main submission that the students worked towards in the NVP course was the final business plan, which was due in the penultimate week of the semester. The final business plan needed to consist of the following sections: an executive summary; a business canvas; an introduction; a product description; marketing; financial planning; operations; and references (more about the business plan follows in Section 5.1.2. below). The task was scaffolded¹⁵ in that there were two recommended milestones, at staggered dates, to work towards during the course. The first was a product description, market analysis and marketing plan, while the second was the financial plan. The recommended completion dates for these milestones were provided, but these tasks were not submitted or assessed,

¹⁵ In an education context, “scaffolding” refers to the process in which an educator supports a student in achieving a task that is initially beyond her capacity (Wood, Bruner & Ross, 1976: 20). There are different techniques for this, including breaking the task up into sections and modelling solutions. As the student masters the task, the “scaffolds” are gradually removed, so as to promote independent performance by the student.

and feedback was not given. The reason for this may have been logistical, given that the NVP class was large (it consisted of 148 students). However, this was never clearly explained by the NVP lecturers.

5.1.1. Curriculum

The aim of the NVP lectures was to provide students with the knowledge that would be required to launch a new venture. Table 11 below outlines the content of the lectures delivered over the course of the semester. The course consisted of two 45-minute lectures per week, which were held on Tuesday and Wednesday afternoons.

Table 11: Outline of the NVP course

Week	Tuesday Lecture	Wednesday Lecture
1	Introduction to the course: Ideas and concept proposal	Business planning: the business canvas
2	Business planning: product description	Health, safety and environmental protection: sound business and moral sense
3	Business planning: market assessment	Guest lecturer
4	Financial planning: cash flow statement and forecast; importance of cash flow and solvency	Guest lecturer
5	Financial planning: income statements; difference between income and cash flow statements	Guest lecturer
6	Financial planning: dividends; interest depreciators; bad debts; simple company tax and VAT	Business planning: operational planning; dealing with objects, time and money; using Gantt charts as a planning tool
7	Financial planning: statements of financial position; drawing up a balance sheet; owner's equity	Risk assessment and management
8	Financial planning: time value of money; net present value	Risk assessment and management
9	Raising funds: government agencies; FFF; bank loans; angel investors; venture capitalists	Business planning: operational planning; dealing with people
10	Business planning: what actually makes a business succeed?	Guest lecturer
11	Intellectual property	Intellectual property
12	Business planning: obligations on directors	Business planning: course conclusions
13	Business planning: presentation of best three projects	

As is evident from Table 11 above, during the course, four sessions were allocated to guest lecturers. These guest lecturers had started their own new ventures and were, as such, working entrepreneurs. They were all from fields

that related to electrical engineering in some way. Two examples of these ventures were vehicle tracking and breast imaging for detecting cancer.

The NVP curriculum was underpinned by ECSA's Exit Level Outcome (ELO) 5, "Engineering methods, skills, tools, including information technology". This includes the following:

1. Sub-discipline-specific tools, processes and procedures;
2. Computer packages for computation and information handling;
3. Computers and networks and information infrastructures for accessing, processing, managing and storing information to enhance productivity and teamwork;
4. Basic techniques from economics, business management;
5. Health, safety and environmental protection appropriate to the discipline;
6. Risk assessment and management;
7. Project management.

(ECSA, 2012: 5)

In addition, the course also touched on ELO 8 ("Individual, team and multidisciplinary working") and ELO 10 ("Engineering professionalism") (ECSA, 2012). The full ECSA outcomes can be found in Appendix 1.

5.1.2. Assessment

The mark assigned for NVP was determined through four tasks: a test, a presentation, the business plan and a final examination. Student marks for NVP were calculated according to the mark breakdown presented in Table 12 below:

Table 12: Mark breakdown for NVP

Assessment Task	
Class test	10%
Business plan	60%
Final Examination	30%
Total	100%

Each of the assessment tasks in Table 12 is elaborated on below.

The class test

The NVP class test was written in week 9 of the course. This 48-mark test consisted of five questions, each of which related to a sub-level of ECSA ELO 5. The questions related to basic techniques of economics and business management; health, safety and environmental protection; risk assessment and management; and project management. By answering the questions correctly, students demonstrated achievement of the ELO. Students who failed one or more of the questions were required to rewrite the test until they passed, thus demonstrating that they were able to meet the outcome.

The complete business plan

Comprising 60 percent of the students' total NVP mark, the final business plan constituted the major hand-in for the course. Students were not given a length stipulation for the assignment but were encouraged to make the document as long as required to serve its intended purpose, which was to convince a potential investor to make an investment. Students were given clear guidelines of what to include in their final business plan. The content required for the business plan is outlined in Table 13 below:

Table 13: Business plan sections and content

<i>Business plan section</i>	<i>Required content (where specified)</i>
Executive summary	
Business Cards	
Introduction	
Product description	<ul style="list-style-type: none"> • Technical description of product • What need the product meets • How it relates to competing and substitute products • Customers' purchasing criteria • Intellectual property • Freedom to trade
Marketing	<ul style="list-style-type: none"> • Market analysis • Customer analysis • Competitor analysis • Pricing • Promotion
Financial Planning	<ul style="list-style-type: none"> • Projected cash flow (monthly for one year; thereafter quarterly) • Income and expenditure (annually) • Balance sheet (annually) • Plan for raising finance • Analysis of risks and rewards
Operations	<ul style="list-style-type: none"> • Strategic timeline • Staffing plan, job descriptions and organogram • Production timeline • Factory location and layout • Hazard analysis and issues that may affect Occupational Safety and Health Act compliance • Requirements for quality assurance
References	

The mark breakdown for the business plan was calculated by taking into consideration the concept proposal discussed above and the final business plan itself. In addition, the mark for the PCS presentation, discussed under Section 5.2.2 below, was also used, ostensibly as a means of ensuring that the concept could be clearly articulated both orally as well as in writing. In addition, students anonymously evaluated their fellow group members, and the averages of these evaluations were included in their grades. The breakdown of these marks is found in Table 14 below:

Table 14: Mark breakdown for business plan components

Assessment Task	% of final mark
Presentation of business plan	10%
Concept proposal	10%
Final business plan	30%
Individual contribution	10%

Note that, in Table 14 above, the percentages add up to 60 percent, the total percentage of marks allocated to the business plan in NVP.

The exam

A 110-mark exam was written by students at the end of NVP. The exam tested content similar to that which was covered in the class test, including economics, risk assessment, project management and health and safety. Moreover, the exam paper included questions concerning the business plans, intellectual property and what students had learned from the various guest lecturers.

5.1.3. Pedagogy

The NVP lectures, which were not compulsory, were held in different lecture theatres on Tuesdays and Wednesdays. Both of these lecture theatres are laid out according to a proscenium-arch-type format, with the students, sitting in rows, facing the lecturer at the bottom of the angled venue. Each venue is fitted with a control unit that consisted of a computer and data projector.

The NVP course was convened by Prof. Harris of the EBE Faculty, who also taught some of the business planning sessions. The rest of the sessions were taught by experts from other departments within UCT. The financial planning section was taught by an associate professor from the College of Accounting, the

additional business planning sections by an associate professor from the Commerce Faculty and the intellectual property section by a lecturer from the Law Faculty. In addition, the aforementioned guest lecturers held sessions concerning their entrepreneurial ventures.

All of the NVP sessions were structured as traditional lectures, with lecturers delivering their presentations with the support of PowerPoint slides. This was generally a one-way exchange from the lecturer to the students, with very little class interaction. Following the lectures, the slides were uploaded onto VULA, UCT's online student portal, thus allowing students to access them at a later stage. There were two situations in which lecturer-student interaction did, however, occur: The first was the financial planning lectures. In these lectures, students were required to complete short exercises in pairs or small groups, and the lecturer asked for feedback from the class. The second was the guest lecturer sessions. In all of these sessions, a high level of back-and-forth between the presenters and the students was present. For example, one of the guest lecturers began his session with a ten-minute overview of his business; he then ran the remainder of the 45-minute session as a question-and-answer session with the students.

5.2. The Professional Communication Studies course

The fourth-year PCS course follows a third-year offering to the same group of students. The third-year course teaches basic written and oral workplace communication skills, with the major outcomes being a professional business report and an individual 5-minute persuasive presentation. The fourth-year course, which is a co-requisite for the NVP course and is also run in the first semester, builds on this foundation by focussing particularly on the written and oral skills students will need as they launch their own entrepreneurial ventures or enter the formal workplace. Working in their NVP groups, students use their new venture concepts developed in NVP as the basis for a number of PCS tasks.

Because of the interactive, workshop-style of the course (see Section 5.2.3), class sizes were kept to a minimum, with approximately 35 students per class. The PCS lecturers are categorised as professional, administrative and support (PAS) staff at UCT, and, as such are part-time contract lecturers at the university. To allow for the small class sizes given the electrical engineering cohort of 148 students, four PCS lecturers taught concurrently.

5.2.1. Curriculum

The PCS course consisted of one double-lecture per week, totalling one hour and 45 minutes. The lecture was held on a Tuesday morning. Table 15 below outlines the content of the PCS course:

Table 15: Outline of the PCS course

Week	Lecture content
1	Professional online presence and CVs
2	Working in groups: group dynamics
3	Working in groups: conflict resolution; negotiation skills
4	Ethics
5	Persuasive group presentations: effective PowerPoint slides
6	Posters: critique and planning
7	Summary and business correspondence
8	Interview skills
9	Presentation rehearsals
10	Presentation rehearsals
11	Presentation rehearsals
12	Final presentations
13	Final presentations

As is evident from Table 15 above, during weeks 9-11, students rehearsed their presentations, while weeks 12 and 13 were given over to the final presentations. Students were given an opportunity to perform a dry run of their group presentations (discussed in the following section) during one of the rehearsal slots. These rehearsals were filmed by the PCS lecturers, with the footage being played back to the students with additional input from the lecturers. The students then used the feedback received during the rehearsal in their final presentations, which were for marks. Additionally, external examiners, who were professionals from related industries, were also brought in to assess the final presentations and to interact with the students. The students only needed to attend the sessions in which their respective group's rehearsal and final presentation were scheduled.

The PCS curriculum is underpinned by ECSA ELO 6 (“Professional and technical communication”), ELO 8 (“Individual, team and multidisciplinary working”) and ELO 10 (“Engineering professionalism”) (ECSA, 2012).

5.2.2. Assessment

The grade for the PCS course was determined through a number of assignments throughout the course. The assignments added up to a total of 600 marks, which was converted to a percentage in order to calculate the students’ final marks. The tasks in PCS, as well as the total marks for the tasks, are listed in Table 16 below:

Table 16: Mark breakdown for PCS

Assessment Task	Marks out of 600
Poster	100
Ethics Essay	100
Summary	80
Eportfolio	100
Group presentation	
Group Mark	100
Individual Mark	100

As is shown in Table 16 above, the total for the tasks added up to 580 marks. The additional 20 marks were determined by a peer-assessment form completed by each student. Each student was required to rate her group members on the basis of group functioning. The marks were tallied and converted to a total of 20, which was then added to the overall PCS result to make a total of 600 marks. (There was no exam for this course.) Each of the assessment tasks is elaborated on below.

Poster

In their NVP groups, students were required to conceptualise, design and produce a poster for potential investors for their product. This poster could, hypothetically, be used at a conference or similar event to attract funding for their new ventures. Figure 7 below presents an example of a new venture poster from the PCS course.

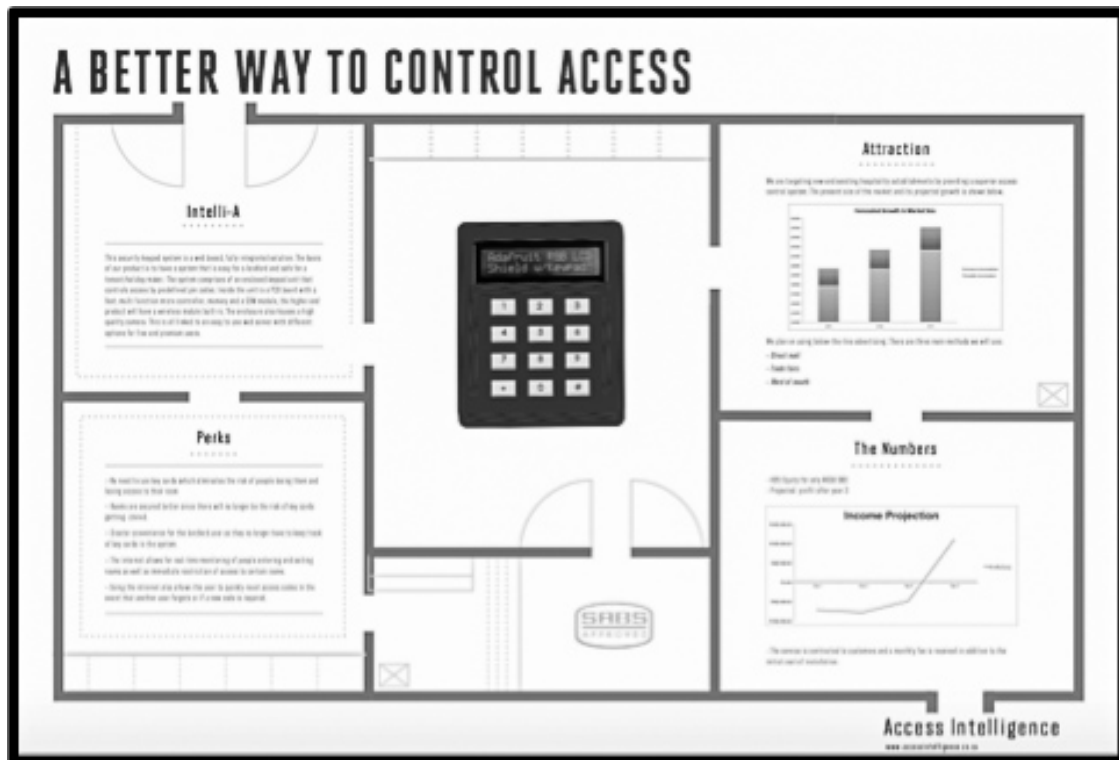


Figure 5: Example of a PCS poster

The posters were designed in PowerPoint, Photoshop, or any similar computer programme, printed out to A1 size, and displayed, on an appointed day, in the lobby of a large engineering building on the UCT campus. Both PCS staff and the students were required to assess each poster in terms of visual appeal, logic and the appropriateness of its content, and these marks were averaged to obtain the total group poster mark.

Ethics essay

As is evident from Table 15 above, the fourth session of the course was dedicated to an exploration of professional ethics within the world of industry. This lecture covered the differences between ethics, morals and law; approaches to ethics, conflicts of interest; and codes of conduct. During class, students were given short scenarios concerning different ethical quandaries and were required to discuss these within their NVP groups. The purpose of these discussions was twofold: First, they presented an opportunity to highlight the prevalence of ethically challenging scenarios within the engineering environment, as well as the complexities involved in determining and following an ethical course of action. Second, the group interaction provided an opportunity for students to practice group communication skills such as voicing opinions and critical listening. Following the lecture, an essay of between 600 and 800 words was set that required them to engage further with the issues that were raised in class. The essay topic posed a scenario in which the students needed to imagine that they were professional electrical engineers setting up a Cape Town branch of a UK-based business. They were required to weigh issues associated with choosing potential suppliers of components for the business, taking into consideration potential conflicts of interest to do with personal and professional factors. In the essay, students needed to propose an ethically appropriate course of action, using the ECSA Code of Conduct to justify and substantiate it. This was an individual assignment. Assessment was based on content (identification of issues, justification of actions chosen, discussion of potential conflicts of interest and quality of ethical argument), style and structure (language, style and tone and logic and coherence) and referencing.

Summary

The students were required to produce a business plan summary. The summary took the form of a 1-to-2 page document that had to be able to stand independently from the rest of the business plan. The purpose of the summary

was to attract attention and to encourage potential funders to invest in the business. The summaries were based on the new venture business plan developed in the NVP groups, but each student submitted his own summary, which was assessed individually. The summaries were assessed according to content, consideration of audience and purpose and style.

E-portfolio

In Table 5 above, it is evident that the first PCS session was focussed on the development of a professional online presence. Following the input given in this lecture, which focussed on professional image, social media and websites, students were tasked with developing their own e-portfolios.¹⁶ Students could use any website builder (for example, wix.com or Wordpress) to create their sites and submitted the URLs thereof to PCS lecturers. This task was scaffolded. In the third week of the course, students had to submit their homepages, with a link to their CVs, to their lecturers for comment. Following this input, they submitted the links to their final e-portfolios in the penultimate week of the course. The e-portfolios were assessed according to content (clear understanding of audience and purpose, appropriate tone, professional “branding”, scope and variety and appropriate documentation/artefacts and evidence being used to reveal skills and achievements) and presentation (originality, readability, format, accuracy, design, navigation, links and graphics).

Group presentation

As mentioned previously, the final PCS sessions were dedicated to student presentations. In their NVP groups, students were required to present their new venture business plans as if they were presenting to an audience of potential investors. Each student was required to speak for approximately five minutes on a different aspect of the business plan, such as the product overview, potential

¹⁶ An e-portfolio is a website on which students are able to showcase their achievements, skills and interests to a professional audience in a positive manner.

markets, financials, marketing, business operations and risk. Despite the fact that students presented individually, the overall group presentation also needed to be coherent. Given that students were to imagine that they were presenting to potential investors who may be from industries not related to electrical engineering, a focus of these presentations was on the students being able to describe their technical idea to a non-technical audience. In addition, they were required to integrate some form of visual aids (i.e. PowerPoint or Prezi) into their presentations. Students were assessed according to their content, visual aids, delivery and responses given during the question and answer session that followed the presentations. Students received both an individual and a group mark for the presentations.

5.2.3. Pedagogy

As mentioned previously, teaching and learning in the PCS course relied heavily on small group activities, including group discussions, role-play activities and providing feedback to the class. This was in contrast to the NVP course, in which lectures generally consisted of one-way communication from the lecturers to the students, with very little interaction. Each PCS lecture was structured so that it began with input from the lecturer and was followed by exercises and activities that relied on input from the group. In some situations, students were randomly divided into groups for different exercises. For the majority of activities, however, students worked in their NVP groups. This provided students with an opportunity to deepen their own connections with their group members.

Many of the PCS activities centred on hypothetical situations in which students had to imagine that they were in a particular professional situation and had to respond accordingly. For example, in session 3, the different groups were given one of two organisational identities: Klipdale Hospital or John Brown Inc., the building contractor. Each group was given a sheet of paper with information concerning their respective organisations, with a particular focus on content relating to a helipad that was to be built on the hospital site. Klipdale Hospital wanted the helipad to be built as rapidly and cheaply as possible, with minimal

interruption to hospital functioning, whereas John Brown Inc. wanted to be given the job, making as much profit as possible. After some initial planning time, the groups were paired up and required to negotiate an outcome that was favourable to both parties.

Another example of this type of hypothetical situation-based activity occurred in the lecture on job interviews. After some initial input regarding the skills required to convey a positive image of oneself during a job interview and a technique for answering interview questions, students were divided into groups of three. The groups were then paired up, with one group imagining that they were the interviewers, and each member of the other group having an opportunity to be an interviewee. The interviewers asked each interviewee a typical interview question, and the interviewees responded using the technique that was taught previously. In the feedback provided following the activity, the interviewers told the class who “got the job” and why they had impressed the interviewer/s during the interviews.

Not all group activities relied on this type of role-play: For example, in the fourth session, which focused on posters, after the lecturer provided initial input concerning the principles of good poster design, the students, in their groups, provided feedback on posters from previous years. The goal of this activity was for the students to begin to form their own opinions about what makes a poster effective by interacting with past examples. This also provided them with a clear impression of what was required from the assessment task. For this activity, students were provided with criteria for effective posters to guide their discussions; these criteria were based on the design and layout of the posters. After assessing two posters according to these criteria, students gave feedback to the entire class concerning what they liked and did not like, and this formed the basis of a class discussion.

While the PCS lecturer, Helen, used PowerPoint slides during all of her sessions, these slides were not available to the students on VULA following each session,

as they were for NVP. Helen explained this by stating that the slides were used to guide the students through the lecture and were not intended as a record of everything that had been covered in class. All written tasks were submitted by the students and assessed on VULA, with students receiving ample written feedback on their tasks.

5.3. Conclusion

This chapter provided an overview of the two case study courses that were the focus of my study, namely NVP and PCS. While I made it clear that the two courses intersected in the sharing of the new venture project and in the groups in which the students worked, I have not explicitly addressed the efficacy of presenting the two courses as a pairing – this is discussed in Section 7.1.3. The goal of this chapter has not been analysis but rather the provision of a description of the NVP and PCS courses so as to “set the stage” for the analysis that follows in the forthcoming chapters. It has done so by outlining the curricula, assessment strategies and pedagogies of these courses, thereby presenting an overview of the course pairing in terms of Bhaskar’s (1975) domains of the empirical (in that my description is inevitably based on my subjective experiences as researcher) and the actual (as evidenced by the discussion of the schedules of and material covered in the courses, and my observation). In the analysis that follows in the forthcoming chapters, the focus shifts towards developing understandings of what is occurring on the domain of the real or, in other words, the generative mechanisms that underpin the NVP/PCS course pairing. As a first step toward achieving such an understanding, the next chapter moves beyond this chapter’s description of the two courses to an analysis of the structural and cultural context at T1 of Archer’s morphogenetic cycle and the ways in which this context conditions the behaviour of agents. This widens the focus beyond what occurred in the classroom during the NVP/PCS course pairing to the consideration of institutional structures (ECSA, higher education and industry) and contemporary cultural conceptions regarding the role of the contemporary engineer. Thus, while this chapter began by stating that it would be “zooming in” to the specific

context of this research, the next chapter once again “zooms out” in a bid to develop a macro-view of T1 of the morphogenetic cycle – the start of the NVP/PCS course pairing in 2015.

6. The macro-context of the New Venture Planning/Professional Communication Studies course pairing

Social theory has to be useful and usable: it is not an end in itself. The vexatious fact of society has to be tackled *in* theory and *for* practice.

(Archer, 1995: 135)

Archer's quote above indicates her belief that the only way to approach the "vexatious fact of society" – the relationship between structure and agency – in a given context is through the application of social theory that is both grounded in solid theory and cognisant of the practical ends to which it will ultimately contribute. In this chapter, Archer's social realist (SR) tools of analytical dualism and the morphogenetic cycle are used to set in motion the analysis of the New Venture Planning (NVP)/Professional Communication Studies (PCS) course pairing that follows in the subsequent chapters. While the impetus for this analysis stems from the critical realist (CR) objective of identifying the generative mechanisms that were at work on the domain of the real during the NVP/PCS course pairing, the analysis is firmly grounded in the practical objective embodied in my main research question concerning the ways in which participation in an undergraduate course pairing can prepare electrical engineering students for the workplace.

At the core of the conceptual framework of this dissertation, as outlined in Chapter 2, is a shift of the conception of work readiness from the attainment of a set of decontextualised skills to an on-going process of identity development. Given this understanding, the engineering students who are the focus of this dissertation would not be deemed "work-ready" merely because they had provided evidence of being able to write a report, create a PowerPoint presentation, design a poster and so on; rather, they would need to have begun an on-going process of developing their engineering identities. How this

occurred is the focus of this chapter and those that follow in the remainder of this dissertation.

In this chapter, I present an analysis of the structure, culture and agency at T1 of Archer's morphogenetic cycle, which, for this study, is the beginning of the NVP/PCS course pairing in February 2015. While the objective of the chapter is to address the first research sub-question that guides my study, which relates to the SEPs and CEPs that operate at the University of Cape Town (UCT) and in the NVP/PCS pairing, I have chosen to refer specifically to the "macro-context" of T1 in the chapter's title. This is because emergent structures impose objective limitations on the circumstances that agents encounter (Archer, 1995: 169). In Section 4.3, I described some of the ways in which higher education, both in South Africa and globally, is intertwined with society, meaning that it would be impossible to provide an analysis of a specific higher education context (for example, in this study, the NVP/PCS course pairing) without an explicit analysis of wider societal concerns. Thus, I have chosen to include the wider structural and cultural contexts in my analysis of T1 in order to develop understandings of how these conditioned the possibilities in terms of agency at a societal level. This is done by examining the relationships between structural emergent properties (SEPs) and cultural emergent properties (CEPs). The chapter therefore begins with an overview of the SEPs at T1, including the relationship between them, using Archer's configurations. Next, it does the same for CEPs. Finally, given that "structures are the results of human interaction" (Archer, 1995: 196), the chapter ends with an analysis of the ways in which agency contributed to the shaping of the structural and cultural contexts described above and was simultaneously shaped by them.

6.1. Structural emergent properties

Archer (1995: 175-176) refers to structures as distributions, roles, institutional structures and social systems that are primarily dependent on material resources. In the context of this study, the macro-level structures that are most

relevant can be grouped into three main clusters: higher education (including the Department of Higher education [DHET], UCT, and the EBE Faculty); industry, which includes the workplaces that many graduate engineers will enter; and the Engineering Council of South Africa (ECSA), the statutory body that oversees all engineering activity in the country. Figure 6 below depicts these three clusters:

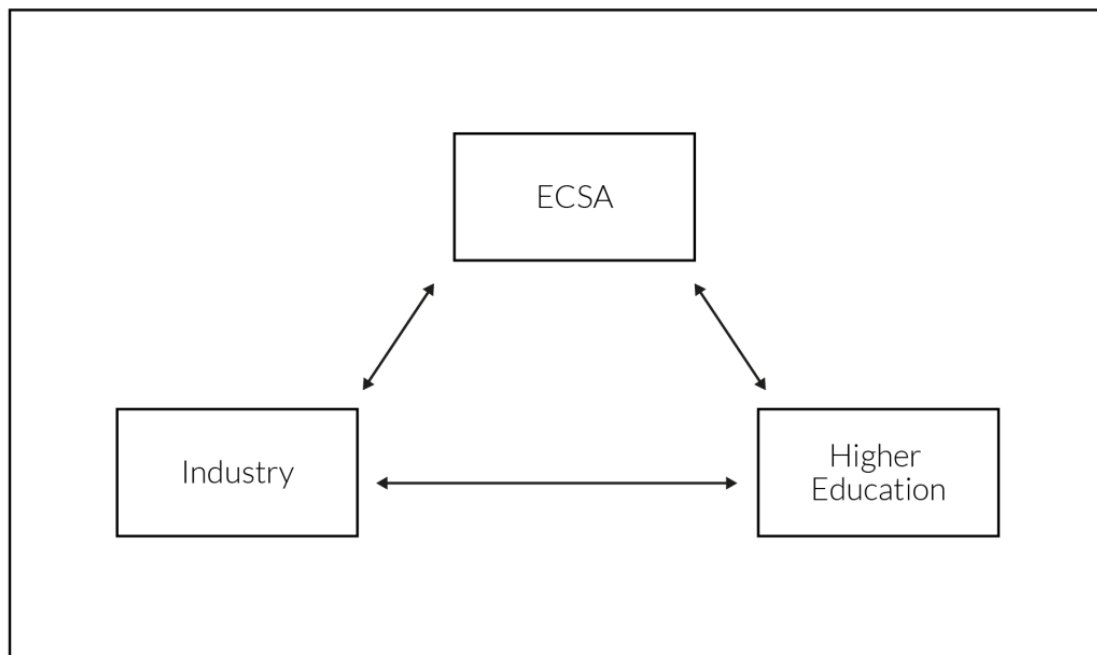


Figure 6: Macro structures at T1

Each of these clusters of structures was previously discussed in Chapter 4, with particular focus on their roles in relation to the NVP/PCS course pairing. In this section, I focus on how the structural emergent properties (SEPs) provide insights into the structural conditioning that existed at the start of the morphogenetic cycle under examination. This is necessary because, as Archer (1995: 176) explains, analytical dualism sees SEPs as defined and identified independently of their occupants. What follows, then, is a discussion of the relationship between these SEPs. I show that, while the relationships between ECSA and industry and ECSA and higher education reflect necessary complementarities, the relationship between higher education and industry is marked by necessary incompatibilities.

6.1.1. ECSA and industry

As discussed in Section 4.2.3, ECSA's primary role relates to the regulation of the engineering profession in South Africa in terms of the Engineering Professions Act (EPA), No. 46 of 2000. As such, it has a number of core functions that impact industry, including the registration of individuals as professionals and the regulation of professional conduct (for example, through acceptance of ECSA's code of conduct). Only once individuals have registered with ECSA, which requires evaluation of their qualifications and evidence of at least three years of post-qualification training and experience, can they use titles such as "Pr Eng" for professional engineers and "Pr Tech Eng" for engineering technologists. In addition, ECSA registration is an important step for professional recognition and a condition of employment with major engineering employers such as Transnet and the Metro Councils. Thus, just as Archer (1995: 216) argues that the polity and a command economy are necessarily and internally related to one another, so too are ECSA and industry linked to one another, since ECSA needs industry in order to perform its regulatory function, and industry needs ECSA to regulate professional conduct.

Mutereko (2017) demonstrates that accreditation processes such as those undertaken by ECSA are never neutral and apolitical; rather, they emerge from a complex interaction of power relations. For example, by setting and enforcing the criteria for what constitutes an acceptable engineering professional, ECSA shifts power away from industry to itself as a centralised accrediting agency. This goes further, since ECSA, by defining norms and standards as well as ultimately permitting or denying membership to professional engineers, sets the boundaries regarding what is valued and included and what is excluded from the scope of the profession (Evetts, 2012). For example, ECSA is also involved in setting and monitoring standards and encouraging the growth of the profession in the country (ECSA, n.d.). In doing so, it "professionalises" engineering, setting boundaries around the field in terms of what (or who) is valued and included and what (or who) is excluded from the scope of the profession (Nudelman, 2017b).

It thus exercises its power to determine what kinds of values underpin the enactment of the engineering profession in the country. For example, an ECSA brochure on professional registration identifies some of the principles that underlie the status of being a professional engineer in South Africa. These include the following:

- Striving to improve all work using the most up-to-date techniques and procedures
- Proper credit for work done and ideas developed by subordinates.
- Loyalty to one's employer and clients, always with concern to public safety in construction, product design, plant operation and all other phases of engineering.
- Leadership of less experienced colleagues and subordinates toward personal development and enthusiasm for the profession.
- Activity in professional and technical societies.
- Registration with ECSA as demonstration to co-workers and the public that you adhere to the one important hallmark of a professional person - a willingness to go beyond the minimum to improve standards and protect public health, safety and interests.

(ECSA, n.d.)

Through this outline of some of the ideal characteristics, values and actions of a professional engineer and the requirement that professionals align themselves with such qualities in order to participate in the field, ECSA wields significant influence in determining the nature of the engineering industry. Entrusting this kind of oversight function to one central professional body can often have very material results. Evetts (2012: 3) explains that, by dictating the bounds of a field, this process of professionalisation aims towards closure of the occupational group, thereby contributing towards the maintenance of practitioners' self-interests in terms of salary, status and power. For example, certain positions in industry are reserved for ECSA-registered engineering professionals, and many employers pay registered engineers higher salaries (ECSA, n.d.). In addition, there are a host of "lifestyle benefits" of ECSA registration: For example, registered engineers have access to a financial services package with a leading bank with reduced lending rates and increased investment rates ("Professional Engineering Registration | SAIE", 2008). Thus, the act of professionalisation by ECSA serves to separate those who are registered from those who are not as an elite group: the former are educated, experienced and therefore "worthy" of

reward. By its nature, this is exclusionary, as those who do not fulfil ECSA's stipulations for accreditation cannot partake in these benefits.

It is clear, therefore, that the necessary relationship between ECSA and industry is one of complementarity. Archer (1995: 219) refers to this as the state in which systems are mutually reinforcing, mutually invoke one another and work in terms of each other. This configuration is evident here, since ECSA's power to regulate industry allows it to fulfil its statutory aim of ensuring a strong, competent, growing, sustainable and representative engineering profession (ECSA, n.d.), while, at the same time, this power is legitimated by industry, which is supplied with professionals who are registered and therefore qualified and experienced (Mutereko, 2017). Moreover, other benefits provided to industry by ECSA include recourse for employee misconduct, in that ECSA will investigate employer complaints regarding improper conduct by employees and take appropriate action and marketability, since it reflects well on companies to employ professionally accredited people (ECSA, n.d.). Finally, industry interests are served by ECSA's academic accreditation system, which aims to ensure that graduate engineers are equipped with the requisite skills and knowledge. This relationship between ECSA and higher education is discussed in the following section.

6.1.2. ECSA and higher education

In addition to those ECSA roles that relate to industry, it also performs an important function with regards to engineering education through its accreditation of engineering programmes in South African higher education institutions (HEIs).¹⁷ Attainment and renewal of accreditation by ECSA is crucial for HEIs that offer engineering programmes because it means that their graduates will be eligible to register as professionals with ECSA once they have

¹⁷ For the purposes of this study, this relates particularly to accreditation of the BSc(Eng) programmes; however, ECSA also accredits BTech and National Diploma programmes.

attained the necessary experience. Moreover, ECSA's status as a signatory of international education agreements means that the qualifications offered by accredited programmes are internationally recognised. For example, ECSA's accreditation of the UCT electrical engineering degree means that graduates will meet the specifications for the Washington Accord, which allows South African engineers to work abroad. For HEIs, therefore, it is vital that their programmes are accredited because this functions to certify the quality and applicability of the qualifications that they offer. A loss of ECSA accreditation will inevitably result in a drop in student numbers and a concomitant loss in reputation and revenue to an institution.

To ensure that engineering departments are fulfilling the accreditation requirements, ECSA conducts accreditation visits every five years. During these visits, engineering departments must provide evidence that they are satisfying ECSA's accreditation requirements. These visits also reflect the fact that ECSA's role within higher education extends beyond individual institutions. This is because of its working relationship with the Council on Higher Education (CHE), which is the body tasked by the Higher Education Act to quality assure higher education programmes. A Memorandum of Understanding (MoU) signed between ECSA and the CHE in November 2006 resulted in an arrangement whereby ECSA, in carrying out its accreditation programme, also quality assures engineering programmes on behalf of the CHE (ECSA, n.d.). There is thus a mutually beneficial relationship between the CHE and ECSA, one which the ECSA Annual Report 2015/2016 characterises as "symbiotic" (ECSA, 2016: 51).

ECSA's requirements for accreditation for BEng programmes consist of 10 exit-level outcomes (ELOs) that students must be able to demonstrate before they graduate. Aside from ensuring that these ELOs are incorporated into their programmes, individual faculties and departments have the freedom to make decisions concerning content and structure. Thus, in terms of Archer's configurations, the relationship between ECSA and HEIs (including UCT's EBE

Faculty) is necessary in that ECSA needs HEIs in order to ensure that the labour market is supplied with adequately qualified graduates, and HEIs are given a framework with which to ensure that their degrees are acceptable and of value to both current and prospective students. Jawitz (2001: 175), writing soon after ECSA's adoption of the outcomes-based framework, highlighted some significant opportunities that the shift provided. These included a renewed focus within engineering departments on educational issues, such as the relationship between learning objectives, pedagogy and assessment, thus indicating a shift away from what he referred to as the current "ad hoc approach". However, the risk exists that providing these ELOs can engender conformity and lack of critical engagement on the part of academics. A deputy dean of an Engineering Faculty at a South African university of technology expressed relief for the ELOs when planning his/her institution's curriculum, stating 'Thank goodness, there's not much designing that we need to take care of here' (cited in. Mutereko, 2017: 9). From his perspective, the ELOs provided a quasi-blueprint of what a successful programme should look like. Nevertheless, the relationship between ECSA and higher education is clearly one of complementarity in that they facilitate one another's operations (Archer, 1995: 216).

6.1.3. Higher education and industry

While the relationships discussed above both reflect necessary complementarities, the relationship between engineering higher education and the engineering industry is different. Engineering higher education and the engineering industry are necessarily related in that the goal of joining the labour market is arguably the major motivation behind the choice of most students to enter an HEI. In addition, one of higher education's functions is to provide new labour for industry. One example of this is provided by Case, Heydenrych, Kotta, Marshall, McKenna and Williams (2017), who outline how, in the late 1980s, the Chemical Engineering Department at UCT formed strong ties with industry. This occurred through collaborative research (with much industry funding stemming therefrom) and the creation of a body constituted of academic staff and invited

industrial advisors, typically senior executives in the industries in which the graduates of the chemical engineering programme would likely work. Furthermore, the article describes how the Department grappled with the issues involved in producing the new generation of black engineers that was required by industry. The links between higher education and industry illustrated in this example are evident of how intertwined the two SEPs are and, in Archer's terms, how necessarily and internally related they are.

However, there is evidence to show that, in the case of engineering, there are significant misalignments between higher education and industry. This manifests in a number of ways: First, in a general sense, there is a perception amongst many South African employees that the knowledge, skills, competencies and values that higher education sets out to develop may be out of sync with the needs of employers and the rapidly changing world of work (Griesel & Parker, 2009), and this seems to hold true for the engineering industry too. In a survey of over 700 engineers working in South Africa, 57 percent felt that the current engineering degree does not adequately train students (PPS, 2013). However, industry continues to place significant demands on higher education to produce more engineering graduates, particularly given the skills shortage in the sector (see Section 4.2.3). Higher education institutions need to grapple with the dual imperatives of, on the one hand, maintaining rigorous standards within degree programmes in order to ensure that those who do "make it" are of a high enough calibre to carry out vital engineering work and, on the other hand, satisfying industry's demand for a large number of engineering graduates from a broad range of social backgrounds (Case et al., 2017: 248).

The complexity of the relationship between higher education and industry, particularly with regard to issues of demand and supply and quality and quantity, is evident in certain key examples. One of these involves the case of the 35 Cuban engineers who were seconded in South Africa for two years in 2015 by the Ministry of Water and Sanitation, on the basis that they would improve systems in the country through the application of their expertise (McDonald, 2015).

Prominent engineering bodies, including the South African Institution of Civil Engineering (SAICE) and Consulting Engineers South Africa (CESA) protested this, claiming that there were many qualified engineers in the country who could carry out the work; furthermore, they noted that the Cuban engineering qualification is not accredited by ECSA, and therefore the quality of these professionals could not be guaranteed. In this case, a key employer of engineers – government – chose to spurn locally trained engineers, ostensibly because they did not rate their expertise as being adequate.

In another example of the complex relationship that exists between higher education and industry, the 2015 and 2016 student protests, which were alluded to previously, brought to light the high level of graduate¹⁸ unemployment in the country. General statistics show that this is less of a problem for engineering graduates, with those with science, engineering and technology qualifications 2.7 times more likely to be employed than graduates from the humanities and social sciences (Baldry, 2016: 804). However, statistics aside, it seems that many individuals with engineering qualifications from HEIs are struggling to find employment. News sites abound with photos and stories of engineering graduates who have resorted to standing at traffic lights pleading for employment (see, for example, Radio 702, 2016; The New Age, 2016). Various reasons have been given for this persistent level of graduate unemployment in the face of critical skills shortages in engineering. Baldry (2016), for example, explains that employees have expressed concerns regarding many students' poor command of English. In addition, she mentions existing biases on the part of employees against employing graduates from historically black institutions (HBUs) due to actual or perceived differences in the quality of education provided at these HEIs. Furthermore, a perception exists that engineering graduates are not equipped with the skills that are really needed in the workplace. Selema (2016) explains that the engineering workplace is no longer

¹⁸ For the purposes of this discussion, the word "graduate" refers to individuals with any form of post-matric qualification.

about bolts and nuts or nails and hammers but innovation and productivity and laments that these are not taught in current engineering curricula. For all these reasons, while the relationship between higher education and industry is necessary, it is also evident that it is, in some ways, one that is characterised by incompatibility.

The institutional configurations of the SEPs discussed in this section are summarised in Figure 7 below:

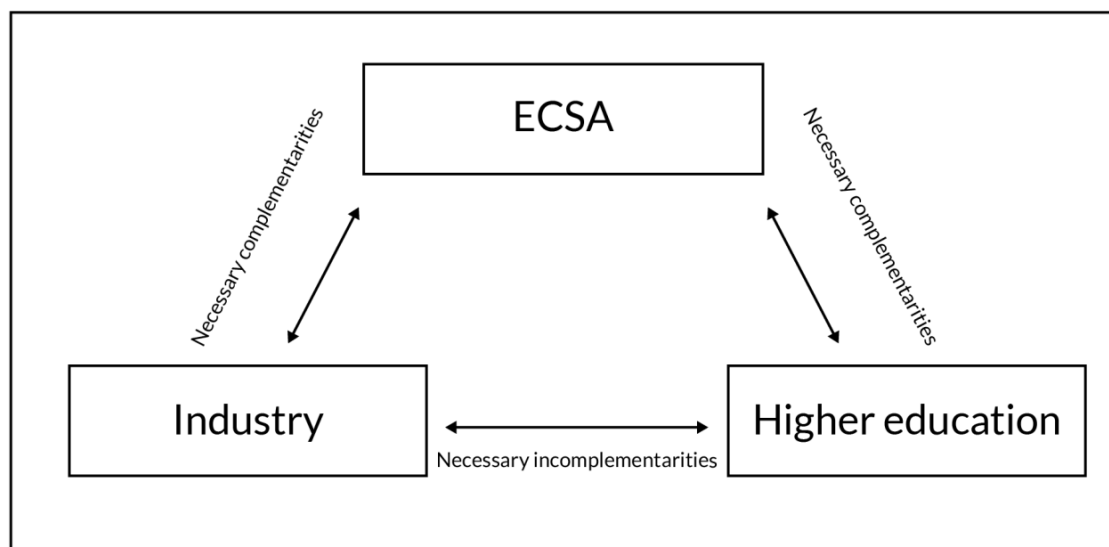


Figure 7: Relationships between the SEPs

6.1.4. Situational logics at T1 emanating from the structural emergent properties

As argued previously, the relationships that exist between ECSA and industry and ECSA and higher education are characterised by necessary complementarities. Archer (1995: 219-221) explains that this means that these institutions are mutually reinforcing, as they mutually invoke one another and work in terms of each other. This creates a situation in which everyone has something to lose should the relationship be disrupted. For example, should ECSA lose its power to register professionals, industry would lose a key indicator of quality and experience in potential and current employees. Should HEIs no

longer be able to boast ECSA accreditation for their programmes, they would suffer reputational damage. Should ECSA no longer have control over engineering curricula, there would be no oversight in terms of consistency of qualifications in the country. Many more of these potential negative effects exist.

Thus, necessary complementarities lead to a situational logic of protection, meaning that there are penalties for disruption and premiums for reproduction of the structural status quo (Archer, 1995: 221). Innovation or diversification is repressed and the relationship itself, as it stands, is reinforced. Evidence of this is clear in the form of the actions taken to strengthen these relationships. For example, ECSA's "Engenius" campaign aims to attract (particularly black and female) school learners to the engineering profession (ECSA, 2010). In the 2015/2016 financial year alone, the campaign interacted with 22,381 learners through workshops and exhibitions (ECSA, 2016: 13), indicating that ECSA is considering both the long-term supply of diverse students for the engineering programmes of HEIs and attempting to ensure that there will be enough skilled labour to meet the development challenges of the future. This sort of initiative cements relationships that are characterised by necessary complementarities and thus the situational logic of protection is unlikely to produce change; in Archer's terms, this situational logic instead tends towards morphostasis.

The necessary incompatibilities between industry and higher education, on the other hand, can promote a situational logic of containment and compromise. This may prove to be the case because the promotion of interests entails a cautious balancing act and a weighing up of gains against losses or what Archer (1995: 223) refers to as a "see-sawing" between interests. This balancing act is done because, despite their differing interests, any radical change in strategy will lead to negative repercussions for both structures. This results in coexistence on uneasy compromises, which contributes to the maintenance of the incompatibility itself (Archer, 1995: 224). Thus, with particular reference to my study, the fact that UCT now requires undergraduate EBE students to complete a PCS course can be seen as a means of attempting to make the students more

aligned to industry's requirements with regard to graduates being able to communicate effectively. While this takes time away from the more theoretical courses that are traditionally the focus of academic engineering teaching, the introduction of these two courses can be seen as a compromise intended to fulfil industry's demands. Should compromises such as this not be possible, the relationship between these structures would likely collapse, and both would suffer: Industry would lose a portion of the skilled labour that it so desperately requires, and students would no longer enrol at UCT, resulting in a loss of revenue, not to mention the funding the EBE Faculty receives from industry for research.

The conclusion that can be drawn from this discussion of the situational logics that emerge from the combinations of SEPs in this case study is that there is a clear tendency towards structural morphostasis in engineering education at UCT. This is because the situational logics of protection and compromise do not encourage structural change. With particular reference to the relationship between higher education and industry, however, this relationship is more tenuous given the delicate balance that compromises often entail. Archer (1995: 225) explains that changes in available resources can result in there no longer being a need to compromise in order to defend vested interests. For example, if industry were hypothetically given large amounts of funding by government, private companies could start their own in-house training for engineers, thus dispensing of the need for a lasting relationship with HEIs. As mentioned previously, these situational logics will motivate different sections of the population who are associated with ECSA, industry and/or higher education to consider their respective vested interests as being best served by different modes of interaction with other groups. Again, this situational logic is not deterministic, but it does "strongly condition" (Archer, 1995: 229) agents' interpretation and action by influencing their systemic contexts - in this study, the electrical engineering students (Archer, 1995: 214). How the situational logics that emerged from the relationship between the SEPs influenced these students is analysed in the following chapter. The discussion turns to an overview

of the CEPs at T1, the relationships between them and the resulting situation logics.

6.2. Cultural emergent properties

Archer (1995: 229) explains that CEPs supply guidance in terms of agency in exactly the same manner that SEPs do. While the cultural system (CS) consists of the “doctrines, theories, beliefs etc. in existence” (Archer, 1995: 196–197) in a given context, she emphasises that, in terms of identifying how the situational logics of different cultural configurations act as mediatory mechanisms, the focus is on the *effects of holding* theories/beliefs that stand in particular relationships to other theories/beliefs (Archer, 1995: 229). Thus, the focus on CEPs at T1 is not intended to explore where different beliefs have arisen from or why people endorse particular views. For example, this chapter does not discuss why ECSA chose to define an “ethical engineer” in the way in which it does in its Code of Conduct (ECSA, 2017). Rather, analysing the CEPs at T1 provides an understanding of how the relationships between different concepts create various situational logics for their holders, which in turn mould the context of cultural action and condition different patterns of ideational development. In this way, CEPs provide directional guidance, predisposing their holders towards different courses of action (Archer, 1995: 229).

For this reason, this chapter now turns to a discussion of some of the students’ ideas/beliefs/theories concerning engineering education and professionalism. In the context of my research, which aims to investigate how participation in an academic initiative can prepare students for the workplace (if at all), this focus on the ideas/perceptions that students hold provides elucidation of the nature of the CS. The CS in turn shapes the action context for T2-T3, the actual NVP/PCS course. While they do not fully control whether students do or do not develop engineering identities, the various configurations of CEPs do exert a conditional influence on the students’ courses of action and affect how likely morphogenesis

– in this case, the development of a new discursive identity by the agents – is to occur. In this manner, it is a vital part of analytical dualism and, hence, this study.

6.2.1. Senior students and professionals in training

The students who were interviewed as part of this study indicated that they concurrently inhabited a double role; they were both senior students and professionals in training, straddling both academic demands and their burgeoning professional identities. The former was evident in their discussion of the academic-related pressure they had experienced as electrical engineering students, which, given that most of them were approaching the end of their degrees, had reached its apex at the time of the NVP/PCS courses. However, the students explained that academic pressure had been a feature throughout their university experience.

One of the major pressures that the students described was the sheer amount of work that they faced in their courses: For example, Mary explained that “there’ll be a week where you have... where each and every day there’s something that’s due, or you have a test. There, like, there can come a week where you don’t sleep at all” (focus group, 11/3/15). Another common theme was that of a curriculum that was too tightly packed with many different courses, meaning the students felt that they did not have enough time to adequately focus on individual courses. The students frequently seemed to struggle to understand the relevance of particular courses, as well as how the courses linked together (Kelly, interview, 28/5/17; Nosipho, focus group, 24/3/15; Adam, interview, 2/6/15; Faith, focus group, 27/3/15). Many students described how the academic pressures of the programme were such that it consumed their whole lives, forcing them to sacrifice personal time, relationships and hobbies. As Adam explained, “... it pretty much forces you to work 90 percent of the time on it. If you do have spare time, you kind of feel that you aren’t doing enough, ‘cos you know that everyone else is doing work, why am I not doing work?” (focus group, 12/3/15). Some

students described the emotional struggles, depression and even physical illness that had stemmed from the academic pressures of the course.

Over the years, however, the students had developed ways to deal with the immense academic pressure that they felt. One of the most common was the adoption of a surface approach to learning (Ramsden, 2003: 47), in which the students' intention was simply to complete the task requirements, not to understand the material taught or to relate previously acquired knowledge to new knowledge. For example, many of the students mentioned cramming content for tests and exams (often using past papers for reference) and thus never actually needing to understand the content. Paul described being too busy with tutorial submissions and assignments to actually attend a laboratory session; however, he knew that he could obtain an impression of what transpired from someone else's lab report (focus group, 25/3/15). Regarding a calculation-based course, Mike explained "I can do a derivation in Networks but not know what I'm doing. I've memorised all the Xs and don't know what I'm doing" (focus group, 12/3/15). Another strategy that the students implemented to cope with the pressure involved reliance on group networks. For some, these networks were quite well established: For example, Sami, Ali and Yasin explained that they and nine other students had gravitated towards one another at the end of first year and continued to rely heavily on one another for help with understanding difficult concepts, catching up missed work, preparing for assignments, tests and exams and so forth. However, for other students, these informal groups were less structured and simply represented opportunities to discuss complex content and develop new ways of understanding the material. For example, Nosipho described how, in the lead-up to tests, she liked running through the material with classmates in order to assess her understanding (focus group, 24/3/15). Likewise, Ken explained that he and some friends shared a Google Drive space, where they saved any useful material they might come across (focus group, 12/3/15).

While focussing on the demands of final year, the students were simultaneously also looking forward to the not-so-distant future in which they could become working engineering professionals if they chose to follow this career path. By this stage, all of the students had completed at least one of two compulsory vacation-work stints in industry, so they already had a clear vision of what to expect once they were in the workplace. Furthermore, the students had encountered lecturers who had worked as professional engineers, and many of the students had relatives who were engineers and technical artisans. Many students had already started searching for employment for the following year or putting plans in place to fulfil their bursary employment requirements, implying that they were necessarily also considering their identities as professionals-to-be. Students shared their understanding of what being a professional engineer entails: Paul, for example, characterised a professional engineer as someone who combines technical knowledge with “add-ons” such as listening skills, out-of-the-box thinking and presentation skills (interview ¹⁹, 28/5/15). Senty associated engineering professionalism with a significant societal power to positively impact people’s lives (interview 29/5/15). Both Ravi (focus group, 24/3/15) and Mike (focus group, 12/3/15) noted that professional engineers often assume managerial roles and therefore need to be proficient in dealing with people. The students discussed and responded to elements of the professional world that they would soon confront, such as dress codes, the structured nature of the working day, and what it would be like to earn a pay cheque. For the most part, they felt that UCT had not equipped them for what was to come in the professional world, particularly because of the focus on theoretical content to the detriment of practical application. Consider, for example, the following exchange between Ali and Sami (focus group, 5/3/15):

Ali: I’m concerned for when I get hired. Do I know enough?

Sami: Ja, I also have that fear of, once I graduate, I won’t be able to do what they give me.

¹⁹ I have used the reference “interview” to refer to the individual interviews carried out with students following the NVP/PCS course pairing.

Ali: Ja, what do they expect from me...

Sami: Straight away. It's always been one of my fears... In the first, on the first day, what am I going to do?

Some of the students disputed the view that it was even possible to be taught workplace readiness while still at university. Laurie put this down to the fact that the engineering workplace is so diverse in scope and focus that it is impossible for a university to teach “every skill that every job might look for”, and, as such, it makes more sense to receive on-the-job training (focus group, 12/3/15). Sami felt that the context of an HEI is so different from that of engineering workplaces that it is impossible for a student to truly understand what the workplace will be like and thus to begin preparing for it (focus group, 5/3/15). However, this was clearly something that concerned the students as they began to consider their options for the future and straddled the dual roles of senior students and professionals in training.

According to Archer's cultural configurations, the relationship between the two roles that the students in this study were embodying concurrently was one of constraining contradictions (similar to the SEPs relationship of necessary incompatibilities). This is because constraining contradictions are a site of “cultural tension” (Archer, 1995: 230) in that the skills, knowledge and attributes required by the two roles differ significantly. On the one hand, the students needed to focus on the academic requirements of their degrees, which, as shown above, required coping skills (including the adoption of surface approaches to learning to ensure that they passed), reliance on group networks, and fulfilment of deadline-driven academic demands such as tests, exams, assignments and tutorials. On the other hand, the students were already considering their professional identities, which would require them to display innovative, deep-thinking skills in the pursuit of the betterment of society, good leadership qualities and proficiency in terms of the practical application of engineering knowledge. The relationship between these two roles is certainly necessary in that the majority of students study engineering in order to become professional

engineers, and professional engineers need to demonstrate that they have attained academic qualifications in order to work. However, the contradictions between these roles can make the relationship challenging for the students, who may have struggled to decide where to place their focus and effort.

6.2.2. Elements of the “new engineer”

Since, in this study, I specifically set out to examine how students developed their discursive identities as engineers, it was important to interrogate what the students believed that such an identity consists of. In Archer’s terms, this implies gaining insight into the beliefs that the students hold (the CEPs) regarding what a professional engineer is and then examining how these different beliefs are related in order to better understand the effects of holding them. The literature (see, for example, Conlon, 2008; Galloway, 2008; Sheppard et al., 2009) suggests that rapid shifts in the technological, environmental, political, demographic and other societal spheres have changed the nature of what an engineer is expected to be and do. Conlon (2008: 151) terms this the “new engineer”. According to him, contemporary engineers are broad-based experts who are by necessity socially and environmentally responsible, suggesting that today’s engineers need to exhibit a level of awareness and responsiveness not previously required of those in the profession.

The participants in this research similarly indicated that they, as engineers, had a vital role to play in society. As Senty explained, whenever things go wrong, people know they can “call the engineers, and we’re gonna fix everything and make everything okay” (interview, 29/7/15). Whereas engineering may once have been viewed purely as a technical industry, the students indicated a belief that engineering today is a multi-dimensional career field, with a wide range of possible career paths being available to those who are in possession of a wide repertoire of generic and engineering-specific skills and knowledge. Some of the key qualities that the students felt defined professional engineers are described below.

Engineers are leaders

A number of the students highlighted their belief that engineers are leaders. One of the ways in which they did so was through their descriptions of what they believed their roles would be once in the workplace. Mike, for example, stated that the majority of engineering graduates would most likely not simply work on tasks such as building or designing but would instead be managing teams of people (interview, 29/5/15). Ravi also assumed that, at some point in his career, he would occupy a team leadership position (interview, 28/5/15). This is borne out by statistics that show that 36 percent of ECSA members self-identify as being in positions of management, ranging from executive to junior management (Edu-surveys, 2013: 27). This number is no doubt even higher when also considering the number of engineering graduates who have left the engineering sector and are now working in management positions in other fields. Paul, who hoped at some stage to launch his own business venture, saw leadership as a vital attribute for entrepreneurialism (interview, 28/4/15). As he explained, "...nobody wants to be led, you know?"

Engineers work as a team

The notion that contemporary professional engineers need to be able to work effectively in teams emerged in many of the participant interviews. This was a topic of discussion in two particular areas: First, when the students were contemplating what the workplace would be like, they identified working in teams as one of the primary defining factors. Adam, for example, stated that, in every engineering workplace, no matter the discipline, teamwork would be necessary (interview, 2/6/15). Even in the case of more solitary disciplines such as computer coding, he said, each section of code would always be part of a larger project that involved more people. Second, the students referred to teamwork skills when discussing the personal attributes that they would need to be able to demonstrate once they were in industry. For example, Vuyo explained his belief

that an important part of being a professional engineer entailed being willing to take responsibility for one's co-workers since projects would largely be collaborative (interview, 28/5/15). It would not be enough, therefore, to simply ensure the quality of one's own work.

Engineers are problem solvers

The notion that engineers are society's problem solvers is widely accepted as a core element of the industry globally (Galloway, 2008; Mohd-Yusof, Phang & Helmi, 2014; Valentine, Belski & Hamilton, 2016; Koro-Ljungberg et al., 2017), and this was supported by the students' assertions. Senty articulated this understanding when she explained that the role of engineers is to deal with the "bad things happening in the environment" and to find ways to make human life better (interview, 29/7/15). To support her statement, she gave the example of engineers finding ways to stop the rolling electricity blackouts that had been prevalent in South Africa at the time of the interviews. Thina asserted that solving society's problems did not only start once engineers are in the workplace, as she and her friends already had solutions for many of the world's problems (focus group, 27/3/15). The notion of applying engineering skills and knowledge to make a positive contribution to the world was also a key theme that emerged from this student cohort's e-portfolio sites (Nudelman, 2017c). The students specifically mentioned sustainable energy and renewable resource solutions, environmental initiatives, and finding innovative ways to harness the digital realm to the benefit of all.

Engineers are socially conscious

Linked to the notion of engineers developing solutions to society's problems was the emphasis placed by many of the students on the necessity of engineers being keenly socially conscious. This encompassed both cultural awareness and an understanding of how the actions that they would take would impact the people

who stand to be affected by them. With regards to the former, this theme emerged in terms of the fact that students would be entering workspaces that featured diverse co-workers and would need to know how to connect with people who differ from them in a variety of ways, such as in race, gender, language or age. For example, Vuyo explained that, during vacation work, he had had his first experience of working on a team with people who were very different from him, and he had to learn how to negotiate these differences sensitively whilst still focussing on productivity (interview, 28/5/15). The notion of social consciousness that arose from the interviews related to the necessity for engineers to take contextual factors into consideration. Thina explained that, traditionally, engineers carried out their clients' instructions without considering the social impact of what they were asked to do (focus group, 27/3/15). The example Angela provided was of civil engineers working on a building without taking into consideration issues regarding accessibility for disabled people (interview, 8/7/15). Vuyo questioned whether the engineers installing electricity generators in Khayelitsha (a township in Cape Town) would be equipped to deal with people protesting about service delivery (interview, 28/5/15). Contemporary engineers, these students argued, need to be conscious of these issues and equipped to negotiate often tricky social terrain as they carry out their work.

Engineers have career flexibility

The flexibility that an engineering qualification offers graduates was, for many of the study's participants, one of the major motivating factors behind their choice to study engineering. Faith, for example, had seen how her engineer father and his friends with engineering qualifications were able to work in other professions (focus group, 27/3/15). Kelly was also attracted to engineering because she felt that it would provide her with a wide variety of skills that would be applicable to other fields (focus group, 11/3/15). In addition, the students' plans for the future indicated that even those who chose to remain in the engineering field would have a wide range of choices available to them. Some students, such as Mary, Portia and Senty, were planning to remain in academia and to enrol for their

master's degrees in order to specialise in particular engineering fields. Others, such as Vuyo and Sami, intended fulfilling the terms of their bursaries by working as junior engineers at large parastatals. Paul and Sharone spoke about starting small businesses, Mary was interested in project management within the engineering industry and Jeff was planning on applying the design skills that he had developed during his degree to becoming a landscape architect. The nature of the engineering work that one chose to engage in offered a host of different potential experiences, Faith explained (interview, 1/6/15). If she ended up working for a consulting firm, she said, she would probably be required to be "serious and professional", whereas, if she chose to work in the fields of software and coding, everything would probably be "much more chilled".

Engineers can be entrepreneurs

It was clear from the number of study participants who articulated the desire to one day start their own businesses that the notion of engineers becoming entrepreneurs has become commonplace in industry. Mike was unique in that he had already started his solar energy business and was running it alongside his studies. Other students, such as Sharone and Paul, planned to start small side-businesses when they graduated and to work on these alongside full-time jobs in the engineering industry. Finally, for students such as Vuyo and Ravi, starting a business was something they could envision doing in the distant future. The reasons for wanting to start businesses ranged from the potential extra income stream to the desire to avoid working in formal, hierarchical workplaces. Finally, some students articulated a desire to break away from the conventional hierarchical engineering workplace. Thina, for example, explained that she hoped to one day work in a dynamic engineering start-up space comprised of a small group of people.

These six key notions regarding who/what contemporary engineers are represent the main CEPs held by the study's participants with regard to defining the scope of the profession. These notions are not related in a necessary, internal,

inescapable manner, as engineers do not need to concurrently embody all of them in equal measure. They are thus contingently related, and, in that students have the choice of which to draw from as they develop their own professional identities, they are, in Archer's (1995: 243) terms, in a relationship of contingent complementarities. The implications of this are discussed in the following section.

6.2.3. Situational logics at T1 emanating from the cultural emergent properties

As discussed above, the relationship between the students' conceptions of themselves as senior students and professionals in training was characterised by constraining contradictions. Archer (1995: 233) explains that constraining contradictions give rise to the situational logic of ideational syncretism, which she describes as the attempt to sink differences and effect union between the contradictory elements involved. In this case, this means that the students would have to find ways to deal with both of these conflicting roles. The way in which they do so will differ depending on where each student's focus lies: For example, some may change their understanding of a professional so as to better align it with their experiences as students, whereas others may choose to focus on the aspects of being a student that best align with what they believe being a professional engineer will require. Finally, students may moderate their embodiment of both of these roles in such a manner that they become mutually consistent. Whichever path the students choose, however, constraining contradictions condition a situational logic that is conducive to morphogenesis.

With regards to the various notions regarding who/what a professional engineer is, the contingent complementarities represented by their relationships present a situational logic of opportunity in that the students have freedom in terms of how they constitute their professional identities. Archer (1995: 244) explains that this is because they "objectively increase the opportunity for cultural free play" through the possibility of combining and integrating of ideas. What this

indicates, in the context of this study, is that there is significant space for students to choose the “shape” of their identities as engineers. This is certainly aided by the fact that engineers are in high demand for employment both in the private and public sectors and across other industries (Du Toit & Roodt, 2009: 28), giving them the freedom to follow their own career paths that is generally not available to graduates of other fields. In the possibilities that situational logic presents for these students to shape their own engineering identities, the potential for morphogenesis is present.

6.3. Implications of the situational logics

Up to this point, this chapter has provided an overview of the SEPs and CEPs present at T1 of the morphogenetic cycle under examination in this dissertation. As discussed previously, Archer explains that the purpose of such an examination is to understand how the situational logics suggested by combinations of the relevant SEPs and CEPs condition (not determine) particular courses of action for a study’s agents. In this study, the agents are the students, so the conclusions that are drawn here relate to how the situational logics condition the possible action that might arise in T2-T3. Structurally, it seems unlikely that the relationships between higher education and ECSA and industry and ECSA will change because of the situational logics of protection and compromise, which stifle structural change. There does seem to be scope for some structural morphogenesis in the relationship between higher education and industry because of the very tenuous balance implied by the situational logic of compromise. In terms of the CS, there is definite potential for morphogenesis because the situational logics of ideational syncretism and opportunity both create space for the possibility of something new (albeit in different ways), as discussed previously.

Despite the tendencies that these various cultural configurations suggest, Archer (1995: 245) reminds us that they stem from the relations between ideas only. Thus, while this chapter fulfils the first methodological directive of

analytical dualism, it is not, as Archer (1995: 246) puts it, “the whole story”. Only social actions taken by agents in pursuit of their interests determine which of these situational logics are actually borne out in reality. It is thus at this point that she exhorts us to “reintroduce the people” (Archer, 1995: 135).

6.4. Reintroducing the people

Social realism (SR) presents a stratified view of human beings. Archer (1995: 254–255) explains that there is an indeterminate number of different strata, but, given that morphogenesis is a tool for practical social theorising, it deals only with *persons*, *agents* and *actors*. All three of these strata are indispensable to social theory but are irreducible to one another (1995: 249). This is because they are emergent, in that the person fathers the agent who, in turn, fathers the actor. As discussed in Section 2.5.2, the emergence of agency is the end-product of *double morphogenesis*, whereby agency leads to structural and cultural elaboration and is itself elaborated upon in the process (Archer, 1995: 247). Simultaneously, actors develop from *triple morphogenesis*, whereby the particular social identities of individual social actors are forged from agential collectivities in relation to the array of roles available in a society at a given time (Archer, 1995: 256). Both agents and actors, however, remain rooted in persons – real people with continuous senses of self (Archer, 1995: 282) – who are capable of weighing up constraints and enablements in order to determine the courses of action that promote their vested interests.

Since the contribution of the morphogenetic framework is to enable social theorising in the form of “analytical histories of emergence” (Archer, 1995: 327), this examination of T1 would be incomplete without a discussion of the contribution of agency in terms of conditioning the structural and cultural context of this research, as well as in shaping the nature of agency and scope of the roles available to actors. Persons become agents before they become actors; as Archer (1995: 277) explains, humanity enters society through the maternity ward doors, and we become agents simply by being born into certain

collectivities. I therefore begin this discussion by focusing on agency at T1, the start of the NVP/PCS course pairing. This requires an analysis of the ways in which agency contributed to the shaping of the structural and cultural contexts described above and was simultaneously shaped by them. Thus, this section begins with a discussion of double morphogenesis.

6.4.1. Double morphogenesis

Section 2.5.2 provided an overview of Archer's explanation of agential morphogenesis. However, I provide a brief summary of the theory here in order to assist my explanation of agency at T1. Agents, according to Archer (1995: 256), are collectivities who share the same life chances. Within the category, she makes a distinction between *corporate agents* and *primary agents* (Archer, 1995: 258–260): Corporate agents are aware of what they want, can articulate it to themselves and others and have organised in order to obtain it. In contrast, primary agents neither express interests nor organise for their strategic pursuit. For this reason, one can state that it is corporate agency that engages in concerted action intended to shape or retain structural or cultural features (thus shaping the context in which all agents operate), while primary agency lacks a say in this modelling (although it does have the potential to affect structural and/or cultural morphogenesis through sheer demographic numbers). Nevertheless, agency is an emergent stratum, thus implying a dynamism that holds potential for morphogenesis. Additionally, Archer (1995: 259) reminds us that a primary agent in one domain may be a corporate agent in another in any particular T1, since these categories are not fixed but can change over time.

This latter point is important, because it reinforces that, while students may be political activists, entrepreneurs or student leaders who operate as corporate agents by actively organising in order to achieve their goals, within the context of the NVP/PCS course (and indeed most university courses), they are primary agents. This is because they do not actively organise and participate in making decisions concerning issues such as course structure, pedagogy, assessment and

course material. As an example of how their demographic numbers impact the structural context, an examination into how the increased number of students enrolling in engineering degrees have impacted class size and assessment methods could be conducted. (For example, academic staff may have decided that it was no longer feasible to mark long essay assignments and opted for online multiple-choice tests instead.) However, within the context of this research, they remain primary agents.

An examination of T1 of this study reveals a number of different corporate agents who occupy positions and roles in key structures in engineering education. First, for example, there are those on the Education Committee (EC) of ECSA, whose job it is to develop the accreditation and qualification frameworks, including the LOs that guide decisions concerning the curricula of electrical engineering degree programmes.²⁰ Second, there are industry stakeholders, particularly the major employees, who consult with ECSA and academic departments in order to ensure that the particular skills and knowledge that they require from engineering graduates are emphasised within degree programmes. Finally, academic staff members may work together to play a major role in making decisions concerning what is taught, how it is taught and methods of assessment. There is significant crossover between these three groups, since some academics also consult with industry, and there are ECSA decision-makers who are members of staff at academic institutions.

From a more macro perspective, there are corporate agents such as policy makers in the national Department of Higher Education and Training (DHET), members of UCT's Executive Committee and the Dean and leadership of UCT's EBE Faculty, who have also made decisions and implemented actions that have shaped the structural and cultural context in which the participants of this study, as primary agents, interacted in T2-T3. All aspects of the NVP/PCS course pairing, including the length of the courses, their content and the teaching and

²⁰ Since 2017, this function has been overseen by the Policy Development and Standards Generation Committee (PDSGC).

evaluation methods employed, are the results of previous morphogenetic cycles. In particular, these are the outcomes of previous T2-T3s, given that social interaction is the sole mechanism that governs stability or change (Archer, 1995: 260).

While these categories of agents are vital in contributing to the “analytical history of emergence” mentioned previously (a full examination of each could form the basis of its own morphogenetic study), they are not the focus of this research. Archer (1995: 255) reminds us that one of the affordances of the stratified model of the human being is that we may only need to draw on those properties pertaining to the person, the agent or the actor, depending on what we are seeking to explain. The focus of this study is on professional identity transformation in that it aims to understand whether/how students develop engineering identities. This notion of inhabiting a new role is encompassed in SR through the concept of triple morphogenesis.

6.4.2. Triple morphogenesis

As mentioned previously, triple morphogenesis refers to the emergence of the social actor, which, in contrast to agency, is always understood as being in the singular. It is at this level of morphogenesis that a particular individual acquires an identity as a social self. The social actor is one who has chosen to identify himself with a particular role and to personify it actively in a particularistic way (Archer, 1995: 274). This, says Case (2013: 63), is the desirable outcome of higher education in general: a graduate who has developed personally and engaged with knowledge in such a way that she is able to take on a social role that reflects her ultimate concerns. With specific reference to this study, therefore, the graduates of an engineering degree should leave university having become actors in that they embody the social role of being engineers. As discussed in Section 2.3, this involves the development of a discursive identity of engineering.

Archer (1995: 280) reminds us that actors, as role incumbents, cannot be understood without reference to agency. This is the case for two reasons: First, given that different opportunities and information are open to the privileged and closed to the non-privileged, agency influences what types of actor people can choose to become (Archer, 1995: 277). In the context of my study, this is evident in the fact that, even though funding is available for students from disadvantaged backgrounds in the form of bursaries or loans, the financial costs associated with tertiary study are prohibitively high and therefore exclude many people from the possibility of ever becoming engineers. Moreover, the fact that many disadvantaged South African youths attend sub-standard schools which do not equip them to deal with the challenges of an electrical engineering curriculum means that they are unable to pass and end up dropping out, ultimately not becoming engineers. Those who are able to afford university fees and possess cultural capital that facilitates their time at university are more likely to succeed and embody the role of an engineer.

Second, while corporate agency transforms the structural and cultural contexts through double morphogenesis, it also transforms the existing array of roles in society (Archer, 1995: 279). One example of this is how the definition of what being an engineer entails has changed over time. Elements of this have already been highlighted in this thesis. For example, Section 4.2.1 discussed the development of the field of engineering, with particular emphasis on its relation to education and training. In addition, Section 6.2.2 mentioned the fact that the rapid technological, political, social and environmental changes that have occurred in recent years have resulted in altering conceptions of the role of the engineer in society. However, the deeper focus on particular examples over time which follows illuminates the ways in which corporate agency affected the scope of the role of being an engineer as it negotiated the existing structural and cultural systems.

One example of this was already mentioned in Chapter 4: The emergence of engineering as a distinct profession can be traced back to the Industrial

Revolution (Seely, 2005). At that time, engineering was primarily a common sense, hands-on field that focussed on practical work. It was only in the mid- to late nineteenth century that leaders in the engineering profession pushed for the integration of science and maths into the work carried out by engineers. This was as a response to a perceived lack of social status in relation to other professions, such as the sciences and law (Seely, 2005: 116). In this case, the leaders in the field, the corporate agents, altered the basis of what engineers did through their organisation and took action intended to produce structural and cultural transformation.

Within a South African context, another example of corporate agency shaping the role of engineers is described by Kloot and Rouvrais (2017: 8), who outline how, in 2001, the national Department of Education introduced the Bachelor of Technology (BTech) qualification. This qualification added an additional year of academic work to the diploma programmes offered at technikons and produced graduates with the title of “engineering technologists”. This was the third and final category of engineering qualifications, along with “engineers” and “engineering technicians”. The particular foci of these different categories is not of importance here, but what is relevant is that decision-makers in government created a new category of engineering professional, thereby altering both the array of roles available and their nature.

It is clear from these examples that a social realist perspective leads to an understanding of “engineer” as a role that has transformed over time and has been influenced in various ways by social agency in previous morphogenetic cycles. In Section 6.2.2 above, I outlined the CEPs held by the study’s participants concerning what a contemporary engineer is, and, while it is beyond the scope of this study to examine how each of these elements emerged, doing so could contribute significantly to an analytical history of the emergence of this profession, both locally and abroad.

6.5. Conclusion

This chapter has laid out the structural and cultural situational logics at T1, thus answering the first research sub-question of this dissertation, which relates to the SEPs and CEPs operating at UCT and the NVP/PCS pairing from a macro-societal perspective. It has also provided an overview of how agency has functioned to shape this context and how agency has, in turn, been shaped over time. In this manner, it represents the end-product of many morphogenetic cycles in the fields of engineering, engineering education and higher education, to name some of the realms that this chapter has drawn from. I hope that, through this analysis, I have demonstrated how “useful and usable” (Archer, 1995: 135) social theory can be, as per the quote that opened this chapter. Yet, as Archer (1995: 295) indicates, “in our end is our beginning”: This means that the end of one morphogenetic cycle is the starting point of another, and thus the purpose of this analysis of T1 has not only been to retrospectively consider the history of what has been but also to set the stage for what is yet to come. The central research question of this dissertation relates to the ways in which two undergraduate courses particularly geared towards promoting workplace readiness on the part of students can achieve their objectives of preparing students for the engineering workplace. In order to answer this question, the focus of this dissertation now moves to an analysis of T2-T3 of the morphogenetic cycle in question.

7. The social interaction phase: structure and culture

Yes – it's given more insight as to what is required professionally and a chance to practice skills.

No - I do not plan on doing anything like this ever. NVP projects should be done alone to avoid circumstances where group members have to act about their passion and interest in products.

(Department of Professional Communication Studies, UCT, 2015a)

The quotes above were taken from the course evaluation forms completed by students following their completion of the New Venture Planning (NVP)/Professional Communication Studies (PCS) course pairing. They show two different responses to the question posed on the form regarding whether the students felt that participation in the NVP and PCS courses had helped to prepare them for their future careers. I chose to showcase these particular answers because they represent opposing poles of a wide spectrum of responses. These quotes from the students are clearly located in Bhaskar's (1975) critical realist (CR) domain of the empirical, given that they consist of subjective experiences (see Section 2.1.1). As such, they are not sufficient as a means to develop understandings of the generative mechanisms at work on the domain of the real, which, given its CR underpinning, is the aim of this dissertation. Nevertheless, they do demonstrate how divergent the students' experiences of the NVP/PCS course pairing were, even though they were all exposed to the same curricula, assessment strategies and pedagogy as described in Chapter 5. This shows how, in Archer's words, agents are capable of "resisting, repudiating, suspending or circumventing structural and cultural tendencies" as a result of their creative powers as human beings (Archer, 1995: 195). They do so through social interaction, which occurs between T2-T3 of the morphogenetic cycle.

This chapter and that which follows focus on attempting to explain this agential process through an analysis of T2-T3 of the morphogenetic cycle under examination in this study, namely that of the NVP/PCS course pairing offered to fourth-year electrical engineering at UCT in 2015. In service to the study's central objective – to understand the ways in which participation in an undergraduate course can prepare electrical engineering students for the workplace – this chapter begins by dealing with the second research sub-question of this dissertation, which is intended to develop understandings of the pedagogic characteristics of the course pairing that condition the development of discursive identities on the part of the students. To this end, analytical dualism continues to be used as a tool to analytically (and thus temporarily) separate structure, culture and agency and to address each of these elements in turn (see Section 2.5.1). However, whereas the previous chapter dealt with the macro-level SEPs and CEPs that shape engineering education (in that they related to national bodies and policies), this chapter focuses more directly on the case study in order to determine how SEPs and CEPs, as they manifest in the teaching and learning that occurred in the NVP/PCS course pairing, conditioned the participants' development of discursive identities.

7.1. Structural emergent properties

This analysis of the socio-cultural interaction that occurred in T2-T3 involves a focussed analysis of the specific structures that arose in the NVP/PCS course pairing that is the focus of this case study. In terms of SEPs, the EBE Faculty and the departments that convened these two courses (the Electrical Engineering Department and the Professional Communication Studies Department) are the main focus of this section because, ultimately, they influenced the teaching and learning environment that the students encountered while enrolled in the NVP and the PCS courses.

7.1.1 The Engineering and the Built Environment Faculty

The University of Cape Town's EBE Faculty is not the largest faculty at this institution in terms of student or staff complement (both the Faculties of Commerce and Humanities have more students); however, it contributes significantly to UCT, particularly in terms of income from research. The EBE Faculty was responsible for generating R144 million of the critical income that UCT accrued as a result of research work performed for external stakeholders in 2015 (UCT, 2016e: 133). In addition, significant income was generated from UCT's equity in spin-off companies launched within the EBE Faculty (UCT, 2016f), which was over and above the funding received from the DHET for the 111 accredited journal articles published that year (EBE, 2016). Within the organisational structure of UCT, the EBE Faculty also plays an important role in shaping the teaching and learning environment that engineering students are exposed to during the course of their studies. In being able to propose changes to programme structures, suggest new courses and determine assessment methods, the EBE Faculty has a great deal of latitude – although decisions must ultimately be approved by the university's "Senate". This also illustrates the degree of forethought and the multiple levels of approval that go into the design of the courses for which students register.

This understanding of the structures involved in decision-making regarding academic matters at UCT also adds depth to the analysis of the role and function of the NVP/PCS course pairing by illuminating the intentionality of the curriculum. Careful consideration is clearly given to the development of courses within the EBE Faculty, and, as such, it is important to analyse the purpose of this course pairing. One approach to doing so is by returning to the Engineering Council of South Africa's (ECSA) Qualification Standards (ECSA, 2012), which the EBE Faculty Board is aware it must incorporate into its curricula in order to continue to reap the benefits of professional accreditation (see Section 6.1.2). In the Qualification Standards, ECSA defines five "knowledge areas" that engineering curricula must incorporate. These are mathematical sciences,

natural sciences, engineering sciences, design and synthesis and complementary studies. As mentioned in the introduction to Chapter 5, the final category – complementary studies – must, according to ECSA (2012: 3), account for at least 56 of the minimum of 560 total credits required for an engineering degree. Within this stipulation, however, different institutions have significant scope in terms of what they choose to include within this category and how they go about doing this. ECSA specifies that the knowledge area of “complementary studies” consists of fields which are

...disciplines outside of engineering sciences, natural sciences and mathematics which are relevant to the practice of engineering including but not limited to engineering economics, management, the impact of technology on society, effective communication, and the humanities, social sciences or other areas.

(ECSA, 2014b: 9).

As is clear from this extract, the academic staff members who plan engineering curricula have many options when it comes to choosing what courses to include under the knowledge area of “complementary studies”. This area can include courses already offered by other faculties within the university. For example, in first year, all electrical engineering students at UCT enrol in a compulsory Humanities course titled “Culture, Identity and Globalisation in Africa”. The course, which is run by the African Studies Unit, introduces and develops understandings of culture, identity and globalisation in contemporary Africa (“Africa”, 2016). While it aims to contribute to more thoughtful professional practice within the current South African social context, the course does not directly incorporate engineering practice into its curriculum. Furthermore, while the course is also intended to be “generally enriching”, the feedback provided by this study’s participants indicates that most of these students struggled to identify its relevance to their development as professional engineers. For example, looking back on the course, Thina remembered watching videos depicting genocide and not understanding how they connected to anything related to electrical engineering (focus group, 27/3/15).

That many students found this course irrelevant does not mean that it lacks value: After all, the goal of Bhaskar's depth ontology is to encourage researchers to probe beyond empirical assertions. It could be argued that including courses from different faculties represents a means by which those responsible for the planning of engineering programmes can prevent students from becoming myopic regarding the nature of the world around them, particularly because the profile of the "new engineer" is a person who is able to solve complex problems in a socially and culturally sensitive manner (see Section 6.2.2). However, it seems as if, when the "complementary knowledge" courses related directly to the development of engineering workplace skills, such as the business and communication skills covered in the NVP and PCS courses, UCT's EBE Faculty Board decided to utilise departments located within the faculty. In this way, it could be ensured that the knowledge taught in these courses, while "complementary" in nature according to ECSA's stipulations, had direct relevance to the engineering students. Furthermore, relying on engineering departments to offer these courses meant that the EBE Faculty could exercise control in terms of having the final say regarding curriculum and assessment in a manner that would not be possible when offering courses from other faculties. This is because, as explained above, the EBE Faculty Board is responsible for approving all courses offered within the faculty.

The NVP handout for 2015 identifies the course objectives as "Learning business skills involved in starting entrepreneurial businesses from products designed: feasibility analysis, business plan, presentations" (Department of Electrical Engineering, UCT, 2015: 1). The handout specifies that the course touches on three of ECSA's ELOs: ELO 7 (Impact of engineering activity), ELO 8 (Individual, team and multidisciplinary working) and ELO 10 (Engineering professionalism), while the main ELO addressed is ELO 5 (Engineering methods, skills and tools, including information technology) (Department of Electrical Engineering, UCT, 2015: 2). Table 17 below is taken from the NVP course handout from 2015 (Department of Electrical Engineering, UCT, 2015: 2):

Table 17: Extract from the NVP handout

Main outcome	Activities, skills or abilities contributing to the main outcome/ objective	Alignment of assessment with relevant ELO description
Learning outcome 5: Engineering methods, skills and tools, including information technology Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology	Range Statement: A range of methods, skills and tools appropriate to the disciplinary designation of the program including:	
	4. Basic techniques from economics, business management;	Students will be required to demonstrate appropriate level of understanding of financial statements (cash flow, income and expenditure, and balance sheets), project and business financing, net present value and internal rate of return calculations.
	5. Health, safety and environmental protection appropriate to the discipline;	Students will be required to demonstrate understanding of the OHS Act, and at least one programme specific competence such as RHoS, Electricity Act (1987).
	6. Risk assessment and management;	Students will be required to demonstrate the principle of quantitative risk assessment.
	7. Project management.	Students will be required to demonstrate competence in project planning tools such as Microsoft Project

Table 17 above shows how the manner in which the students were assessed during the NVP course was designed to align with the requirements of ELO 5. Range Statements 4-7 in the second column were taken directly from the ECSA Qualification Standard document (ECSA, 2012: 5) and represent specific competencies that students need to have mastered in order to graduate. The content in column three is an explication of how the NVP course determined whether students had achieved these competencies. As was explained in Section 5.1.2, a class test was administered in which each question corresponded to one of the range-statement competencies. According to the handout, the questions were “set at a level that passing the question is equivalent to demonstrating the competence required for the exit-level outcome” (Department of Electrical Engineering, UCT, 2015: 3). If a student failed a particular question in the test, she would have to re-write that question in a make-up test. Subsequent failure would lead to the loss of the student’s Duly Performed certificate and failure of the course.

It is clear, therefore, that decisions concerning curriculum and assessment in the NVP course were strongly influenced by the requirements of the ECSA ELOs. Because the course ostensibly took responsibility for the students' achievement of aspects of ELO 5 at exit-level, it played a vital role in the overall structure of the Electrical Engineering degree programme, the design of which would have been decided by the EBE Faculty Board. It is interesting to note, however, that the ELO test described above only counted for 10 percent of the final course mark, whereas the business plan task, which was not used to demonstrate achievement of any ELOs at exit-level, counted for 50 percent. Thus, while the students were required to demonstrate competency in terms of ELO 5 to pass the course, it was not a determinant of academic achievement in the course. Furthermore, the focus on engineers as entrepreneurs espoused in the course title and objective is, as discussed earlier in this thesis, indicative of contemporary engineering practice and thus touches on ELOs such as ELO 7 (Impact of engineering activity) and ELO 10 (Engineering professionalism). However, the ELOs do not specifically mention "entrepreneurialism", "new ventures" or "small business development". The EBE Faculty's decision to include a course focussed on these issues indicates the balance that must be found between adhering to the ECSA's ELOs while still exercising autonomy in terms of designing courses that the Faculty deems valuable to students.

A similar analysis of the role of the PCS course within the Electrical Engineering degree programme also reveals how this course was key to fulfilling two of ECSA's ELOs at exit-level. These were ELO 6 (Professional and technical communication) and ELO 10 (Engineering professionalism). How these ELOs were assessed in the course is outlined in Table 18 below, which is taken from the 2015 PCS course handout (Department of Professional Communication Studies, UCT, 2015b: 2):

Table 18: Extract from the PCS course handout

Main outcome	Activities, skills or abilities contributing to the main outcome/ objective	Alignment of assessment with relevant ELO description
<p>Learning outcome 6: Professional and technical communication</p> <p>Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.</p>	<p>Range Statement</p> <p>Material to be communicated is in an academic or simulated professional context. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Written reports range from short (300-1000 word plus tables diagrams) to long (10 000 to 15 000 words plus tables, diagrams and appendices), covering material at exit-level. Methods of providing information include the conventional methods of the discipline, for example engineering, as well as subject-specific methods</p>	<p>The candidate exhibits effective written communication as evidenced by using effective structure style and language for purpose and audience ; using effective graphical support to produce a poster using all aspects of design, use of colour and design programmes; applying methods of improving information for others engaged in engineering activity by providing a CV, writing an executive summary and business plan; meeting the requirements of the target readership and being able to select appropriate material .</p> <p>The candidate exhibits effective oral communication as evidenced by using effective structure, style and language; being able to construct and deliver an informative and persuasive oral incorporating purpose and audience; using appropriate visual support; and meeting the needs of the audience. The candidate can achieve fluid transfer from speaker to speaker; provide appropriate introductions and conclusions; make effective use of a template in PowerPoint slides; use video clips, sound clips, models and flipcharts; deliver fluently; use feedback from the rehearsal to improve, and assess own fluency from the play back of the filmed rehearsal presentation.</p>
<p>Learning outcome 10: Engineering professionalism</p> <p>Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.</p>	<p>Range Statement</p> <p>Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate. The contextual knowledge profile specified in the range statement of Exit Level Outcome 7 is applicable here</p>	<p>The candidate exhibits professionalism by the following:</p> <p>Being aware of requirements to maintain continued competence and to keep abreast of up-to-date tools and techniques by learning the theory of diversity and team work; negotiation; and conflict management by team work exercises (this theory is debated from an ethical basis); displays understanding of the system of professional development; accepts responsibility for own actions by showing knowledge of professional development; shows knowledge and appreciation of the King 1, 2, 3 reports; and application of the ECSA Codes of Practice; limits decision making to area of current competence by making ethical judgements and cohesive group decisions within the group; reasons about and makes judgement on ethical aspects in case study context by being able to research the essay topic through appropriate journals, books and websites and to provide a bibliography for readers to reference; debates ethical issues to discern boundaries of competence in problem solving and design by being able to analyse own contribution as a team member and to perform appropriate functions (e.g. drawing up agenda, writing minutes, problem solving, etc.); meets the given deadlines for all projects (ethics essay, MCQ, CV, executive summary, poster and oral presentation).</p>

As in Table 17 above, the first column in Table 18 quotes the ECSA ELO that is the focus of the course. Similarly, the content in the second column is drawn directly from the Range Statements in the Qualification Standard document (ECSA, 2012: 5–6). The content in column three reflects how the PCS course

attempted to ensure that the requirements of the ELOs were incorporated into the course. It is clear that requirements directly influenced the content of the lectures and the methods of assessment. For example, knowing that students needed to fulfil ELO 10, which incorporated engineering ethics, meant that the course convenor decided that there should be a full lecture slot dedicated to this topic. Then, given that the course needed to provide evidence that students could communicate effectively through writing, an ethics essay was set (see Section 5.2.2). This essay could be used to assess the students' writing skills, as per ELO 6, as well as their ability to exercise ethical judgement, as per ELO 10. It is relevant that, even though ELO 10 could be achieved through class role-play and discussion, the PCS Department decided to set an essay. On the one hand, this could be due to the fact that it afforded the students an opportunity to practice formal writing, as required by ELO 6. However, on the other hand, the fact that ECSA requires evidence during its accreditation visits that students have reached the required outcomes means that it is most practical for students to demonstrate their competence via a written text. Documentation can be printed, stored and easily accessed when an ECSA accreditation team visits the university in order to accredit the programme.

As with the NVP course, there was not a direct correlation between the emphasis of the ECSA's ELOs on particular outcomes and the mark weighting assigned to the various assessment tasks within the PCS course. For example, the ethics essay only counted 100 out of 600 total marks for the course, even though the requirement that students demonstrate evidence of critical awareness of the need to act ethically and exercise judgement is, according to the ECSA ELOs, one of the ten most important outcomes of an engineering degree programme. Decisions concerning specifics such as this, as well as aspects such as how much class time should be devoted to different topics, would have been made by the head of department (HOD) of the PCS department and are beyond the scope of this discussion concerning the SEPs at T2 of the morphogenetic cycle being studied. What is relevant, however, is that the content and assessment methods of both the NVP and PCS courses were directly influenced by the ECSA ELOs,

and the requirement that the ELOs be fulfilled was of profound consequence to the EBE Faculty due to the potential impact on its reputation should its accreditation be lost. This would lead to loss of funding from student enrolments and research contracts with external stakeholders and an exodus of quality staff. As the structure ultimately responsible for organising and controlling teaching and research within the engineering and built environment disciplines at UCT, the EBE Faculty clearly wields significant influence with regards to what is taught and how it is assessed.

7.1.2 The Electrical Engineering Department and the Professional Communication Studies Department

As mentioned previously, the NVP course was offered under the auspices of the Electrical Engineering Department itself. As one of seven disciplinary departments within the EBE Faculty, the Electrical Engineering Department plays an important role within this faculty: For one, electrical engineering is a popular career choice in South Africa – a survey of ECSA-registered professionals showed that this is the second most peopled discipline after civil engineering (Edu-surveys, 2013). The Electrical Engineering Department attracts students to the EBE Faculty, which has positive financial effects (in terms of fees and government subsidies), as well as on-going benefits, such as throughput to postgraduate level, for the institution. The Department also plays an important research function within the EBE Faculty. There are 11 active research groups within the Department; these groups focus on topics including radar remote sensing, telecommunications and robotics (EBE, n.d.). They receive funding from government agencies such as the National Research Foundation and the Council for Scientific and Industrial Research, as well as industry partners such as De Beers, Anglo Platinum and Rio Tinto.

The PCS Department is located within the EBE Faculty, which means that, aside from ad hoc lectures delivered to groups of Law and Chemistry students, it focuses exclusively on the teaching of engineering students. The Department

consists of two full-time staff only: the HOD (who is a professor) and an administrative assistant. All decisions regarding course content, structure, teaching methods and course materials (including the required textbooks and PowerPoint slides) are made by the HOD, who is the only liaison with the leadership of the EBE Faculty. At the point in time in which this research was conducted, all teaching in the Department was carried out by six part-time contract lecturers, four of whom concurrently taught the fourth-year electrical engineering students enrolled in the PCS course. This meant that class size could be kept relatively small (with an average of 35 students per class), which enabled interaction and relationship-building between the lecturers and the students. Three of the four lecturers had been teaching in the Department since 2009; the fourth joined in 2014 and had already taught the course the previous year. None of the PCS lecturers were engineers themselves or had experience in the built environment industries, although it is interesting to note that two were married to engineers (as were the HOD and administrative assistant) and two to architects. However, between the four, there were many years of teaching experience, both at school and university level, in fields including English, drama and maths. One of the lecturers had a master's degree in Education, specialising in Curriculum Design.

The PCS Department's role within the EBE Faculty is crucial, but it is not uncontested: On the one hand, as a service department, PCS performs a vital role for different engineering departments in that its courses fulfil a number of ECSA ELOs, which is necessary for accreditation and the local and international professional recognition that it confers. The different engineering departments can rest assured that ELO 6, the outcome relating to professional and technical communication, will be covered by PCS in its semester courses, as this is PCS's functionalist purpose within the EBE Faculty. However, the structure of the PCS Department, with its part-time contract lectures, is unconventional within the Faculty. The university implemented austerity measures in 2016 ("VC Desk", 2016), an aspect of which includes "staff restructuring" through retirements, resignations or retrenchment. In this context, the case can be made that the PCS

Department represents a non-essential expense for the EBE Faculty. After all, it could be argued that, with some planning, the various engineering disciplinary departments would be able to use their own staff to prepare their students to fulfil the required ECSA ELOs.

Additionally, there is no consensus that PCS's model of offering separate semester courses in communications is the most effective means of allowing students to develop these skills, which has led to some engineering departments shifting towards embedding the teaching and learning of communications skills into engineering curricula (Erdil, Harichandran, Collura, Nocito-Gobel, Adams & Simson, 2016). This is the strategy that has been employed by UCT's Chemical Engineering department, which began the roll-out of its restructured curriculum in 2014 (von Blottnitz, Case & Fraser, 2015). Instead of a series of semester courses, the Chemical Engineering curriculum centres on one full-year core course per annum. The theory taught during lectures is applied to projects, the majority of which require students to practice communication skills. For example, one project may require a presentation, whereas another might be assessed by means of a group report. While working on their projects, students are given input concerning the different communication skills they will require, meaning that they develop and practice these skills alongside their engineering knowledge. In this way, communication skills are embedded into the curriculum. While these ad hoc input sessions are currently still taught by staff from the PCS Department, it is plausible that, at some point, Chemical Engineering Department staff will decide to provide this input themselves, effectively making the PCS Department and its staff redundant to its programme. In addition, engineering departments also have access to other resources, such as freelance communication trainers, textbooks and even massive open online courses (MOOCs), which could offer alternative (and often more inexpensive) options for the development of communication skills to the PCS Department.

7.1.3 Situational logics arising from the relationship between the structural emergent properties

The section began by clarifying the nature of the working relationship between the NVP and PCS courses on which this dissertation focuses and then turned to the academic departments that house these courses. The purpose of this discussion has been twofold: First, it has begun to answer the research sub-question regarding the pedagogic characteristics of the NVP/PCS pairing by describing how the two courses operated in greater detail. This included a discussion of the ways in which the ECSA ELOs influenced curriculum, assessment and pedagogy, as well as the balance that was struck between ECSA's requirements and departmental decisions. Second, it provided an overview of the SEPs directly involved in the morphogenetic stage of T2-T3, and, as such, these findings can be used to better understand the situational logics at hand that conditioned the agents' action. The relationship between the EBE Faculty and the Electrical Engineering Department at the start of T2 was one of necessary complementarities, since electrical engineering is a core discipline taught by the Faculty. This tended towards a situational logic of protection due to the fact that the EBE Faculty relied on the Electrical Engineering Department as a draw card for students wishing to pursue this field of study and for the benefits of its research. Likewise, the Electrical Engineering Department drew on the EBE Faculty's institutional reputation to attract students and staff and on its physical resources, such as classrooms, laboratories and equipment, in its everyday functioning.

In contrast, the relationships between the EBE Faculty and the PCS Department and between the Electrical Engineering Department and the PCS Department were characterised by contingent compatibilities at T2 of the morphogenetic cycle. This is because, while the PCS Department provided a "one-stop shop" that allowed the various engineering disciplinary departments to ensure that the ECSA ELOs were covered in their programmes, as was illustrated above, these departments had other options that they could pursue in terms of fulfilling these requirements. Contingent compatibilities create situational logics of pure

opportunism, since there are no effective barriers to the possibility of new relationships arising between the other highly compatible interests of particular groups (Archer, 1995: 226). This often results in an “institutional repatterning” (Archer, 1995: 227) and, as a result, morphogenesis. For example, should the EBE Faculty’s need for a PCS Department fall aside, the Department would likely be disbanded or absorbed into the Faculty.

Similarly, the decision taken by the Electrical Engineering and PCS Departments to pair the NVP and the PCS courses can be said to have been a success in that the new venture conceptualised by the students in the NVP course proved a suitable topic for the PCS presentation. Furthermore, working in the same groups and only having to flesh out one project for two courses proved convenient and efficient for students (Ravi, interview 28/5/15; Adam, interview 2/6/15). However, both logistically and in terms of the students’ feedback, the pairing of the courses was not the only possible approach to achieving the courses’ respective outcomes. Had there been no pairing between the NVP and PCS courses, both could still have fulfilled their objectives. This was pointed out by Adam, who stated that the PCS course could have “... given us a different topic – it just means we would have had to go research something else” (interview 2/6/15). This was particularly the case since a number of students felt that the link connecting the two courses in the pairing was not strong. Mike (interview 29/5/15), Angela (interview 8/7/15) and Faith (interview 1/6/15) all expressed the opinion that, while they appreciated the idea behind the course pairing, the actual execution was lacking. For example, Angela (interview 8/7/15) suggested that, if the goal was really to intermesh the two courses, the NVP guest lecturers should have also discussed the importance of communication skills in their day-to-day work. Similarly, Adam (interview 2/6/15) pointed out that, if the courses were properly integrated, the NVP lecturers would have been present at the PCS presentations. These comments highlight that the fact that the courses were paired, while a unique and convenient experience for the students, was not crucial to the fulfilment of either course’s aims. As such, the potential for

morphogenesis exists in the possibilities of alternate approaches to structuring teaching and learning.

The main focus of this dissertation relates to the potential of higher education to foster workplace preparedness in students. This has been conceptualised as a process of discursive identity transformation, which, according to the social realist (SR) framework, represents agential morphogenesis. However, this discussion of the situational logics that arise from the relationship between SEPs is relevant because they contribute towards shaping the situations in which actors and agents find themselves and thereby provide “good reasons” (Archer, 1995: 207) for various courses of action. Another aspect of this condition relates to the situational logics that arise from CEPs.

7.2 Cultural emergent properties

The discussion of SEPs above teased out the relationships between the main structures involved in the NVP/PCS course pairing and outlined the situational logics arising from these that conditioned the students’ actions by shaping the educational contexts in which they found themselves. However, Fairclough’s (1992: 66) assertion regarding the dialectical relationship between social structure and discourse means that this analysis would be incomplete without a focus on the discourses that both shape and are shaped by these structures. This is also, as I have already shown, a vital aspect of analytical dualism, which rests on the concept that discourses (which are examples of, in Archer’s terms, CEPs) also play a socially constitutive role by conditioning agents’ actions. This means that discourse analysis can provide a way of accessing the CEPs in a given context – in this case, the NVP/PCS course pairing (see Section 3.2.2).

My focus on discourse is particularly appropriate here given that this chapter’s purpose is to analyse the pedagogic characteristics of the NVP/PCS pairing that condition the development of discursive identities on the part of the students. This is because, as Bacci (2005: 199) explains, one of the contributions of

discourse to social analysis is that it provides a means of focusing on how issues are given particular meaning within a social setting. In this study, identifying the discourses at work within the NVP/PCS pairing provides a way of understanding implicit messages concerning issues such as professionalism, the nature of the engineering industry, the relationship between education and the economy and the students' place within higher education that underpin the two courses. In turn, this knowledge is instrumental in developing a deeper understanding of the pedagogic characteristics of the pairing themselves, including aspects such as teaching and learning, curriculum and assessment. Clegg (2011) shows that, despite being presented as common sense, higher education curricula are inevitably ideologically underpinned, as they value certain sorts of knowledge over others. In the NVP/PCS course pairing, this phenomenon is evidenced by three particular discourses that I have identified: the "entrepreneur of the self" discourse, the discourse of "inevitability" and the "one-size-fits-all" discourse. In order to understand these, however, a more critical understanding of the ideological underpinning of the higher education sector in general is necessary, given that it influences all three discourses. To this end, this chapter now turns to a discussion of neoliberalism and its impact on education.

Neoliberalism

Section 4.3 outlined a number of divergent views on the purposes of higher education. While issues such as the civic education of students and development of knowledge that is critical to society were discussed, the section also showed the extent to which contemporary policy and practice within higher education are based on the relationship between HEIs and the economy. Allais (2014: xvii) goes so far as to refer to this as the "intertwining of education and the economy", explaining that this relationship stems from the fact that education is often seen as both the solution to economic problems such as poverty and unemployment and the cause of these problems. She links this to the rise of neoliberalism in both South Africa and around the world. The term "neoliberalism" has, as Ferguson (2010) points out, many definitions: On the one hand, it is a political ideology, a

macroeconomic doctrine focussed on the valorisation of private enterprise and suspicion of the state, that leads to actions such as market liberalisation, privatisation, deregulation and decreasing the role of the public sector in society (Shrivastava & Shrivastava, 2014: 810–811). On the other hand, “neoliberalism” is understood as the results of the implementation of this doctrine, which generally involves the rich getting richer while the poor and working classes are faced with increasing inequality, insecurity and deterioration of quality of life (Ferguson, 2010: 170). Ferguson (2010) goes on to outline other uses of the term, including as a “sloppy synonym for capitalism itself”, before explaining that these different definitions indicate nuances in the concept of neoliberalism that are not usually expressed in the literature. As evidence of this, he shows how some countries that pursue neoliberal macroeconomic policies (South Africa included) budget increasing amounts for social spending. Thus, two ideas thought to be antithetical are brought together, namely those of being neoliberal *and* pro-poor.

This atypical enactment of neoliberalism is not unique to South Africa, but, since this research focuses on engineering education in the local context, it is worth briefly describing the rise of neoliberalism in the country in greater detail. According to Ornellasa et al. (2017), following the end of apartheid, the democratically elected African National Congress (ANC) government demonstrated a strong commitment to a transformative and developmental socioeconomic framework, as was evidenced by 1994’s socialist and basic needs-oriented Reconstruction and Development Programme (RDP), which formed the basis of the country’s economic policy. However, in the early years of democracy, South Africa faced pressure from the International Monetary Fund (IMF), the World Bank and local business organisations, and, by 1996, the RDP had been replaced by the neoliberal Growth, Employment and Redistribution (GEAR) policy. Since then, government policy has been largely driven by neoliberal ideals.

However, despite this, there continues to exist within South Africa a tension regarding the responsibilities of the state, particularly given the massive inequality and widespread poverty in the country. Higher education is just one

sector in which this is evident: For example, the 2013 White Paper for Post-School Education and Training (DHET, 2013: xi) lists as one of its policy goals “a post-school system that can assist in building a fair, equitable, non-racial, non-sexist and democratic South Africa.” This indicates an acknowledgement of the role that higher education can play in the social transformation of society; however, evidence shows that the effects of neoliberalism on higher education quash this potential. Education is marketised; it has become a generic commodity to be delivered to the market by the most competitive provider and that is accessible only to those who can afford it (Davies & Bansel, 2007: 254; Allais, 2014: xxii). In fact, Pennington, Mokose, Smith and Kawanu (2017) draw a direct link between neoliberal ideology and policies and the socio-economic conditions that they believe sparked the #Feesmustfall student protests: fee increases, student debt, labour outsourcing and racial inequality.

While this discussion of the societal manifestations of neoliberalism within higher education is relevant in terms of situating the ideological context of this study, for the purpose of this discussion, the focus needs to shift towards how the individual citizen is conceived of within the neoliberal perspective. This is because the focus in this research is discursive identity development. In order to understand how different aspects of the NVP and PCS courses conditioned their students’ discursive identity development, it is necessary to first situate the role of the individual within neoliberal discourse. This can contribute towards understanding more about the kind of engineer that South African engineering education endeavours aim to develop.

Davies and Bansel (2007) explain that, unlike in previous economic systems, in which the welfare state was seen to encourage passive citizens, neoliberalism results in autonomous “active” citizens with rights, duties, obligations and expectations. The theory driving this conception is that neoliberalism provides an enabling foundation that allows individuals to flourish if they are only willing to work hard. As a result, citizens become “active entrepreneur(s) of the self” (Davies & Bansel, 2007: 252) who have an obligation to take responsibility for

their own economic well-being for the ultimate good of the state. This results in what Davies and Bansel (2007: 252) call the “capitalisation of existence itself”, with success being defined as the accumulation of profit and wealth. Within a neoliberal system, citizens are made to believe that they are free subjects who can determine the courses of their lives through their individual choices. Part of this notion involves a responsibility for both collective and individual welfare (Allais, 2014: xxii). As is evident in the discussion that follows, this neoliberal conception of the individual underlies the NVP and PCS courses, both individually and as a pair. I demonstrate that it is in the interest of the macro-structures that condition engineering education in South Africa – ECSA, the higher education sector and industry – to continue producing graduates who buy into the neoliberal discourse. In the remainder of this chapter, I focus on how this is enacted through these two courses.

7.2.1 “Entrepreneur of the self” discourse

One of the CEPs that underpins the very existence of courses on how to start a new venture and how to communicate effectively in an engineering degree is the neoliberal concept of the individual citizen as an “entrepreneur of the self” mentioned above. This implies a notion of self-motivation: Individuals within a neoliberal society need to continually up-skill and improve in order to thrive in a competitive economic environment. This is because, as entrepreneurs of the self, they need to sell themselves within the labour market. For example, in the South African context, where there are too few jobs available for too many graduates, the onus falls on graduates to ensure that they stand out from other potential employees when applying for a job. While this notion of ensuring that graduates are equipped to compete in the global job market may be viewed as a productive principle by ECSA (through its ELOs) and the EBE Faculty and Electrical Engineering Department (through its complementary course offerings, including the NVP and PCS courses), the fact that graduates are able to compete in the job market is clearly compatible with these structures. ECSA’s oversight role in both industry and higher education rests on its credibility, which would be negatively

impacted should graduates be deemed unfit for the requirements of the labour market. Likewise, one of the main ways in which the EBE Faculty markets itself is through the high likelihood of its qualifications leading to employment. This is evident on the “Why choose UCT” website, which states that “Our graduates are highly sought after, with most securing employment before they have graduated” (EBE, n.d.). This is seen as a selling point for the faculty’s degree programmes, in line with the concept of the marketisation of higher education mentioned above.

One of the justifications for “complementary” offerings such as the NVP and PCS courses is that they contribute towards engineering graduates’ ability to fulfil the requirements of the “new engineer” once they enter industry. The “new engineer”, as discussed in previous chapters, is a transformed engineering professional who is distinct from the conventional stereotype of an introverted technophile “engineerd” (Tonso, 2006: 285). The “new engineer” is multi-skilled and can work across disciplines and demographic and social contexts, applying her knowledge and abilities to solve social problems in ways never thought possible just one generation ago. The inclusion of courses such as the NVP and PCS courses demonstrate the EBE Faculty’s commitment to ensuring that its graduates are able to play this role. The NVP course content was focussed on business skills, such as market assessment and operational planning; financial skills, such as drawing up cash flow statements, financial forecasting and basic tax; and legal issues, such as issues concerning intellectual property and the obligations of business directors. Each section was taught by a member of staff from UCT’s business, accounting and intellectual property departments, respectively. Likewise, the PCS course’s content included the creation of written texts such as business plans and posters (which would normally be created by experts in business and graphic design), as well as oral presentations and the development of PowerPoint slides.

The fact that mastering the courses’ content required students to ostensibly become proficient in so many different fields indicates that the Faculty’s goal was

to prepare students to function as “new engineers” once they were in the workplace. This was, as has already been shown, underpinned by ECSA’s dictates regarding knowledge areas and ELOs. However, with a more critical eye, the students being educated to become “new engineers” could be interpreted not as a process of empowerment of the individual but instead as a fulfilment of the neoliberal exhortation that citizens should constantly strive to do more and be more in order to achieve more. It certainly makes financial sense for an employer to hire one multi-skilled engineer instead of an engineer, an accountant, a business consultant, a lawyer and a graphic designer. Furthermore, in the competitive job market, the more skills a graduate has, the more likely he is to find work. Nevertheless, some students did rail against the notion of having to be jack-of-all-trades during the courses: For example, in response to having designed a poster for his group’s new venture in the PCS course, Laurie said that, if he were really starting a business, he would have hired a graphic designer to create the poster (poster interview²¹, 14/4/15).

Nevertheless, this “entrepreneur of the self” discourse clearly underpinned the two courses, and nowhere was this more evident than in the PCS course’s first lecture, which dealt with CVs, and the assessment task that followed this. During the lecture session, the students were told about the importance of creating standout CVs that would represent them to employers in a positive light. Dos and don’ts were shared regarding format and content, and students commented on some CV examples provided in the class handout. Thereafter, Helen introduced the concept of online CVs to the students, with particular focus on LinkedIn profiles and e-portfolios. The slide introducing e-portfolios read as follows:

Jobs are increasingly temporary and one needs a ready record of accomplishments to continue to be employed or under contract. Graduates today need an e-portfolio after graduation to continue their learning and therefore their employability.

(Department of Professional Communication Studies, UCT, 2015c: 53)

²¹ The reference “poster interviews” refers to the brief spontaneous interviews that I carried out with a number of the NVP/PCS course pairing groups as they were showcasing their PCS posters (see Section 5.2.2).

Several phrases within this quote make reference to some of the effects of neoliberalism discussed above: The fact that “jobs are increasingly temporary” and that it is the individual’s responsibility to find ways to deal with this (for example, by having a “ready record” of accomplishments) is an example of this. In addition, according to the quote, students “need an e-portfolio” – which is painted here as a non-negotiable – and an explicit link is made between lifelong learning and employability. That research with employers has shown that human resource managers seldom tend to consult e-portfolios (Ward & Moser, 2008) was not mentioned in the session. Helen showed the students slides of two examples of e-portfolios and then set them the task of creating their own e-portfolios using whichever online software they chose.

The students had nearly three months to create their e-portfolios. The task was scaffolded, and they received initial feedback from Helen after a month. The final e-portfolios indicated that the students had bought into the need to present themselves positively on their sites. They did so by citing favourable personal attributes, such as tenacity and dependability, describing awards and accomplishments and demonstrating their enthusiasm for the field of electrical engineering (Nudelman, 2017c: 222). Moreover, it was this positive self-reflection that made the students report favourably on the task during their interviews with me. A number of them felt that these sites would be useful for them when the time came for them to look for jobs (Kelly, interview 28/5/15; Ravi, interview 28/5/15; Adam, interview 2/6/15); for example, Angela said “...like, the e-portfolio, I’m thinking of just updating mine and making it better and when I apply for jobs, I’m just gonna put it there. Like, follow this link” (interview 8/6/15). That the students found the task so useful indicates that they believed in the importance of self-promotion through innovative means (i.e. via an e-portfolio) and had undertaken to play active roles in marketing themselves to employers.

While the courses promoted the importance of being an all-rounder to the students, with this not only manifesting in the content but also in the texts that the students were tasked with creating, this “entrepreneur of the self” discourse was also particularly evident in the section of NVP that dealt with intellectual property. The specialist lecturer from UCT’s Research Contracts and IP Services Department defined intellectual property as “...creations of the mind: inventions, literary and artistic works, and symbols, names, images and designs used in commerce” (Smith, 2015: slide 7). In his two lectures, he provided the students with information concerning the different ways of protecting one’s intellectual property, such as through trademarks, copyright, regulated designs and patents, and how to develop an intellectual property strategy for a new venture.

At first glance, knowing how to protect one’s ideas would seem vital for any individual who intends to start a business, and it seems reasonable that a course dealing with new venture planning would include this topic, particularly given that engineers work at the cutting-edge of technology, where innovation is key and global competition is fierce. However, the notion of intellectual property is not without criticism, some of which stems from the fact that it is based on the idea of treating information and ideas as ownable property (Kinsella, 2010). Once an idea is ownable, it means that the number of people who are able to benefit from it, either financially or otherwise, is limited. This is because mega-wealthy companies amass patent portfolios, buying patents from inventors and then cross-licensing them to other large companies. In this fashion, individuals are restricted from entering the market, and only large companies can reap the financial benefits of innovation. The argument also exists that intellectual property rights restrict the free flow of information that would otherwise benefit everyone (Moore, 2017): For example, when intellectual property rights are applied to a piece of medical technology, the number of people that the technology can potentially assist is limited, since the free sharing of the technology is curtailed.

By exhorting students to develop intellectual property strategies for their innovations, the NVP course inculcated them into the economic order in which financial benefit accrues only to those who are able to compete in the market. This is in direct opposition to the national Department of Higher Education and Training's (DHET's) main objective for the sector, namely to contribute to building a fair, equitable South Africa (DHET, 2013: 4) as a means of societal redress. In addition, the NVP course's focus on intellectual property tacitly supported the notion of profit as the ultimate goal of innovation. While this is a wide-spread belief – Sami explained that his desire to one day own his own business was strongly motivated by the earning potential of such an endeavour (interview 1/6/15) – recent examples within the scope of engineering show that this is not necessarily the only way to think about innovation. A different approach is evident in free and open-source software (FOSS), which is freely licensed for anyone to use, copy, study and/or change. Similarly, open-source hardware sees the designs and initial specifications of hardware being published and made freely available to the public. These types of initiatives are seen as being for the public good, since they allow more people to benefit from knowledge that would otherwise have been inaccessible. In addition, people can learn from what already exists and find ways to improve upon what has come before. Incorporating this sort of focus in NVP could have been a way of connecting the experience of starting a new venture to the notion of the higher education sector working toward the a public good (Singh, 2001; Dill, 2005; Calhoun, 2006) as discussed in Section 4.3.

While the e-portfolio task within the PCS course provided a platform for students to market themselves to potential employers, the focus on intellectual property within the NVP course was intended to arm students with the legal knowledge they would need to protect their personal proprietary rights to any innovations they may develop when in industry. The content of these two focus areas was completely different, yet the principle underlying both was the strengthening of the graduates-to-be as entrepreneurs of self. Through the PCS course's focus on the creation of personal promotive texts such as CVs and e-

portfolios, and the NVP course's inclusion of intellectual property within its course content, the students were taught to take control of their careers and to push for and safeguard their personal (and, most crucially, their financial) interests. The argument could be made that the purpose of these foci was to equip students to thrive in industry. The convenors of the NVP and PCS courses may have argued that graduates needed to market themselves to potential employees and that it is prudent to safeguard one's innovations, that this is simply the way things work in industry. This claim that the way things are is the only way that things can be directly links to the next discourse that I identified.

7.2.2 Discourse of "inevitability"

ECSA requires that courses taught to engineers include focus on three separately defined spheres: "knowledge", "skills" and "values and attitudes". The belief that curricula can be so neatly divided into three different areas is indicative of what Allias (2014: xx) identifies as the implicit epistemological stance behind most outcomes-based qualification frameworks: the belief that knowledge can be divided up into neat "bits" that can be selected and combined at will, with no recognition of the conceptual relations within and between different bodies of knowledge, as long as they fulfil the requirements of employers. This is a challenging perspective to adopt with regards to ECSA's ELOs as a whole, since it would imply that the accreditation body's focus on outcomes, as opposed to an existing body of engineering knowledge, has less to do with empowering students with skills (as is touted) than with preventing access to bodies of knowledge that could enable them to understand, critique and challenge their current circumstances (Allais, 2014: xxii).

Under the heading of “Learning Outcomes”, the NVP course handout for 2015 (Department of Electrical Engineering, UCT, 2015: 1) states that students completing the course will be in possession of the following attributes:

- A. Knowledge (Information plus understanding)**
 - 1. Understand the process of starting a new venture, including financial and operational and marketing models.

- B. Skills (Application of knowledge)**
 - 1. Be able to recognise good technical opportunities
 - 2. Work in groups of 4-5 for the written proposal and professional presentation of proposal
 - 3. Be able to identify areas of individual competence and show good judgement in design

- C. Values and attitudes**
 - 1. Understand the importance of new ventures to the national economy.
 - 2. Understand the state of mind required to start a new venture. Be on the lookout for business entrepreneurship opportunities.
Work effectively in teams with diverse members

Figure 8: Extract from the NVP course handout

The format in which these learning outcomes have been structured is typical of what Donnelly (2007: 7) refers to as the “check list mentality” of outcomes-based education, which sees course objectives being segmented into isolated components that can be efficiently marked off as they are achieved. Teaching and learning thus become an exercise in simple bureaucracy, devoid of any complexity, subtlety and nuance. This understanding of the educational process was reflected in the pedagogy of the NVP course, which consisted of lectures being delivered to the students by lecturers who were subject experts, with minimal interaction or discussion. This style of teaching is founded on the assumption that the information that is being shared is absolute, since no space was provided for debate or the encouragement of alternate perspectives. In addition, the course schedule reveals that the different sections of the course were ordered in a seemingly arbitrary manner. Table 19 below represents a

condensed version of the course schedule. (The full schedule can be found in Section 5.1.1):

Table 19: Condensed NVP course schedule

Week	Tuesday	Wednesday
1	Introduction to course	Business planning
2	Business planning	Health, safety and environmental protection
3	Business planning	Guest lecturer
4	Financial planning	Guest lecturer
5	Financial planning	Guest lecturer
6	Financial planning	Business planning
7	Financial planning	Risk assessment and management
8	Financial planning	Risk assessment and management
9	Raising funds	Business planning
10	Business planning	Guest lecturer
11	Intellectual property	Intellectual property
12	Business planning	Business planning
13	Best 3 projects presentation	Consolidation

A survey of the table above reveals the disjointed nature of the course structure: Topics changed from lecture to lecture, and the students' feedback shows that, in many cases, this was problematic. For example, Angela expressed her impression that many separate topics were covered in the course – she specifically mentioned marketing, workplace safety, environmental assessments, entrepreneurial skills and risk assessments – without any clear links being made between these sections (interview 8/7/15). Similarly, Vuyo stated that he had stopped attending lectures because he had found it so difficult to determine how the contents of the different lectures were related (interview 28/5/15).

Course structure aside, however, Davies and Bansel (2007) believe that one of the effects of neoliberal education systems is that subjects are constituted in such a fashion as to believe that the present social and political order is inevitable. A survey of the actions required of the students in the NVP learning outcomes discussed above certainly seems to support this view: According to the extract, students are required to “understand”, to “recognise”, to “identify” and to “be on the lookout”. Each of these verbs positions students as passive recipients of what already exists in society. They are not being taught to change the system, reimagine possibilities, challenge the status quo or redefine the field; rather, the focus is on ensuring that, once they graduate, they will be able to operate in society as it already exists. In this way, the practices of the financial, business and marketing sectors go unchallenged in this educational process. In fact, this principle extends to the depiction of the role of the state. The first outcome under “Values and attitudes” above refers to “... the importance of new ventures to the national economy”. This is presented as a fact (note the use of the definite article “the” before “importance”); however, it could be argued that, by placing the responsibility to grow the national economy on individual citizens, the state abrogates its own responsibilities in this regard. When the fact that ECSA is a statutory body created through an act of the South African Parliament is added to the discussion, the learning outcomes quoted above, which seem to encourage the development of engineers into passive participants, rather than critical challengers of the status quo, seem almost like a sinister ploy intended to perpetuate societal replication.

This leads to another aspect of the courses in which this discourse of inevitability is particularly evident: the ubiquity of ECSA’s influence throughout both courses. As was already discussed earlier in this chapter, the NVP test was structured in a manner that was intended to ensure that aspects of ELO 5 were dealt with. This, in turn, influenced the content that was taught in class. Likewise, within the PCS course, the requirement to fulfil ECSA ELO 10 led to the inclusion of a session on ethics and an ethics essay. However, in addition to influencing course content

and assessment, the influence of ECSA is literally evident in all course documentation: For example, the first few pages of the PCS course handout contain information regarding the ELOs and how these are assessed. In addition, the NVP class test was titled “Test on ECSA ELO Outcomes”, with the ELO that each question assessed also directly referenced. The course descriptions for both the NVP and PCS courses in the EBE Faculty Undergraduate Handbook (UCT, 2015: 140–142) reference “NQF credits” and “HEQSF levels”, both of which are likely for the benefit of the ECSA accreditation teams, even though students do typically use the handbook in order to choose courses. By including this kind of technical accreditation jargon in materials relating to these courses, the handbook seems to suggest that decisions concerning their objectives, content, structure and assessment are made in service of ECSA’s requirements.

Similarly, in the PCS lecture on ethics, specific mention was made of ECSA’s Code of Conduct being the guiding document with regards to engineering ethics, and the class discussed the importance of the existence of this regulating document. In the essay that the students then worked on individually, the topic was related to a scenario that raised issues concerning the selection of component suppliers. Students needed to propose an ethically appropriate course of action, using the ECSA Code of Conduct to justify and substantiate their choices. Students were penalised if they did not specifically refer to the Code of Conduct in their essays and were rewarded for effective integration of elements of the Code into their writing (see Section 5.2.2).

This constant reinforcement of ECSA’s role within engineering education did not go unnoticed by the students. Ravi shared his opinion that the reason the Electrical Engineering Department HOD had attended a recent class representative meeting was because he wanted to create a positive impression for the students in the build-up to the upcoming ECSA accreditation visit (focus group, 24/3/15). Likewise, Nosipho was under the impression that, when course marks were generally low, these were adjusted by the Department so that they would be acceptable to ECSA (focus group, 24/3/15). With specific reference to

the NVP course, Paul expressed his frustration that he had had to rewrite the test twice, even though he had passed, because he had failed two of the ELOs and he had therefore not fulfilled the ECSA's requirements (interview 28/5/15).

The on-going references to and incorporation of ECSA into the courses resulted in the students coming to see the existence and functioning of the regulatory body as inevitable. They knew that ECSA accredits their degrees, and, in the PCS course, they were taught that, once they entered industry, they would need to register and abide by its regulatory Code of Conduct. No options were provided regarding alternative professional bodies with which they could align or what the implications of registration were. Despite the focus on ethical practice in the PCS course (as per ELO 10), ECSA's own track record with regard to ethics was not interrogated, even though allegations surfaced in 2010 of racism and irregularities in the process of nominating council members (Slabbert, 2010). These, and similar allegations about ECSA in 2017 (Kilian, 2017), demonstrate that ECSA is not beyond reproach as the industry's governing body; however, a critical approach to the status quo was not encouraged on the part of the students.

This discourse of inevitability that underpinned the NVP/PCS course pairing reflects the effect of neoliberal education systems of "producing docile subjects who are tightly governed and who, at the same time, define themselves as free" (Davies & Bansel, 2007: 249). Under the guise of empowering students with skills and knowledge intended to propel them forward in their careers, the NVP and PCS courses actually simply prepared students to cope in the world as it already exists. More evidence of this exists in the thematic focus of both courses, which entailed the creation of a new venture for profit. In fact, the courses as a whole were very profit oriented: The NVP lecture on balance sheets began with the lecturer explaining that the objectives of a business are to "maximise the owner's wealth", and the goal of accumulating money was implicit throughout both courses. For example, the business-planning lectures focussed on ways to develop "blue ocean strategies" (Martins, 2015), which maximise a new venture's

potential profitability by locating it in an untapped market place, thereby creating new demand. Furthermore, aside from the ethics essay, all of the texts that the students created during the PCS course had the ultimate aim of securing financial investment. The poster, executive summary and presentation all had potential investors as their intended audiences, and even the creation of the e-portfolios, through their stated aims of helping the students to find work, was financially motivated.

It is interesting that the EBE Faculty chose to focus the course pairing on developing new ventures for profit, given the fact that, as mentioned previously, the ECSA ELOs do not specifically refer to this in the Qualification Standards (ECSA, 2012). There were other directions that the courses could have taken: For example, UCT's Graduate School of Business (GSB) offers a free six-week MOOC on Social Innovation ("Bertha Centre: Becoming a changemaker - Introduction to Social Innovation Course", n.d.). This MOOC guides students through the process of identifying a social problem on which to focus and then designing an innovative solution. Similarly to NVP, it seeks to develop "the entrepreneurial perspective" (Department of Electrical Engineering, UCT, 2015: 2); however, it differs in that the ventures it encourages are developed for the benefit of society. For this reason, the MOOC is marketed to "anyone who wants to make a difference".

One wonders how the NVP/PCS course pairing would have impacted on the students had it had a similar social entrepreneurship focus to the GSB MOOC. Perhaps the students would have been more invested in the process of envisioning and creating their new ventures if they knew that their proposals could have a tangible positive impact on society. As it stood, most students felt removed from the process of developing the business plan and, as such, creating the business plan for the NVP course was seen as simply another university task. Angela described the task as "pseudo" in that the financial figures were all made up, and she knew there would be no real repercussions should there be a mistake in the cash-flow statements or projected sales calculations (interview 8/7/15). At the end of the day, she said, she and her fellow group members would "go home

and watch series” and forget about the project. It seems unlikely that this would have been the case had the new venture dealt with real social issues. Already two decades ago, engineering students in the Western Cape who were surveyed about their choice of field of study cited the desire to make a difference to their community and/or country as one of the main motivating factors (Jawitz & Case, 1998). More recently, a desire to make a difference was also evident in the texts that the students included in their e-portfolios created for the PCS course²². Many students referred to their personal objectives of applying the technological skills and knowledge developed during their electrical engineering studies to the betterment of humankind, particularly in areas such as sustainable energy and renewable resources (Nudelman, 2017c). For these students, a social entrepreneurship course may have represented an opportunity to start developing projects that could have fulfilled this personal goal and, at the same time, positively transformed society.

The impact of the discourse of inevitability discussed in this section was that, through the NVP/PCS course pairing, the students were presented with a model of society and taught how to operate within it. There was no encouragement to challenge, transform and improve what already exists, and it was shown that, in this manner, the courses contributed to the replication of the status quo. The representation of the courses as the fulfilment of a list of discrete objectives, knowledge, skills and values presented an image of teaching and learning as uncomplicated. In this sanitised version of the education process, there are no “messy” moments of struggle and confusion for lecturers or students. There is no ambiguity, scope for pushback or protest; in fact, there is no recognition of the humanity of the individuals involved in the process. This lack of acknowledgment of the agents involved in the education process forms the basis of another discourse that I identified in the data, the “one-size-fits-all” discourse.

²² One of this dissertation’s external examiners pointed out what seems like a contradiction between students choosing to study engineering because of the fundamentally neoliberal concept of financial reward (with engineering salaries generally perceived as high), as opposed to their desire to contribute to the betterment of society. This could provide fruitful material for future research.

7.2.3 “One-size-fits-all” discourse

What follows below are the learning outcomes of the PCS course (Department of Professional Communication Studies, UCT, 2015b: 2). The handout states the following:

Students successfully completing this course and its assignments will be able to demonstrate that they:

A. Knowledge (Information plus understanding)

1. understand group theory and dynamics
2. have developed an understanding of professional practice as defined by ECSA and grasp reasons for codes and rules

B. Skills (Application of knowledge)

1. can communicate effectively in written documents, taking into account appropriate structure, style and language for purpose and readership
2. are able to use effective graphical support in both written and oral presentations.
3. are able to provide information for use by others involved in engineering activity
4. are able to execute effective oral communication using appropriate structure, style and language for a target audience
5. are able to use appropriate visual materials, including PowerPoint, video and sound clips, models and flipcharts.
6. are able to develop business plans and proposals
7. have acquired the ability to write a good executive summary
8. are able to write a CV and covering letter
9. are growing in professionalism by indicating an awareness of requirements to maintain continued competence and to keep abreast of up-to date techniques, and understanding the system of professional development as described in ECSA Codes of Practice
10. are able to reason about and make judgment on ethical aspects in case study context
11. can work effectively in teams with diverse members

C. Values and attitudes

1. understand requirements of individual research
2. appreciate ethics of marketing/proposing concepts for work/funds

Figure 9: Extract from the PCS course handout

In the above extract from the PCS handout, it is once again possible to see the segmenting of content into discrete sections and the grouping of these according to the unproblematised categories of knowledge, skills, and values and attitudes.

For example, whereas “work effectively with diverse members” was a “value and attitude” in the NVP course handout, here it is categorised as a “skill”. This is not to say that group work is not multifaceted, but rather to highlight how labels such as “knowledge”, “skills” and “values and attitudes” serve to eliminate complexities to the point that even compound concepts seem common sense and obvious. This is another example of the aforementioned discourse of inevitability.

However, for the purposes of this discussion, I use this extract from the PCS handout to draw attention to the depiction of two particular sets of agents within the teaching and learning process: the lecturers and the students. As is evident in the extract above, there is no mention of who will be doing the teaching or how such teaching will take place. Rather, the outcomes emphasise what the students will be able to do after the course: For example, students “are able to write a CV and covering letter”; however, there is no explication of how they will learn to do this. This phrasing is also evident in the ECSA ELOs: For example, ELO 4 (Investigations, experiments and data analysis) states that students will be able to “demonstrate competence to design and conduct investigations and experiments” (ECSA, 2012: 5). However, as is typical of curriculum documentation, *how* this occurs and *who* will be leading the students to the point at which they can do this are not discussed.

Similarly, while the extract from the PCS handout above refers to “students” generically, there is no reference to the fact that there were 148 individual students registered for the course, each of whom brought different academic, personal and professional experiences to the learning process. Mike, for example, was already an entrepreneur, having started his own business the previous year, while Adam described himself as a “tinkerer” and shared how he was constantly coming up with innovative engineering ideas. During her vacation work, Thina had delivered a formal presentation to her workplace colleagues. Each of these students brought a different set of prior experiences to the NVP and PCS courses, yet the generic nature of the outcomes did not make allowance

for these. The discourse implicit in this is that the teaching and learning experience being offered is “one-size-fits-all”.

This was also reflected in the pedagogy of the courses: The lecture-style NVP sessions meant that students were passive recipients of information transmitted by the lecturers. There was no space for more individualised interaction, which could have been particularly useful for the sections of the course that dealt with financial planning, wherein the mathematical content was new to the majority of the students. Whilst the PCS workshops were longer and took place in smaller groups, providing more space for discussion, sessions were compulsory, and all students’ tasks were assessed using the same rubric. Again, the “one-size-fits-all” discourse is evident in the approaches of the two courses.

However, at a deeper level, it seems as if the references to the generic “student” in both the learning outcomes of the NVP and PCS courses and in ECSA’s ELOs represents a means of masking many complex social issues in the higher education sector. For example, as mentioned above, both the NVP and PCS course handouts mention the outcome of students being able to “work effectively with diverse members”. To achieve this, the business plan task developed in the NVP course and the presentations in the PCS course were framed as group tasks. However, the word “diverse” is used here as a kind of catch-all phrase, without any clarification of what exactly it means in this context: For example, it could refer to students from different countries or students with different areas of personal experience.

More likely, though, “diverse”, as it is used here, is a proxy for issues such as race, gender and social class – issues that are critical within the field of engineering, which is still largely white and male, as was discussed in Chapter 4. Had the course handouts explicitly stated the required demographic mix of each NVP group (for example, one white male, one black female, one Asian and so on), this would likely have been viewed as an unacceptable form of social engineering. Stating that the groups must be “diverse”, therefore, is a nod to the idea of

promoting transformation amongst those who are soon to enter industry, without having to become immersed in the messy, murky issues surrounding identity politics. In addition, the vague notion that students must “work effectively” in these diverse teams is never interrogated: For example, it could simply refer to the requirement that groups complete their tasks on time, or, at a deeper level, it could refer to a process of real listening, connecting and undergoing personal transformation. The meaning of “work effectively” is never stipulated, and, in any case, could likely not be captured in a concisely stated objective.

Another issue that is brushed over in the “one-size-fits-all” discourse (and therefore never explicitly referred to) is the fact that the business-related texts that the students create in both courses were required to be in English. The case can be made that English is the main language of teaching and learning at UCT and that it is the language most commonly used in South African industry, and students therefore need to be skilled in its use. However, this argument ignores the realities concerning students’ varying levels of English language proficiency. While the PCS course learning outcomes stipulated that students would “acquire the ability to write a good executive summary”, this certainly meant different things to different students: English language first speakers are likely to have found that learning to write an executive summary entailed simply familiarising themselves with the format of a summary and inputting the necessary information from the business plans into each section. On the other hand, students who were second- or third-language English speakers and/or did not have adequate schooling in English were more likely to have struggled with such a task. Vuyo, for example, explained that, even after four years at UCT, he still found that, when given an English writing task, he first had to translate it into his home language, process it in isiZulu, then translate it back to English (interview 28/5/15). For him, and most likely many other students, writing a “good” executive summary involved struggling with basic language tasks such as negotiating grammar and spelling and being able to craft an argument through text.

Because of these kinds of inequalities, language is a highly politicised issue within the higher education landscape in South Africa, with Pennington et al. (2017: 31) deeming most university language policies “colonial artefacts”. From this perspective, the notion of providing a “one-size-fits-all” course on (English) professional communication skills to students seems to be ideologically motivated: This is because, first, the PCS course did so to the exclusion of other South African languages, thereby providing fuel to claims that have driven student protest in South Africa in recent years, including that universities are anti-black and stuck in colonial frames (Lange, 2017: 32). Second, in requiring students to read, write and present in English, both the NVP and PCS courses were preparing students to function within what the course convenors clearly believed would be an English-speaking industry. Although this was unspoken, it was implied, and this reflected that the assumptions of course convenors did not extend to the envisioning of workplaces in which other South African languages are used. Finally, the reality for the NVP/PCS course pairing was that students who struggled with English were less likely to attain marks as high as those achieved by students who were fluent. It could be argued that, particularly in the context of communication skills development, the courses privileged those for whom English was a first language. This was despite the fact that, for example, an isiXhosa-speaking student may be a dynamic communicator in her home language.

On the “Transformation” page on the EBE Faculty’s website (EBE, n.d.), it states that the the Faculty is committed to “support[ing], promot[ing] and inform[ing] the unfolding transformation objectives of the university”. A closer study of UCT’s transformation objectives indicates that one aspect of the institution’s strategic plan involves “engaging with African voices” (UCT, n.d.); however, the “one-size-fits-all” discourse evident in the NVP and PCS courses meant that general references to “students” and “diversity” masked complex issues associated with race, background and language. The result of this was that, during the courses, in direct contradiction to UCT’s strategic plan, African voices

were literally disadvantaged, as these courses were harder for them and, if they received low grades, could bring down their averages. In addition, if these two courses were seen as intended to prepare students for the workplace, one can imagine how a student who struggled with the PCS course and the written NVP component must have felt about his upcoming entrance into the profession: It must have been very dispiriting for him to be told how important communication skills are while, at the same time, receiving negative feedback on his efforts. While the aim of these courses may have been to furnish students with tangible workplace skills, the “one-size-fits-all” discourse evident in their goals, pedagogy, assessment and content meant that many strategies that have been demonstrated to stimulate a deeper approach to learning, such as lecturer involvement, commitment and real interest in the students (Ramsden, 2003: 74), were not evident. How this contributed to conditioning the agents’ actions is the focus of the final section of this chapter.

7.2.4 Situational logics arising from the relationship between the cultural emergent properties

The three discourses discussed in the sections above – the discourse of the “entrepreneur of the self”, the discourse of inevitability and the “one-size-fits-all” discourse – represent the main CEPs that emerged from my analysis of the NVP/PCS course pairing. I argued that that these are all underpinned by neoliberalism, which Metcalf (2017) describes as having shaped society into a universal market and human beings into profit-and-loss calculators. For this reason, the three CEPs are concomitant complementarities, as they feed into one another, thereby supporting and strengthening the underpinning ideology. For example, the “one-size-fits-all” discourse, which was evident in the manner in which the PCS course taught the same set of workplace texts in the same way to all of the students enrolled in the course, irrespective of their previous experiences, English proficiency or plans for the future, was indicative of the belief that there is only one correct way to way to employ these skills in the workplace. This, in turn, supported the discourse of inevitability in that students

learnt that there are set right and wrong ways of communicating within the workplace and that they needed to replicate these if they want to succeed. Furthermore, the notion that students need to do whatever it takes to succeed is part of the “entrepreneur of the self” discourse, as a result of which the students learnt that they had to constantly add skills and knowledge to their employability arsenals, as it was their personal responsibility to propel themselves forward in their careers, both for their own benefit and for that of the country.

Concomitant complementarities have a strong tendency towards morphostasis. This is because the CEPs are mutually reinforcing: Because of their consistency, they clarify, confirm and vindicate one other (Archer, 1995: 234). The resultant situational logic “stimulates nothing beyond cultural embroidery” (Archer, 1995: 236) because the CEPs serve to strengthen one another, resulting in ideational systemisation, density (whereby what already exists deepens in complexity as it is further reinforced), protection and reproduction. Indeed, this was already evident in the NVP and PCS courses in the manner that, through the discourses identified above, both sought to replicate the engineering industry as it already exists by preparing students to seamlessly move into this environment without challenging or disrupting the status quo. Because of a lack of challenge being presented by competing, contradictory CEPs, adherents to concomitant complementarities are unlikely to have their beliefs challenged in any way and are therefore not confronted with ideational problems. This means that they tend to replicate what has occurred before (Archer, 1995: 236). In the case of this research project, with its focus on the development of discursive identities of engineering, this situational logic of protection is relevant to the extent that it constrains the likelihood of the morphogenesis of student agency and the prospects for identity transformation.

7.3 Conclusion

The goal of this chapter was to determine how the SEPs and CEPs within the NVP/PCS course pairing conditioned the development of discursive identities on

the part of the electrical engineering students. It was concluded that the situational logic of protection between the EBE Faculty and the Electrical Engineering departments meant that the relationship between these two structures was unlikely to change in any way. In contrast, the situational logic of pure opportunism evident in the relationship that exists between the EBE Faculty and the PCS Department, as well as that between the Electrical Engineering Department and the PCS Department, meant that there was scope for potential reconfiguration and, therefore, morphogenesis. With regards to CEPs, it was shown that the three main discourses underpinning the content, pedagogy and assessment of the NVP and PCS courses had relationships with one another that were characterised by concomitant complementarities. This was evidence of how densely consolidated these discourses were, which reduced the likelihood of agential morphogenesis, which, in this dissertation, has been theorised as being one of the key components in the discursive identity transformation implied in the concept of work-readiness.

In addition, in response to my second research sub-question, this chapter identified the pedagogic characteristics of the NVP/PCS pairing that contributed towards this conditioning of discursive identity development. Some of these characteristics included the impact of the ECSA ELOs on all aspects of the courses, including materials, content and assessment tasks. The notion of group work, which was a requirement of both the NVP and the PCS courses, was discussed, as well particular assessment tasks, including the ELO test in the NVP course and the e-portfolio, ethics essay, poster and summary in the PCS course. I demonstrated that there was an emphasis on the students developing knowledge and skills above and beyond those required by technical engineering curricula throughout these courses. Since the objective of these courses was to prepare students for the workplace, this emphasis on complementary knowledge shows that, for the course convenors, the Electrical Engineering Department, the EBE Faculty and, indeed, UCT, industry represents a world in which students will need to use their personal drive and motivation to stand out from other job-seekers and workers. This is both sanctioned by ECSA through its accreditation

of this electrical engineering programme and actively promulgated through its ELOs, which were shown in the discussion above to encourage passive participation in industry rather than critical innovation and boundary-pushing. This chapter opened with two quotes from students showing contrasting reactions to the NVP/PCS course pairing; it was noted, however, that these responses were located in Bhaskar's domain of the empirical. In the following chapter, I intend to engage with the domain of the real as I delve in greater depth into the ways in which seven students responded to the courses and the extent to which the situational logics highlighted in this chapter were borne out in reality.

8. The social interaction phases: agency

Following their completion of the Professional Communication Studies (PCS) course, the students completed course evaluation forms. The forms included a number of questions based on a Likert scale of 1-5, with 5 being “strongly agree” and 1 being “strongly disagree”. The final question on the form was “Has participation in PCS and NVP helped prepare you for your future career?” It is interesting to note that, despite the divergent opinions expressed regarding the courses in the open-ended question that followed, 86 percent of the students strongly agreed with the question, while only 1 percent strongly disagreed.

This gives an indication of the students’ positive response to the course pairing. However, quantitative data such as that collected in the course evaluation survey is far better suited to identifying trends and correlations than the deep explanatory critique required in a critical realist (CR) study (see Section 3.1). The statistic above offers no insight into what it was about the course pairing that the students felt had prepared them for the workplace. This chapter aims to address this issue by dealing with the third research sub-question of my study, which is concerned with the constraints and enablements that students encountered in their development of discursive identities as engineers during the New Venture Planning (NVP)/PCS course pairing. While the previous chapter outlined the “parts” of the morphogenetic cycle through an analysis of the structural emergent properties (SEPs) and cultural emergent properties (CEPs) that existed in the interaction phase (T2-T3) of the NVP/PCS course pairing, this chapter’s focus is the “people”. This is, of course, vital to any social realist (SR) study, as the development of an explanatory, analytical narrative of emergence relies on an examination of the intertwining of both of these elements, the “parts” and the “people”.

Since this study links the concept of workplace readiness to identity transformation through the conceptualisation of students developing discursive

identities as engineers, its focus is on the ways in which the students under investigation changed (or did not change) during the course pairing. This is due to the fact that both courses explicitly set out to prepare their students for industry. As was shown in the previous chapter, this was not only evident through their course objectives (Department of Electrical Engineering, UCT, 2015; Department of Professional Communication Studies, UCT, 2015a) but also through their curricula, methods of assessment and pedagogy, which were underpinned by the Engineering Council of South Africa's (ECSA) exit-level outcomes (ELOs) and, at a deeper level, by neoliberal perspectives on education, labour and the role of the individual. Thus, the process of developing an analytical narrative of emergence, which is both the objective and the product of SR research (Archer, 1995: 343), requires focus on the students themselves and, in particular, the transformations that they (may have) undergone as they acquired their social identities, which, if the NVP and PCS courses fulfilled their objectives, involved embodying the role of an engineer as social actors.

Section 2.4.2 provided an overview of Archer's (1995, 2000) theory of morphogenesis of personal and social identity. Through a discussion of human beings' three emergent strata (person, agent and actor), it was shown that the relationship between personal and social identity is dialectical. This is because both are emergent and distinct, even though they contribute to one another's emergence and distinctiveness (Archer, 2000: 288). The process whereby humans become "successful subjects" (Archer, 2003: 296) who have managed to attain both personal and social identities by first finding a role in which they found it worthwhile to invest themselves and then personifying it in a unique manner was also shown to be the outcome of a morphogenetic cycle, the endpoint of which, at T4, was the "elaborated 'You' – PI +SI" (Archer, 2003: 296). Translated to the context of my research project, this means that, if the NVP/PCS courses achieved their aims, at T4 of the morphogenetic cycle of this study, the students would be social actors who had embraced and embodied their roles as engineers.

Another way in which Archer (2000: 295) represents the acquisition of social identity is as movement through four quadrants. This is depicted in Figure 10 below:

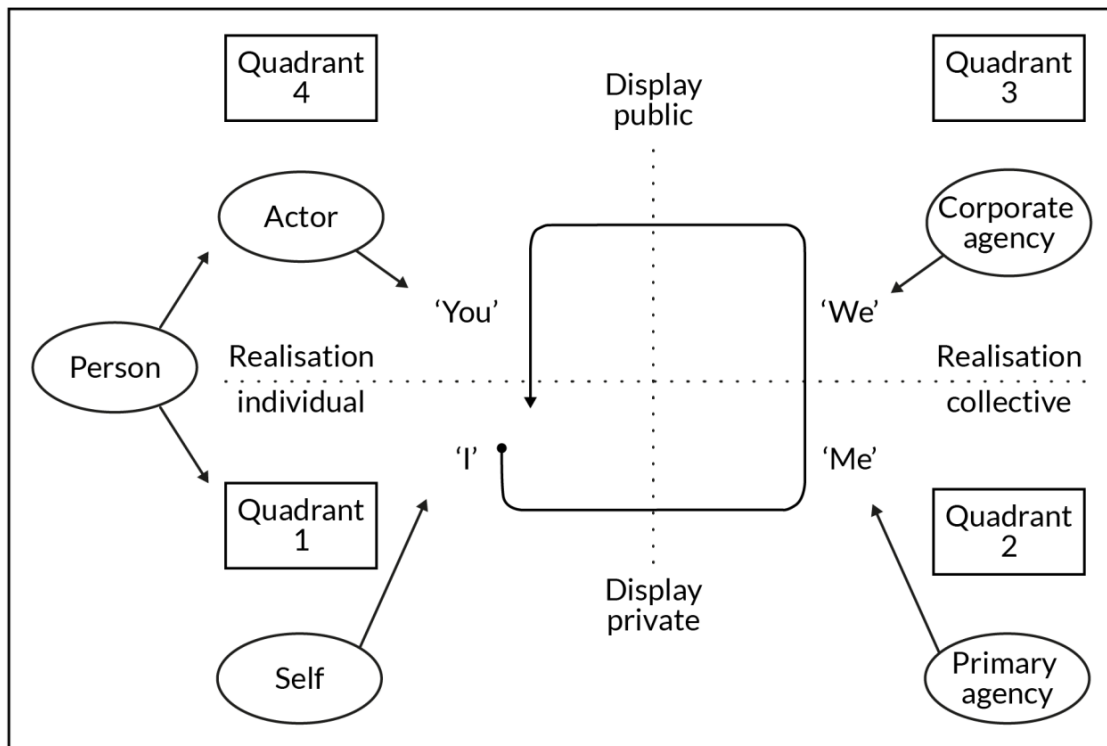


Figure 10: The acquisition of social identity (Archer, 2000: 295)

What this depiction makes explicit is the fact that movement through these quadrants is unending and that, as human beings, we may be operating in different quadrants concurrently in different spheres of our lives. For example, it was highlighted in Chapter 6 that the students who participated in the NVP/PCS course pairing were primary agents because they lacked a say in determining structure and culture and the only way in which they could influence the courses' structures, pedagogies, assessments and materials was through their impact as a group. (For example, the fact that there were 148 students would have influenced decisions concerning pedagogy and assessment). As such, according to Figure 10 above, they would be operating in quadrant 2. However, as well as being primary agents in the course pairing, many students were also corporate agents (operating in quadrant 3) in other parts of their lives: For example, Angela

was an executive committee member of the UCT branch of the Namibian Society on campus, a student group intended to promote the wellbeing of Namibian students enrolled at the university. Furthermore, some students may even already have been social actors (in quadrant 4) outside of the university space. An example of this was Mike, who had started his own solar energy business the previous year and, despite being a full-time student, was entirely committed to his role as an entrepreneur business owner. It would even be possible to assume that some students found the role of “student” to be the role with which they chose to identify and actively personify in a particularist manner. These students may have decided that they wished to stay on at university once they graduated in order to study towards their master’s and PhD degrees; they would thus become social actors by dint of their commitment and embodiment of the role of “student”.

The acknowledgement that the students in this study concurrently embodied multiple roles in different quadrants is vital for two reasons: First, it reinforces that the distinctions between different strata of humans are temporal and analytical. As humans, we are, of course, all complex beings, and Archer’s theories are, as she calls them, “analytical contrivances” (Archer, 2000: 299) that allow us to devote our selective attention to particular research problems. Second, the only way to understand the unification of the multiple roles that a student occupies concurrently is through acknowledging that each person must have a unique personal identity. This is our “continuous sense of self” (Archer, 1995: 282) that anchors any roles we may embody as agents or social actors. It is as persons that we utilise our personal emergent properties (PEPs) in the pursuit of our projects, weighing up constraints and enablements with the understanding that the decisions that we make today will impact our tomorrows.

It is this emphasis on the importance of personal identity to the emergence of the social actor that guides the remainder of this chapter. This is because the research sub-question regarding the constraints and enablements that students encounter in their development of discursive identities as engineers can only be

answered through a focus on students as “persons”. While the SEPs and CEPs that condition agency were dealt with in the previous chapter, this research still needs to make an allowance for the “enchantment of being human” (Archer, 2000: 318), which is the fact that, fundamentally, despite the advantages and penalties involved in adhering to conditioning, people are capable of unpredictable actions due to their PEPs (Archer, 1995: 195). It is for just this reason that Archer (1995: 343) calls for the inclusion of “analytical narratives”, since it is only through narrative that a researcher can recognise “the intervention of contingency and the need to examine its effects on the exercise or suspension of the generative powers in question”. What follows in the remainder of this chapter, therefore, are a number of analytical narratives, represented as vignettes describing the experiences of particular students who, during these courses, exercised their PEPs in order to mediate the conditioning influences of the SEPs and CEPs described previously. The intention is that these vignettes will provide greater insight into facets of the students’ personal identities, which, as discussed above, will be vital in developing an understanding of how (and indeed whether) they became social actors at T4.

8.1. Paul: “Sometimes you just need to stand out”

In Section 6.2.1, I discussed the conflicting CEPs associated with the dual role that students enrolled in the NVP/PCS course pairing inhabited, namely those of being both senior students and professionals in training. I reached the conclusion that the constraining contradictions in the relationship between these CEPs was conducive to morphogenesis because it required the students to find ways in which to effect union between these conflicting roles and that, although the manners in which they achieved this would differ according to the individual students, some degree of transformation was inevitable. In the discussion of personal identity above, I demonstrated that it is the students’ unique personal identities, their PEPs, that serve to differentiate how they embody the ideational syncretism conditioned by these constraining contradictions. In this section, I

focus on the PEPs that Paul enacted in his process of negotiating these conflicting roles during the NVP/PCS course pairing.

Paul's feedback regarding both the NVP and PCS courses was positive. With regards to NVP, he felt that it was a "great experience" (interview, 28/5/15), specifically because of the potential application of the course material to his future goal of owning his own small business. In particular, he believed that the focus on financial matters, such as cash flows and balance sheets, was important since it would help him handle money in a more professional manner. Similarly, he felt that the PCS course had taught him aspects of professionalism that he truly needed as he faced his graduation and imminent entry into industry, such as how to behave during a job interview and how to speak professionally. According to him, these skills were absolutely vital for the workplace; as he put it, "if you go out there without any of these, you're really gonna slack" (interview, 28/5/15).

Yet, despite these positive reviews of the course pairing in general and his explicit expression of how important he believed the skills taught in the courses to be, Paul clearly struggled to reconcile himself with what he believed were the low marks he received for both courses. This was the case for several of the assessment tasks: For example, he explained that, for the PCS e-portfolio task, he had used all of Helen's feedback on his initial submission as a checklist when preparing his final e-portfolio, ticking off each of her comments as he addressed them. However, he only received 68 percent for the task, which he found disappointing. With regards to the poster, he was assigned the roles of designing the poster and unifying the separate contributions of various group members by his group. The group received 63 percent for the poster, which was the second-lowest mark in the class, and Paul felt both responsible for this and somewhat despondent, given how long the task had taken. With regard to the NVP ELO test, Paul passed, but he failed two of the ELO-based questions, despite stating his certainty that he had written very similar answers to those of some of his classmates who had passed these questions.

These examples show Paul grappling with, on the one hand, his burgeoning professional identity, which saw him appreciate the focus of the curricula of the two courses and, on the other hand, his student identity, which was disappointed that his enthusiasm was not reflected in the form of marks that he felt justified his hard work. However, he was able to mediate between these two to reach the conclusion that “You know, sometimes it’s, although you have certain expectations, and they don’t come out how you want them to, for me I know sometimes I become really happy, even if they don’t come out as I expected, because I learnt from that, you know what I mean?” (interview, 28/5/15). Paul was able to overcome his disappointment with his marks through his PEP of resilience, which for him was buoyed by the knowledge that what he had learnt was going to be of use to him when he entered the professional world.

Archer (1995: 187) states that “a person occupying a particular role acquires vested interests with it and is both constrained and enabled by its ‘do’s and don’ts’ in conjunction with the penalties and promotions which encourage compliance”. For Paul, the vested interests involved with being a senior student were grades. Since good marks are, within a university space, the reward for good academic work and bad marks punishment for poor academic work, marks can serve as both “penalty and promotion”. The vested interests involved in being a professional in training are, however, different. With regards to his vested interests, Paul was thinking about much longer range projects, such as his desires to eventually have a successful career in the robotics industry, to start his own business and to be able to contribute financially to his mother and younger sister (focus group, 25/3/15). For him, compliance with the course pairing, which manifested in acceptance of their curricula as vital for the workplace and of the pedagogy and assessment as, if not perfect, then at least adequate, was more beneficial to him. This accounts for his positive response to the courses, despite the fact that he was disgruntled as a result of the grades that he received.

Paul thus found a way to moderate between his conflicting roles as senior student and professional in training in a manner that embodied his PEP of career ambition. However, he did experience a “moment” where these two roles were in synch: In the same semester as that in which he was enrolled in the NVP/PCS course pairing, Paul had also taken a course called Engineering Design (ED). As one of the tasks for ED, he and his group were required to present a poster depicting their work. He decided to use wix.com, the software he had learnt about in the PCS course and used to create his e-portfolio, to extend the ED poster presentation. Instead of the normal cardboard poster expected, Paul created a website for the lecturer to engage with. He was aware that this was taking the task “a step further” (interview, 28/5/15), but his decision paid off, and he received 100 percent for the task. In fact, at the end of the semester, he discovered that his overall mark for the course was 90 percent, meaning that he had received the highest mark in the class.

Two things stand out about Paul’s experiences that are relevant to this discussion: First, his use of wix.com to create a website demonstrates that he applied the knowledge and skills that he had been introduced to during the PCS course and had practiced through one of the assessment tasks (the development of an e-portfolio) in another course. This seems to support the conception of “neat” learning transfer (as discussed in Section 2.1) that this study avoids through its theorisation of workplace readiness as a form of discursive identity development; however, there is evidence to indicate that his use of wix.com was more than simply the application of a decontextualised skill. Rather, his choice to create a website instead of a poster was closely tied to who he was as a person: It indicated his PEP of bravery in his willingness to take a risk; had his lecturer not liked the idea, he could have been penalised for creating a website or even failed outright for not conforming to the task. It highlighted his desire to show himself as being cutting edge (hence the choice to create a website rather than a cardboard poster). It showed how his PEP of creativity gave him the ability to distinguish his assignment from those of his classmates. Thus, examination of how he applied what he learnt in PCS clearly entailed more than “neat” skills

transfer and, in this way, adds credence to my argument made in Section 2.3 of learning as a process of becoming. Paul's creation of a website for ED demonstrates how he enacted his developing discursive identity.

Second, Paul stated that his decision to create a website instead of a conventional poster for ED and the subsequent affirmation that he received for this decision in the form of the high mark that he received taught him that "...sometimes standing out is really important" (interview, 28/5/15). While this would not be deemed as a written or oral communication skill, and it certainly is not mentioned in the ECSA ELOs, it is interesting to consider how vital the PEP of being able to stand out from the crowd can be in the professional world that the NVP/PCS course pairing was intended to prepare students for. This was particularly the case given the two courses' entrepreneurial focus, the purpose of which was to provide students with the means to ensure that their products stood out from others that already existed and to create texts concerning these that were distinctive and therefore impactful. Paul's realisation regarding the benefits of standing out from the crowd occurred in a moment in which his identities as a student and a professional in training corresponded, since he was awarded high marks for pushing the boundaries beyond what was conventionally expected of a student. This taught him the importance of differentiating oneself from others, a realisation which is far more significant than merely the accumulation of a tangible skill.

Paul's experience of the NVP/PCS course pairing provides one example of how students negotiated the dual roles of student and professional in training. As ideational syncretism occurred for him, emphasis was clearly on the latter role, given that his main "take-homes" from the courses related to skills that he believed would be of use to him once he was in the workplace. However, when he encountered synthesis between these two roles in the form of receiving high marks for an innovative approach to an academic task, it was a significant moment of learning for him. Fundamentally, NVP and PCS were academic courses like any others in that they required students to complete tasks for

assessment. However, the fact that these sparked Paul's PEPs of resilience, ambition, creativity and risk-taking meant that he moved beyond purely rational exercises of knowledge and skills to drawing strongly on, and indeed impacting on, his personal identity.

8.2. Yasin: "As a group, we knew we'd make it eventually somehow"

Figure 10 above provides a graphic representation of the four quadrants that agents move through in the acquisition of social identity. It depicts the progression from person to primary agent, corporate agent and then to social actor, which is the point of synthesis between personal and social identities. I stated previously that the students enrolled in the NVP/PCS course pairing began as primary agents in the context of the courses, given that they lacked a say in fundamental decisions concerning structure, curriculum or assessment practices. However, I argue that the group work focus of the courses meant that a number of the students operated as corporate agents; Yasin's group is an example of this. In this section, I show how Yasin was, during the course pairing, part of a group of corporate agents and how this impacted his personal and social identities. In the process, the conditioning effects of the SEPs and CEPs are highlighted, and the ways in which he used his PEPs to negotiate these are outlined.

Yasin's group for the NVP/PCS course pairing consisted of him and three of his good friends – this was made possible by the fact that students were allowed to pick their own groups for the new venture project. These four students were a subset of a larger group of 12 students who had worked together since their second year in the electrical engineering degree programme and had come to rely on each other. The group studied for tests and exams together, collaborated on projects and assignments and spent a great deal of time together socially. Having the support of his group meant that Yasin had been able to adopt a fairly lackadaisical approach to his studies: If he missed lectures or pushed deadlines,

he knew that his fellow group members would be able to help him, so he did not put too much pressure on himself academically. The group members had been working together for such a long time that they had slipped into patterns of cooperation. As Yasin explained, "...by now you know exactly, everyone in the group, you know how they're gonna work, what they're gonna do, who to go to for this, who to go to for that" (interview, 17/7/15).

Because of his PEP of trust in his fellow group members, he was able to rationalise a relaxed attitude towards his studies, and this carried over into his work on the NVP/PCS courses. He seldom attended NVP lectures (since he knew his friends would help him catch up any missed content) and admitted that he did not put as much effort as he could have into his PCS presentation – he and his group had decided not to show up for their rehearsal presentation. Yasin was unique amongst my sample of students in this approach to his course work and to the degree in general. For all the other students who were interviewed for my study, academic pressures were overwhelming, trumping focus on any other aspects of personal or social life. Yet Yasin was adamant that he was not a "typical engineer...who works all the time. Doesn't go out. Is nerdy. Is into anime and Pokemon and all that stuff" (interview, 17/7/15). The support of his group had given him space to continue to pursue his passions for cars and cricket and to engage in private tutoring for high school mathematics and physics students, as well as to enjoy socialising and getting up to "crazy things" (focus group, 5/3/15) with his fellow group members.

For Archer (2000: 302), establishing one's status as a corporate agent involves monitoring one's commitments and determining how one will stand and with whom in pursuit of the attainment thereof. Yasin and his group members were corporate agents in the NVP/PCS context by dint of their active choices concerning the commitment they were willing to make to the courses and how they worked together. This was especially evident through the example of the business plan assignment for NVP. The new venture that Yasin's group chose to

focus on for this project was a product called the “VapeVoid²³”, an electronic cigarette (e-cigarette) with an embedded monitoring device intended to allow for the recording of information such as puffs per day and nicotine consumption. This information would be uploaded via Bluetooth to an app through which the data could be accessed, interacted with and shared via social media. The aim was to allow smokers to exercise better control over their habit, ultimately contributing health benefits to the user.

When Yasin’s group submitted their initial product proposal to Prof. Harris, he dissuaded them from following through on the concept because he believed that there was no space for another e-cigarette in the market. However, three of the four members of Yasin’s group smoked e-cigarettes, and one had worked for a company that sold a similar product, so they were certain that there would be a market for their new, hi-tech version of the product. They thus ignored his advice and continued working on their full business plan for the VapeVoid. Because of their interest in the product, they put more work than they usually would into developing the business plan. Each student was responsible for a section of the business plan – Yasin focussed on marketing – and they then combined these different sections to form a cohesive document. The product proposal was a very comprehensive 61-page document outlining all of the aspects of the new venture, including a product description and market, financial and operational plans. Despite putting in this effort, however, the group received a mark in the low 50s for their business plan. Again, the minimal feedback that they were given was that there was no market for the VapeVoid, and, as such, the business could not be a success.

The feedback they were given as justification for their low mark reflects the influence of the neoliberal-based CEP of the discourse of inevitability, as a result of which students were prepared for how to survive in the business world as it is, not as it could be (see Section 7.2.2). Since Prof. Harris determined there was no

²³ I have changed the name of the product for the purpose of this dissertation.

current market for the product, it was deemed that Yasin's group's new venture would not be a success, without any consideration of how demand could transform over time. This seems contrary to the notion of "blue ocean strategies" (Martins, 2015) taught in NVP, which encouraged students to find untapped markets in order to create new demand for their products. In addition, the necessary incompatibilities between the SEPs of higher education and industry mentioned in Section 6.1.3 are embodied in this example: It seems as if, when it came to evaluating the business plan, for Prof. Harris, the perceived lack of the market potential of the VapeVoid outweighed the more academic requirements of the task, such as structuring the document effectively, including well-developed arguments and fulfilling the requirement to reference sources. While the relationship between these two SEPs was alluded to in Chapter 6 in relation to the macro-context of engineering education, this is a clear example of the enduring nature of the conditioning influence of SEPs at multiple levels.

However, with specific regard to Yasin and his NVP/PCS group, what was telling was their responses to their low mark: Yasin explained that, while they were disappointed with the mark, "we actually didn't take his feedback seriously, 'cos we know that if we were to do this it would work, so that's all that counts" (interview, 17/7/15). He later said of Prof. Harris that "I just think he wouldn't understand it because he doesn't know the market, for example. Like, he said there was no market for it, but how would he know?" (interview, 17/7/15). Through statements such as these, Yasin showed how he and his group subverted traditional top-down educational models wherein the lecturer is seen as the font of all knowledge and the students as striving to attain the same level of knowledge. Instead, Yasin and his group believed in their work, despite a lack of affirmation through initial feedback and marks. Thus, upon re-evaluating their attitudes to the task, the students' PEPs of confidence in their idea took precedence over the conventional notion of the lecturer as an "expert".

This directly reflects the notion of corporate agents as groups of people who are "aware of what they want, can articulate it to themselves and others, and have

organised in order to get it” (Archer, 1995: 258). Yasin and his fellow NVP group members chose to proceed with a project that they believed in, despite the fact that they were aware of Prof. Harris’s scepticism. They worked towards the project, systematically focussing on their individual sections of the business plan and then unifying them in the form of one document. Although the mark they received was low, once the project was over, they were satisfied because they believed in what they had done. In spurning high marks and belief in the expertise of the lecturer, these corporate agents transformed the traditional role of the student in an act of double morphogenesis (as described in Section 2.5.2), shifting the markers of student success from achieving high grades to sticking to one’s principles. This represented a new approach to being a student, which could be attractive to other students who had struggled to adapt to conventional academic discourse.

Yasin’s feedback regarding the course pairing was circumspect. While he did not find that they had significantly altered his perceptions or taught him knowledge that would guarantee his success as an entrepreneur, he did find them worthwhile, particularly with regards to starting a business. To this end, he said that the value of the courses was that they “...made you think about it ... it’s there in your head so that if you really want to pursue it one day, you know where to look or you have a rough idea how to start. So, then you’ll know what to do or what more to research, to put more effort into it” (interview, 17/7/15). On the surface, this seems to indicate that the courses contributed to the ECSA’s requirement that engineering programmes provide “a viable platform for further studies and lifelong learning” (ECSA, 2012: 3), thereby demonstrating an example of compatibility between ECSA and higher education as SEPs. While this may be the case, at a deeper level, the fact that Yasin’s main takeaway from the course was raised awareness shows that he not only endorsed the interpretation of the role of “student” developed by his membership of his corporate agency group but that he actively personified it (Archer, 2000: 303). This is because he did not articulate that the courses had fulfilled the traditional academic goals of imparting knowledge or improving skills, which would be the effective outcome

of what is referred to throughout this dissertation as the “transfer metaphor” (see Section 2.3); rather, in his assessment, the value of the courses lay in simply alerting the students to the fact that the knowledge and the skills that were covered existed “out there”, leaving it up to them to decide whether/how they wished to engage with that knowledge. This view of students having agency to make decisions concerning when, where and how to access knowledge is in synch with the alternate interpretation of the role of student espoused by Yasin’s corporate agency group.

This was further reinforced for Yasin during his vacation work experience at a diesel engine dealer in the semester following the NVP/PCS course pairing. While he was not familiar with the technical material that was dealt with in the project he was working on, since he knew he needed to master it, he spent time researching on his own and was able to develop his knowledge. This meant that he could engage with his colleagues concerning work matters, and he even shared that, at one point, he was so confident that one of the company’s clients did not realise he was a student when interacting with him (interview, 17/7/15). Thus, the strategy of choosing when and how to engage with the knowledge that he had adopted as a student was effectively implemented in the workplace. This provided him with further affirmation of his academic choices. Both his experience at university and that gained during vacation work drew on the expanded role of student generated by his corporate group and, as such, it is clear that there was alignment between his social and personal identities.

8.3. Angela: “Right now, there isn’t really much time to learn about yourself”

As I discussed above, the acquisition of social identity as conceptualised in Figure 10 is an on-going process. Since emergence as a social actor indicates a “moment of synthesis between personal and social identity” (Archer, 2000: 293), as people move between groups of agents and social roles, they constantly reflect on their choices, revisiting their commitments and deciding whether they are willing to

re-endorse and to re-commit to their role commitments (Archer, 2000: 303). Through this process, a person may find that his personification of roles is no longer a performative expression of who he is, either because the role in question may have changed due to the activities of corporate agents or because his own concerns may have shifted. This process of reflection is thus vital in the morphogenesis of agency because it is a way of establishing whether an individual's personal identity can be expressed through a particular social identity. It thus impacts whether he becomes/remains a social actor. My analysis of Angela's interview data in the following section indicates the potential value of such spaces for reflection within the educational processes through a discussion of her experience of the NVP/PCS course pairing.

Angela explained that her approach to NVP had been much the same as her approach to most other courses in her electrical engineering degree programme: While she appreciated the aim of the course and agreed that teaching students how to start businesses was a useful goal, she felt that, like so many other courses she had completed, "...the end of the day it's just a lot of theory that's thrown in your face. And if you can take that theory, absorb it, and put it on a paper, then you pass" (interview, 18/6/15). Some examples that she gave to support this claim included the fact that there was no interaction between students and lecturers during class, the fact that the lecturers' slides contained all of the information that was necessary meaning that students did not really need to engage in the sessions and the fact that the final assessment for the course took the form of an exam. While the content of the NVP course may have been, according to ECSA, "complementary material", the pedagogic characteristics of the course were the same as the more technical engineering courses offered in the degree programme.

This fed into Angela's experience of the electrical engineering degree programme as a whole. At school, she explained, she had had a wide range of interests, including singing, drawing and creative writing (focus group, 25/3/15). However, once she started her degree, she had quickly learnt that there was

simply no time for such pursuits: If she wanted to pass, she needed to spend all of her time working. This had been a great loss for her, as she felt that, in having to give these activities up, she was suppressing her PEP of creativity and stifling other PEPs that made her unique. This happened, she said, because the Electrical Engineering Department just wants to “produce engineers” (interview, 18/6/15) and is not concerned with encouraging self-development in non-academic realms. This is very much indicative of the effects of the “one-size-fits-all” discourse highlighted as a CEP in Section 7.2.3, which were shown to condition an environment of constrained possibilities in terms of agential morphogenesis. The result of this was that NVP was just another experience of “the typical EBE thing of, just get your pass” (interview, 18/6/15).

Her experience of the PCS course had, however, been different because she felt that it had provided her with opportunities to re-connect to who she was as a person. One of the main ways in which it did so was through its assessment strategy: Because there was no exam, Angela was able focus more fully on the various assessment tasks. She liked that the CV and the e-portfolio tasks had presented her with opportunities to express who she was as a person. In this manner, the CEP of the “entrepreneur of the self” discourse, which was discussed in Section 7.2.1 as a key ideology underpinning the NVP/PCS course pairing, provided Angela with an opportunity to reconnect with herself as a person, to reflect on her experiences over the past few years and to decide how to portray these to a wider audience. She also highlighted the PCS course’s small-group exercises, specifically the discussion concerning a morally challenging scenario in lecture 2 and the built environment-situated negotiation role-play exercise in lecture 3 (see Section 5.2.1 for the full course outline), as having helped her to learn more about herself. By being put in a situation in which she had to articulate her ideas to the group, Angela said that she had not only become more aware of her opinions and beliefs but had also developed her PEP of confidence in that she learnt how to communicate her perspective. This, she said, would be very important in the workplace, where she expected that she would not simply need

to follow instructions but to take stances on important issues and articulate these to her colleagues (interview, 18/6/15).

As well as valuing the opportunity to formulate and express her opinions that the interactive nature of the PCS course afforded her, Angela also specifically emphasised the benefit she had gained from listening to her classmates. She explained that, on a social level, this was enlightening because, even three and a half years into the degree program, there were many people in the class whom she did not really know (interview, 18/6/15). This supports the assertion that the majority of the students enrolled in the NVP/PCS course pairing remained primary agents throughout the courses and, indeed, the degree program, and that this lack of social integration indicates that they were most likely not working together as corporate agents in the pursuit of a goal. Angela enjoyed finding out more about her fellow students through the class engagements in the PCS course. However, the social isolation that Angela experienced as part of her studies extended beyond the classroom: According to her, most courses simply taught the students to “work, calculate, design this, and then you’re done for the day” (interview, 18/6/15), without encouraging them to consider the social impact of the work that they did. Her sense was that, although they learnt the technical knowledge required to implement engineering projects, they were seldom (if ever) encouraged to communicate with the people on the receiving end of these projects in order to determine their needs, wants and circumstances. This is an example of how the “one-size-fits-all” discourse within engineering education can result in engineering graduates developing “one-size-fits-all” solutions for the problems with which they are tasked once they are in industry.

While the NVP course’s focus on health, safety and the environment could provide a means of focussing on the social implications of engineering work, Angela felt that the way in which this material was taught was not conducive to real engagement with the material. In Section 7.1.1, I showed that these elements were included in the course in order to fulfil section 5 of ELO 5 (Engineering

methods, skills and tools, including information technology). This required that the students were able to demonstrate understanding of “Health, safety and environmental protection appropriate to the discipline” (ECSA, 2012: 5); to this end, the students wrote an ELO test that featured a question concerning the Occupational Health and Safety (OHS) Act. Similarly, there was a 10-mark question in the exam regarding how to ensure compliance with the OHS Act. Angela explained that, for this kind of assessment, the students simply crammed the material without really connecting with it. In particular, she described exams as “a full stop to the course...once you write the exam and you go through it, you never have to look at it ever again” (interview, 18/6/15). For the students to meaningfully connect with social issues such as health and safety, she said, Prof. Harris could have brought in someone from industry who had real experience with the Act. She provided the example of a person who had been taken to court for contravening the OHS Act and who could share the ramifications of this experience. This kind of engagement, she said, would make the issues personal and real for the students, thereby highlighting the need for them to consider the social implications of engineering work.

This section began by highlighting the importance of personal reflection to the process of becoming a social actor, since it is only by reassessing one’s role commitment in relation to one’s PEPs that one is able to decide whether to commit to a role. For Angela, the most powerful moments of the NVP/PCS course pairing were those that promoted a reconnection with herself that she felt had been lost through the years of the electrical engineering degree programme. Through the small-group work in PCS and some of the assessment tasks, Angela found that she had learned more about herself as a person. This self-knowledge would be vital when it came to deciding whether and/or how much she was willing to commit herself to the role of engineer; such deliberations which would imply that she was becoming a social actor. Archer (2000: 303) states that how an individual chooses to personify a role determines the “*kind* of parent, teacher, churchgoer or colleague” he/she is”. In Angela’s case, getting to know herself meant that she became more self-aware; she said that, during the semester of the

NVP/PCS course pairing, she had already discovered that “I’m actually a compassionate person. I care about people” (interview, 18/6/15). It is likely that this self-knowledge would impact her professional practice once in industry and, in this way, may have influenced the *kind* of engineer that she went on to become.

8.4. Vuyo: “How is it going to affect my family and my social life after I graduate?”

While in this chapter, I specifically consider the development of agency within the NVP/PCS course pairing, in the introduction, I established that students experience many cycles of agential morphogenesis concurrently. As such, Figure 10 above, which depicts the acquisition of social identity, also relates strongly to Vuyo’s university experience as a whole. Vuyo’s arrival at UCT signalled his positioning as a primary agent in that, as a student, the only agency that he wielded with regards to the structural and cultural context of the university related to the fact that he was one of a large group of students, which would have impacted factors such as class size and teaching methods. However, having come from a small rural village in the province of KwaZulu-Natal, where there was no “culture of university” (interview, 28/5/15) and having not received any sort of career guidance while still at school, he had strong feelings concerning changing the status quo for current high school students. As a result, he and the few members of his matric class who were also studying at universities around the country decided that, when they returned to their village during university vacations, they would run workshops for the learners at their local school in order to make them aware of the post-school education options that existed and act as mentors for learners who were keen to pursue further study. In this manner, Vuyo became part of a group of corporate agents (quadrant 3 in Figure 10) who sought to work together to transform their society by empowering learners to seek and attain further education. These efforts were successful in that another student from his village was already studying at UCT, and a number of others were enrolled at different HEIs throughout the country. As corporate agents, Vuyo and his classmates wanted to impart to the high school learners that

“...you are not at university so that people can tell you that you are better than everyone. You are there to learn and then pass that thing back to the community” (interview, 28/5/15). In doing so, they created a transformed interpretation of what the role of a “graduate” was (the result of double morphogenesis), adding an aspect of responsibility for social transformation to the role. It is evident that Vuyo’s PEPs of commitment and social responsibility were directly aligned to his corporate agent role, and it can therefore be said that he was a social actor (quadrant 4 in Figure 10) in this sphere of his life.

This enactment of agential morphogenesis was not explicitly tied to the field of engineering. None of the fellow corporate agents to whom he referred were studying engineering; what connected them was the fact that they were all working towards degrees that would provide them with a means of finding employment and earning reasonable salaries. For Vuyo, the purpose of a university education was not to pursue one’s passions; rather, he said, when choosing what to study, learners needed to consider “How is it going to affect my family and my social life after I graduate?” and “Is it going to help me... live a better life than I am living now?” (interview, 28/5/15). This functionalist approach to university education also extended to the strategies that he adopted within his studies: His main goal was to pass his courses (focus group, 24/3/15), and, since he believed that this meant cramming material rather than truly engaging with it in order to understand it, this was the approach that he adopted.

His experience of the NVP/PCS course pairing had, however, challenged this approach to his studies because both courses required him to draw on a new set of skills. Whereas, in the engineering courses, “...it’s 1 plus 1 is equal to 2. There’s no other thing you can do with that. It’s this right answer or this wrong answer” (interview, 28/5/15), in the NVP and the PCS courses, he was faced with an ambivalence that he was unaccustomed to. Rather than simply providing the one correct answer to a problem, as was required in his engineering courses, Vuyo now found himself having to consider issues such as audience requirements, how to structure an answer so that it corresponds to the specifications of a task and

how to formulate a strong argument. Here, he gave the specific example of the ethics essay that students were required to write for the PCS course: The essay task laid out an ethically challenging scenario for the students and asked them to respond to it, formulating an ethical argument through the incorporation of the ECSA Code of Conduct (see Section 5.2.2). Vuyo explained that, when he first read the question, he did not know how to answer it and had felt quite overwhelmed (interview, 28/5/15). However, he then decided to approach the topic systematically, breaking it into separate parts, ensuring that he understood the requirements and formulating a plan for his response before he started writing. While this strategy did not guarantee that he would come up with a “correct” answer, he felt that the process had helped him connect with the material in a deeper way than in his usual courses, wherein he had worked out how to pass assignments and exams without really understanding the material. Thus, in finding ways to cope with the ambivalence engendered by the more open-ended tasks in the NVP/PCS course pairing, Vuyo had stimulated his PEPs of critical thinking and meaning-making.

Another related way in which the NVP/PCS course pairing differed from his engineering courses was in the new approach to assessment that he was exposed to. He was accustomed to assignments in which the correct answer earned him good marks and an incorrect answer did not. This was far more straightforward than the NVP and PCS course assignments, which were graded in a more subjective fashion (interview, 28/5/15). For these tasks, he felt that the reasoning behind the marks he achieved was never made explicit. Even for assignments for which there were rubrics, he wondered what the differentiating factors were between receiving 3/5 or 4/5 for a section and whether this was driven by the lecturer’s mood on the day she was marking. With reference to his own experience, Vuyo believed that Helen had marked too generously when assessing his written tasks (the ethics essay and the executive summary), stating that he felt his marks were too high given the feedback he had received regarding proofreading, sentence construction and tenses. Interestingly, his assumption was that Helen had marked leniently because she had taken into account the fact

that English was not his first language. Whether or not this was the case, that Vuyo even assumed this represents a direct manifestation of the CEP of the “one-size-fits-all” discourse, particularly with regards to the use of English, that was shown in the previous chapter to have had been inherent in the courses.

Before coming to UCT, Vuyo had never considered what professional field he would like to enter. Both medicine and engineering had been suggested to him, so, with very little knowledge of what either entailed, he applied for, and was accepted, to both. He initially chose to study medicine, but, after his funding fell through, he took up a Sasol²⁴ bursary and changed to electrical engineering (focus group, 24/3/15). In retrospect, Vuyo counted himself lucky because he “fell in love with” (interview, 28/5/15) engineering over the years of the degree programme. However, his decision to study engineering was clearly influenced far more by the relationship that exists between higher education and industry discussed in Section 6.1.3 (in that he received a bursary from industry without which he would not have been able to study) than by a deep desire to be an engineer.

The notion of falling in love with a field implies that Vuyo came to learn more about engineering throughout the course of his studies, and the new ways of thinking engendered by the NVP/PCS course pairing would have added to his conception of what an engineer is. In Section 6.2.2, various CEPs regarding student conceptions of the role of engineer were discussed, and it was shown that these were connected by relationships characterised by contingent complementarities. The resultant situational logic of opportunity meant that the students had freedom to constitute their professional identities, thus creating conditions for morphogenesis. This is evident in Vuyo’s case, since his understanding of what being an engineer entailed was transformed through the NVP/PCS course pairing. For example, he stated that, while he had initially been sceptical of the idea of guest lecturers in the NVP course given that these would

²⁴ A major South African energy and chemical company.

take away from teaching time, these sections had ended up being his favourite part of the course. This was because they had shown him that an engineer does not only have to deal with technical things but “can venture into anything” (interview, 28/5/15). In addition, his approach to tasks in this course pairing was different to that which he adopted in his technical engineering subjects, and he became aware that, far from being straightforward, engineering tasks could be complex and entail subtleties and ambiguities that stretched his PEPs beyond the capacity to merely provide correct technical solutions. To this end, while ECSA’s ELO 1 (Problem Solving), which states that graduates must be able to “Identify, formulate, analyse and solve complex engineering problems creatively and innovatively” (ECSA, 2012: 4), was not explicitly referred to in either the NVP or the PCS course handbooks, it would appear that the very characteristics of the courses that were distinctive – the nature of the tasks, the style of assessment and the guest lecturers – were those that developed his PEPs of creativity and innovation.

Thus, the NVP/PCS course pairing contributed to expanding Vuyo’s understanding of what being an engineer entails. The end of an agential morphogenetic cycle (quadrant 4 in Figure 10 above) represents the point at which a person has found a role in which he finds it worthwhile to invest himself and has the personal identity to personify it in a manner that reflects his PEPs (Archer, 2000: 296). In engineering, Vuyo found a role that he had come to love because of what he had learnt at university, including that which was taught through the NVP/PCS course pairing. Moreover, this was a role through which his PEPs of commitment and social responsibility could be enacted, given that, as a professional engineer, he would have the means (both financial and in terms of experience) to “give back” to his community. While Vuyo’s status as a primary agent from a small rural village influenced the type of social actor he could become in that the only reason he studied engineering was because he received a bursary to do so, it is clear that, in engineering, he found a role in which his personal and social identity were in synthesis.

8.5. Ravi: “I’m learning about ... everything that I want to learn about”

Previously in this chapter, I explained that the endpoint (at T4) of the morphogenetic cycle for the emergence of personal and social identity was the “elaborated ‘You’ – PI + SI” (Archer, 2000: 296). This refers to the synthesis between personal and social identities that I have discussed in several of the other narratives above as a marker of a social actor. However, this raises the question of how the relationship between personal and social identity works: Specifically, it raises the issue of whether personal identity (including an individual’s PEPs) or social identity (pre-existing social roles, such as “student” or “engineer”) hold sway over a person becoming the type of social actor that she becomes. Archer’s (2000: 288) response is that there are three “moments” of interplay between personal and social identity, which culminate in their synthesis. In this section, I use Ravi as a case study to examine how these three “moments” led to his choosing to identify himself with the role of engineer and to personify it in a particularistic way or, in other words, how he became a social actor. In particular, I focus on the NVP/PCS course pairing in order to better understand the constraints and enablements that these courses engendered throughout his process.

The first “moment” that Archer (2000: 289) discusses is one in which nascent personal identity holds sway over nascent social identity (PI→SI). Here, a person draws on her experiences in the three orders of reality (natural, practical and social) in deciding what role would be worth investing in (see Section 2.5.2). For Ravi, the choice to become an engineer was straightforward: He had been interested in computers all his life and knew that he wanted to work with them in his career. While still at school, he found out about UCT’s degree programme in Electrical and Computer Engineering (ECE) and decided that this was the appropriate course for him, as it appealed to his natural inclinations. Given his high marks (he received nine distinctions for matric), he would likely have had his

choice of fields of study. However, the bursary he received from ESKOM²⁵ fulfilled his requirements on a practical level (by covering his fees and expenses), and this was an important factor in his choice. Finally, on a social level, his experiences of vacation work (he had engaged in three separate stints thereof by fourth year) had given him a sense of what his life would be like as a working engineer, and he found that this was a lifestyle that he could commit to. Thus, the PEPs of his passion for computers, his academic acumen and his workplace experience were all integral parts of his personal identity, and they contributed to his decision concerning which career to pursue.

The second “moment” identified by Archer (2000: 291) sees the nascent social identity impacting the nascent personal identity (PI←SI). Here, induction into a role presents an opportunity for an agent to decide whether the role in question is sufficiently agreeable to make it his own. Ravi was unique amongst the student sample in this study because of his positive attitude towards his degree programme: While he believed that some of the lecturers were not as impactful as they could be, he felt that “the majority, for ECE at least...the lecturers are good, the content is really interesting” (focus group 24/3/15). Ravi was truly passionate about his subject and felt that the courses he had taken had fed his interests in such a manner that he felt prepared to enter industry once he graduated. As part of this generally positive outlook, Ravi felt that the NVP/PCS course pairing had been effective in deepening his knowledge of what the role of engineer entailed. Before the courses, he said, he had thought that being an engineer was “just sort of working, being given designs, designing, and those sorts of aspects of engineering” (interview, 28/5/15). As a result of taking these courses, he realised that the role included far more than this: For example, the PCS course’s focus on creating written and oral texts had taught him that, as an engineer, he also needed to focus on how to communicate in such a fashion that he could make his technical engineering work appealing to people. This became

²⁵ South Africa’s national power utility.

clear to him because of the course's focus on the engineering workplace environment, which allowed him to see the relevance of what was taught.

When discussing the PCS poster task, Ravi explained that, whereas other students had felt that learning to design a poster was an unnecessary skill given that, in industry, they would be more likely to simply hire a graphic designer, he had enjoyed the opportunity to work on his design skills (interview, 28/5/15). He explained that this was because he was the kind of person who liked doing as much as he could and getting involved with many different aspects of a project. Furthermore, as he understood it

...maybe in the long term, you know, having sort of these other skills, just to complement your own sort of professional work, is good. It helps you stand out, if you are able to do these things, you know? Make posters and presentations...You know, it's likely, if you're working as a professional, you're going to need to be presenting some projects or something to someone.

(interview, 28/5/15)

Ravi expressed his desire to “stand out” from others a number of times during his interview, explaining that this was because, once he entered industry, he did not want to “be just some worker at a machine” (interview, 28/5/15). This is indicative of the effects of the neoliberal “entrepreneur of the self” discourse, which conditions students to believe that success involves finding ways to stand out from the crowd (see Section 7.2.1). To this end, he felt that the NVP course had also made him aware of important aspects to consider regarding the engineering role. Working on the business plan showed him that, beyond simply designing a product, engineers should also consider the process of introducing that product to market. In addition, his experience of group work during the project taught him how to manage people. Because the group had struggled to get started, Ravi applied his PEP of leadership and started to allocate work to the others in his group. Through this process, he said, he had learnt to evaluate other people's strengths and weaknesses and to plan the work in a manner that took these into consideration. For example, one of his group members was good at drawing, so Ravi asked him to help with the poster design. There were two group

members whom he perceived as struggling to make decisions, so he arranged for them to work together on one of sections of the business plan. This experience of group work reflected what he had seen during his vacation work at ESKOM, and, as such, he felt that, despite the fact that this was an academic project, it was still authentically aligned to what occurred in the workplace.

In these examples of what Ravi learnt about the engineering role through the NVP/PCS course pairing, the conditioning effects of the three CEPs discussed in the previous chapter is evident: the discourse of inevitability, the “entrepreneur of the self” discourse and the “one-size-fits-all” discourse. This was made clear through his uncritical acceptance that the content covered in the two courses would be necessary in the workplace and his assertion that the reason why one needs to master this content is to be able to differentiate oneself from others, which he clearly sees as an important aspect of professional progression. I explained in Section 7.2.4 that the three CEPs mentioned above are concomitant complementarities and thus exhibit a situational logic of protectionism. The effect of this is ideational systemisation, and this is evident in the way that, for Ravi, the courses served to deepen his developing notion of what the role of an engineer is, not to push back against it or challenge it with new interpretations. Thus, it is clear that, in this second “moment” of interplay between his personal and social identities, as Ravi deepened his understanding of the engineering role through the NVP/PCS course pairing, he continued to feel that this was a role with which he could identify.

The third and final “moment” identified by Archer (2000: 293) is the one in which there is a synthesis between personal and social identities ($PI \leftrightarrow SI$). This is the point when, having weighed up the associated pros and cons, the agent actively chooses his social identity or, in other words, the role that he will personify, resulting in the “elaborated ‘You’” (Archer, 2000: 296). In Section 2.5.1, I showed that the situational logic of protectionism conditions the morphostasis of agency, and this is clear in Ravi’s case. Given his passion for ECE, his positive response to the degree programme as a whole and his continued commitment to the

engineering role as he learnt more about it through the NPV/PCS course pairing, it is clear that he found in engineering a role that he could accept and personify, even though this choice did not occur as a result of a process of agential morphogenesis. Instead, his choice of the engineering role reflected the inclination that he had demonstrated all along and, as Archer (2000: 2946) explains, choices concerning social identity are undergirded throughout by a human being's continuous self-consciousness. Thus, despite the fact that the NVP/PCS course pairing did not transform his personal or social identities, it did add to his understanding of the engineering role through what Archer (1995: 236) terms "cultural embroidery", and this led to him re-endorsing his personal commitment to it.

8.6. Faith: "I don't know how many people came to varsity sure that they want to be engineers in the end"

In this section, I show how Faith's was a case in which a student approached the end of her degree programme with the same ambivalence concerning whether or not she wanted to embody the engineering role once she graduated as she had when she first decided to study engineering. Her father was an engineer by training, and, growing up, she had seen how he and his engineer friends worked in many different professional fields (focus group, 27/3/15). The wide scope of career possibilities available to engineering graduates (see Section 6.2.2) meant that, by choosing to study engineering, Faith felt that she had discovered a way to keep her career options open. As she approached the end of her degree four years later, Faith was still unsure whether she wanted to work as an engineer. If Archer's (1995: 276) understanding of a social actor is an individual who chooses to identify himself with a particular role and actively personify it in a particularistic way, then it cannot be stated that the NVP/PCS course pairing enabled Faith's agential morphogenesis to a social actor. This is because the engineering role was neither one that she actively chose nor one that she felt any strong personal alignment with. In this section, then, I discuss Faith's experience

of the NVP/PCS course pairing and explain how this contributed to her agential morphostasis, as she remained a primary agent throughout the courses and did not transform into a social actor.

The manner in which Faith referred to her experience of the NVP/PCS course pairing articulated her positioning as a primary agent, which denotes one who is a member of a group of people who share the same life chances and lack a say in structural and cultural modelling (Archer, 1995: 257, 259). For example, with regards to the NVP course, she said "... we've never done a business plan before, we have no business background" (interview 1/6/15) and "... another thing that we struggle with is what we need to learn" (focus group 27/3/15). When discussing the PCS course, her opinion regarding the poster and the executive summary was that "it was different for us because for a lot of us... naturally, what you want to do is think of people as the consumer, the customer, so I think it was nice, them making us try to approach it from, ja, like we're talking to investors" (interview 1/6/15). Faith's use in these examples of the personal pronouns "we" and "us" indicates her sense that she is a member of a collectivity, which, in this case, was the cohort of students registered for the two courses. Furthermore, while she thought that there was a great deal about the NVP course in particular that could be improved, her suggestions were always phrased in such a way that they referred to changes that only the course convenors could have made. For example, with regards to idea generation for a new venture, she said, "for the whole coming up with the idea, I wish they had told us, like, earlier, like over December. It's hard coming up with ideas when you're told you've got one week" (interview 1/6/15). Of the business plan task, she stated, "I think it would have been nicer if they broke it down into milestones. Then, at every point, they evaluate, and then you can improve" (interview 1/6/15). Thus, her response to her dissatisfaction with NVP was to propose that the course convenor make systemic changes to the course. This is in contrast to what her response may have been had she had been operating as part of a group of corporate agents. In this case, the students may have lobbied the Engineering and the Built Environment

(EBE) Faculty to have the course changed or organised an appointment with Prof. Harris in order to attain their goals.

Faith did demonstrate awareness of the nature of the engineering role and, according to her, this was influenced by her experience of the PCS course. She shared her sense that the focus of the course was "... how to present yourself as a professional. To put across your ideas in whatever form they require. Whether you need to do a presentation. Whether you need to... I think it's just how to behave as a professional" (interview 1/6/15). Here, her use of the phrases "*present yourself as a professional*" and "*behave as a professional*" are telling, as they indicate her sense that there is a pre-existing role of a "professional engineer" and that, if people are to inhabit this role, they need to know how to replicate its norms. This is reminiscent of Gee's (2014) D/discourse theory, whereby people become part of a community by adopting the pervasive Discourse (see Section 2.3.1). It also shows, once again, that Faith was not concerned with challenging this pre-existing role in order to transform what is commonly expected of an engineer, which she may have been if she were a corporate agent. Instead, she accepted the representation of the professional engineer that was portrayed to her through her courses, including the NVP/PCS courses. This is an example of the conditioning effects of the discourse of inevitability that were discussed in Section 7.2.2.

However, solely because Faith accepted the veracity of the NVP/PCS course pairing's representation of a professional engineer does not mean that it resonated with her to the point that she was willing to invest herself in it, which is a requirement for becoming a social actor. Given the ambivalence regarding working as a professional engineer that she had demonstrated since the start of her studies, it was unlikely that two courses would have swayed her to such a degree that she would have changed her mind about this. However, it is clear that there were aspects of the course pairing that directly constrained her agential morphogenesis: If adopting a social identity such as the engineering role entails a deep personal connection, Faith found that this was hampered by the requirement that the new venture that the students developed for NVP included

the Internet of things (IoT). This was because, as she explained, South Africa's high Internet costs and poor coverage mean that the majority of the country's population would never have access to the products that the students developed, meaning whatever ideas her group came up with would inevitably be elitist and impractical. She thought that "if they'd actually give us freedom to actually look at real problems and try to solve those problems, we could have done a lot" (interview 1/6/15) and that this would have promoted deeper engagement with the project. Here, she cited the example of the chemical engineering students who, during their NVP course, had been required to develop interventions intended to address with water shortage. According to Faith, she would have engaged more with the task if she thought that what she and her group were developing could be truly useful and have a meaningful impact, as had been the case for the chemical engineering students. As it stood, she was unenthused by the product idea that she and her group had developed, which was an shoe insole for athletes that could collect, store and analyse fitness training metrics such as heart rate, step count, calories burned and speed. While she knew that the technology behind the product was exciting, she stated that she personally would not buy this product; this indicated a lack of zeal for the product, which was a fundamental aspect of the "entrepreneurial perspective" (Department of Electrical Engineering, UCT, 2015: 2) that the NVP course was intended to foster in the students.

Likewise, while she felt that the PCS course "did a pretty good job" (interview 1/6/15) in general, she experienced a similar lack of connection with the tasks that were set as a result of their inauthenticity. She found that the process of creating texts such as the poster and the executive summary that were targeted at investors for the purpose of obtaining financing was limiting because of her awareness that the texts were not real. Since the texts had no real implications, she said, "you only go so far with everything you do with your ideas and everything" (interview 1/6/15). Moreover, while she had valued the opportunity that the e-portfolio task had provided her to review her CV and distil the most important information concerning her experience and skills, she was not

convinced that her website would be of any use to her once the course ended. As she explained, “I thought that was random... do people really look at those? Do employers really look at that stuff?” (interview 1/6/15).

All this is not to say that the courses had no impact on Faith; on the contrary, her participation in the NVP/PCS course pairing provided her with a space in which to exercise and develop her PEPs. For example, her favourite parts of the PCS course were the times when she was engaged in writing activities, since she enjoyed the experience of manipulating words in order to attain a particular purpose. Here, she referred to the way in which a product description would differ depending on whether it was aimed at a customer or an investor. This had shown her that “it’s cool how words have power” (interview 1/6/15) and can thus be said to have contributed to her PEP of written communication. When her NVP group members failed to demonstrate initiative and work on the project had ground to a halt as a result, she had drawn on her PEP of leadership to set the group on course in order to meet deadlines. Finally, by watching her classmates deliver their PCS presentations, she had realised that, aside from presentation techniques such as vocal projection and eye contact, people are more interesting to listen to when they seem passionate about their subject. In attempting to integrate this into her own presentation style, Faith strengthened her PEP of oral communication.

It is clear, therefore, that, while the NVP/PCS course pairing did not facilitate Faith’s transformation into a social actor, it did impact on her in terms of agential morphogenesis. The development of her PEPs, as described above, contributed to her personal identity, which, as I discussed previously in this chapter, is continuous and thus would be the anchor for any agent or social actor that she may become in the future. Should Faith find a role that she feels that she could invest herself in, these PEPs would be an integral part of her “internal conversation” (Archer, 2000) as she weighed up the pros and cons of adopting that role and actively personifying it. In Faith’s case, one can see that the situational logic of protectionism conditioned by the three CEPs that

underpinned the NVP/PCS course pairing did contribute to her agential morphogenesis to a certain degree in that she accepted the representation of the engineering role that was portrayed and did not band together with other students in order to redefine it. However, Archer (1995: 195, 209) reminds us that the conditioning that results from the relationships that exist between SEPs and CEPs are not “hydraulic pressures”, as society is open and people are capable of making their own decisions concerning how to respond to these tendencies. Through her ambivalence regarding the engineering role and her choice not to, at that point of her life, fully commit to it, as would be required for her to become a social actor, Faith serves as an example of this. Her enactment of agency in this regard is an example of our “concrete singularity” (Archer, 2000: 318) as humans, since it shows that, irrespective of structural or cultural factors, we determine our own priorities and define our personal identities in terms of what we care about.

8.7. Mike: “I may be a bit older and grumpier than a lot of the other people”

As I mentioned in the introduction to this chapter, at the time of the NVP/PCS course pairing, Mike was already a social actor because he owned and operated his own small business. His company, SolarSystems,²⁶ which he started with a friend, had been running for over a year and had grown to the point that they had already worked on a number of half-a-million-rand projects in different parts of South Africa. Over the course of the year, Mike had had to juggle his responsibilities with regard to the business with his academic requirements, and this had seen him working on PCS assignments in a hotel room in Bloemfontein at 2am and on an aeroplane. As he put it, “I seem to spend a lot more time on this (the business) than I do at varsity” (interview, 29/5/15). Here, one can see Mike’s response to the situational logic of ideational syncretism conditioned by the

²⁶ I have changed the name of the company.

constraining contradictions that existed between the students' conceptions of themselves as senior students and professionals in training. As discussed in Section 6.2.3, this promoted agential morphogenesis, as each student had to shape her own identity in such a way so as to deal with these conflicting roles. Due to his circumstances, Mike actively chose to focus his energies on his professional role of being an engineer business owner and his active personification thereof through meetings with clients and other professionals, working on site and behind-the-scenes planning and preparation for projects is indicative of his functioning as a social actor.

For him, therefore, the NVP/PCS course pairing did not contribute to his transformation into a social actor, since this had already occurred before the courses started. Mike articulated this clearly when he said that "My personal goals with the business have been set, and I find myself working towards them and actually achieving a lot of my personal goals. But I wouldn't say that any of them have changed because of this course" (interview, 29/5/15). For this reason, the usefulness of applying Archer's (2000: 295) four-quadrant theory regarding the acquisition of social identity (as indicated in Figure 10 above) to Mike's experience of the NVP/PCS course pairing lies in the opportunity it presents to examine a "second tour around the four quadrants" (Archer, 2000: 299). This occurs when a mature emergent individual who is already a social actor re-visits each of the quadrants to inspect the "I" (quadrant 1), the "me" (quadrant 2), the "we" (quadrant 3) and the "you" (quadrant 4) and then decides whether to pursue her replication or transformation. Thus, in this section, I focus on the impact of the NVP/PCS course pairing on Mike's re-assessment of the social actor that he had become. In doing so, I also illustrate his responses to the situational logics conditioned by the SEPs and CEPs in the two courses.

Archer explains that on the "second tour around the four quadrants" (2000: 299), quadrant 1 represents the point at which the social actor reflects on the "I" that he has become. This is the "moment" in which the person considers his personal and social identities, and the self-awareness that arises from this lays the

foundation for his personification of the social actor role to take further shape and become recognisable in the outside world (Archer, 2000: 300). For Mike, the NVP/PCS course pairing did provide him with some opportunities to reflect on his functioning as an engineer who owns his own business. In particular, he found value in listening to the guest lecturers' insights into how they started their businesses, as they afforded him the opportunity to compare their experiences to his own. For example, one guest lecturer described how he had chosen to take out a huge overdraft to avoid giving equity of his company to an investor. Having been through a similar experience recently, Mike felt that he could relate to and learn from this kind of anecdote from an experienced entrepreneur. Similarly, he found that the representation of professionalism that was portrayed in PCS, such as "...what is expected of me, how to act, how to dress, how to come across as confident and reliable" (interview, 29/5/15) reaffirmed what he was already doing in the workplace. This seems to indicate that the discourse of inevitability that was discussed in Section 7.2.2 as contributing to the representation within the PCS course of a single, correct approach to being professional does indeed mirror real practice in industry. However, in Mike's case, this content did not serve so much to teach him *how* to be a professional but had rather contributed to an enlargement of his PEP of confidence in terms of how he was enacting his social identity, as it provided him with a positive benchmark for his own practice in industry. As he explained, one of the benefits of the NVP/PCS course pairing was that "I'm starting to get a bit more comfortable at a boardroom table with people who are engineers already and are highly qualified and highly experienced. I'm getting comfortable presenting my ideas (interview, 29/5/15). The connection between his personal and his social identities was thus reaffirmed through his participation in the courses.

Since he was already a social actor, in quadrant 2, Mike was able to reflect on his social positioning amongst the other students (Archer, 2000: 301). It is important to remember that, at this point, Mike was also a primary agent, in that he was a member of the group of students enrolled for the NVP/PCS course. However, his PEP of real-world experience meant that he was in a position to reflect on the two

courses' offerings and critique them in a manner that the other students could not. For example, Mike's feedback regarding the focus in NVP on health and safety in the workplace was that "...spending five lectures discussing the Occupational Health and Safety Act is just, I think, it's obscene. I don't think that that's useful" (interview, 29/5/15). This sentiment arose from his experience with SolarSystems, which was that, while it was important to be cognisant of the OHS Act's existence, there was no point in knowing its minutiae and memorising parts of it verbatim, as the students were required to do for the NVP test and exam. All that this would lead to, Mike stated, was the students forgetting the content as soon as they had written it off. He would have preferred it if the students had been required to interpret the Act or apply it to a scenario.

In this example, one can see that, in Mike's opinion, the content and assessment methods that were included in the course in order to ensure that students fulfilled ECSA ELO 5 (see Section 7.1.1 for more information concerning this ELO and Chapter 6 for a discussion of the situational logics conditioned by ECSA as a SEP) actually constrained the students' engagement with the role of the engineering entrepreneur because they did not promote deep critical thinking regarding the real health and safety implications of engineering work and did not reflect his experience in industry. In a similar vein, he voiced his impression that the PCS course session on negotiation skills was also not aligned with what actually occurred in industry. He felt that there was too heavy a focus on theory in the PCS course, whereas, in real negotiations, "You have to have a feel for it. If you go in, you have to know how to vary and mix the different stances" (interview, 29/5/15). While he was a primary agent like the other students, Mike's opinions regarding the course pairing drew from his industry experiences in that he found himself comparing what was taught to what he had experienced during his time at SolarSystems and concluding that, in many cases, the two did not correspond.

For an individual such as Mike, who was already a social actor, returning to quadrant 3 presents an opportunity to re-monitor his commitments and "re-determine *how* we will stand and with *whom* in solidarity" (Archer, 2000: 302).

The manner in which Mike expressed his dissatisfaction with the NVP/PCS course pairing was certainly influenced by his embodiment of his social actor role. He described how his fellow students had elected him as a class representative for a previous course, and, in this capacity, he had attended meetings with faculty from the Electrical Engineering Department in order to make students' concerns heard. This shows his willingness to serve as a leader among the students and to work with them as a corporate agent in order to attain particular goals. However, when discussing the problems he perceived with the NVP/PCS course pairing, Mike said "I don't know how to improve it actually, I'm not a lecturer" (interview, 29/5/15). Through this statement, he indicated that he believed it was not within the scope of his social role to make suggestions concerning improving the courses or lobbying with others for them to be changed as a corporate agent would do. This could imply that, since he was in his fourth year and close to graduation, he had no vested interest in working toward changing the courses; this would explain why he was willing to be a corporate agent in previous years but not at this point. Alternatively, it could demonstrate his buy-in to the notion that different social roles have different emergent powers, in that he, as an engineer business owner, could effect certain societal change, but this did not include changes to curriculum, pedagogy and assessment, which are the preserve of lecturers, who inhabit a separate social role. Either way, it is clear that, on assessment, he did not become a corporate agent with regards to the NVP/PCS course pairing.

Finally, in quadrant 4 of Figure 10 above, Mike's process would have involved revisiting his social actor role, deciding whether to endorse it and how this endorsement should be personified (Archer, 2000: 303). This is the point at which his personal identity reflected on his social identity; this would result in morphogenesis if the two were no longer in alignment, in that he would either need to find a new role in which he felt he could now invest or change the manner in which he personified his current role. However, this did not occur in Mike's case, as the NVP/PCS course pairing neither changed him to the extent that he no longer felt the role of engineering business owner was aligned with his

personal identity nor affected his understanding of what this role entailed. This was likely an effect of the situational logic of protectionism resulting from the ideational systemisation conditioned by the relationship of concomitant complementarities between the CEPs within the NVP/PCS course pairing discussed in Section 7.2.4.

8.8. Conclusion

Through analytical narratives that took the form of seven vignettes that described different students' experiences of the NVP/PCS course pairing, I have sought in this chapter to illuminate some of the constraints and enablements that these students encountered in their development of discursive identities as engineers during the NVP/PCS courses. This was the third research sub-question of this dissertation and the one most dependent on an examination of the students themselves, since I showed that their backgrounds, personalities, interests and attitudes – indeed, all of their PEPs – impacted on the ways in which they responded to the conditioning of the situational logics stemming from the relationships that exist between different SEPs and CEPs. In the introduction to this chapter, I noted that any thorough analytical narrative of emergence demands an intertwining of both context and agents or, in Archer's (1995: 15) terms, the "parts" and the "people". Thus, although the focus in this chapter was on the transformation (or lack thereof) of the seven students as agents, it would have been impossible to provide this account without reference to the SEPs and CEPs discussed in Chapters 6 and 7. The vignettes show that, while each of the students took the same courses, engaged with the same course material and wrote the same assessments, the ways in which they responded to the SEPs and CEPs inherent in these, and in tertiary engineering education in South Africa in general, differed. Herein lies the powers inherent in the "enchantment of every human being" (Archer, 2000: 319) – that fundamentally, as humans, our responses to conditioning are not automatic or predetermined.

According to my theoretical and conceptual framework outlined in Chapter 2 of this dissertation, the students in this study could be said to have developed discursive identities as engineers at T4 of the morphogenetic cycle of agency, where they emerged as social actors. In theory, this represented the moment of synthesis between their personal and social identities, whereby the students found that the role of “engineer” was one that they were willing and able to commit to and enact. In practice, I show in the vignettes above that the NVP/PCS course pairing enabled this process in two main ways: The first of these consisted of the manner in which the two courses contributed to the development of PEPs in the students. Some examples of this include the way in which Angela learnt more about herself through the various PCS activities that required her to reflect on her experience and her opinions concerning the world and the way in which Faith developed her leadership skills through having to keep her NVP group on target during the business plan project. Paul’s experience of receiving a poor mark for his PCS poster meant that he had to become more resilient. In all of these cases, what the students gained were not the skills and attributes that are common amongst those who understand employability as the possession of generic, clearly-defined workplace requirements, such as report writing or presentation skills (see Section 2.2.1). Nor were these PEPs explicitly stated in the ECSA’s ELOs or taught and assessed in either course; rather, I would argue that the courses facilitated the development of these PEPs as by-products of the formal curriculum. It was in the “messiness” of fulfilling the academic requirements of the courses, such as meeting deadlines or working with others, that the students encountered these moments of personal learning. This enabled their agential transformation due to the fact that, according to Archer (1995: 282), the “person” is the anchor for both the “agent” and the “actor”. Therefore, the strengthening of personal identity meant that the students would be better equipped for and more confident in their choices regarding whether they wished to adopt the engineering role and the way(s) in which they planned to personify it.

The second way in which the course pairing enabled the students' transformation to social actors was through those elements that helped to deepen the students' understanding of what the role of the engineer entailed. As discussed in Section 6.2.3, the many CEPs that existed regarding the concept of engineering identity conditioned agential morphogenesis; this is because these different ideas provided the students with opportunities for "cultural free play" (Archer, 1995: 244) as they picked and chose amongst the possibilities and negotiated the shape of their own identities as engineers. In the vignettes above, I demonstrated this process in action as, for some students, the NVP/PCS course pairing taught them more about being an engineer, which was in turn the spur that made them realise that this was a role that they would want to personify. For example, Vuyo described how exposure to the guest lecturers in NVP had made him aware of the wide range of career possibilities for an engineer, and this had excited him. For Ravi, working on the PCS texts, such as the poster and the presentation, changed his perception of the engineering role from a purely technical pursuit to one that required creativity and a capacity to connect with people from different disciplines. From the NVP course, Paul came to realise that a focus on finances was an important aspect of the engineering role. I would argue that, in all of these cases, the NVP/PCS course pairing deepened the students' knowledge of what being a professional engineer entailed; this meant that it enabled their agential morphogenesis to social actors in that, when in T4 they made the choice to commit to the engineering role, they had a fuller picture of what this actually involved.

I have therefore shown that the NVP/PCS course pairing enabled the development of discursive identities as engineers on the part of students through those aspects of the courses that developed the students' PEPs and their knowledge of the engineering role. The corollary of this is that those aspects of the courses that did neither of these constrained the students' morphogenesis. For example, the pedagogy of the NVP course, which consisted of lectures being delivered to students on a variety of topics by different lecturers, without any clear overview or explication being provided of how these linked up, meant that

students struggled to grasp the relevance of the content. The ELO test and the exam required memorisation of material, including the OHS Act and the lecture slides that the lecturers had uploaded to Vula;²⁷ this meant that students did not need to work with the material in a manner that would have built connections between the course content and what they already knew from their everyday knowledge or previous university courses, which is the goal of what Ramsden (2003: 47) refers to as the deep approach to learning. Some of the sections of the NVP course that students highlighted as particularly inaccessible were those dealing with health, safety and the environment, which was covered in lectures and assessed in a test in order to satisfy the requirement of ECSA ELO 5 (ECSA, 2012: 5), which is “Engineering methods, skills and tools, including information technology”. Thus, this component of the course, which explicitly set out to equip students with “methods, skills and tools”, actually constrained the students’ progression towards agential morphogenesis.

Another way in which I demonstrated the NVP/PCS course pairing constraining both personal and social identity development on the part of the students was through the focus, in both courses, on a hypothetical new venture product and the creation of texts that, while simulacrums of what actual engineers would create in industry, could not be said to be authentic texts (which are those that Lombardi, 2007: 2, describes as creating genuine interpersonal, intellectual and/or personal connections for students). For example, Angela was aware throughout the development of her NVP business plan that there were no real, industry-related implications to misrepresenting the product or finances, since it was simply an academic project, and this had limited her personal engagement with the task. Yasin was certain that the negative mark given to his group on their business plan was in contrast to the positive response they would actually receive to their product in industry. Faith felt that the requirements of the product detracted from the task because it was unrealistic for the South African context. I would argue that, had the task required students to develop a solution

²⁷ UCT’s online learning system, which houses websites for the various academic courses.

for a real personal, social or environmental issue, they would have engaged more authentically with the task, thereby either developing their own PEPs or developing a better sense of the social good aspect of being an engineer. This, in turn, could have encouraged more students to desire to become social actors.

Archer's explanation of the morphogenetic approach ends with a discussion of the "social elaboration" (1995: 294–342) that occurs at T4 as an outcome of the particular intermeshing of SEPs, CEPs and PEPs within a given context. This includes discussion of how structural and cultural elaboration occurs as a result of the socio-cultural interactions that take place between T2-T3. Were the research focus of this dissertation broadened to explaining how the NVP/PCS course pairing changed over time or to analysing the evolution of employability skills initiatives in an academic department, a focus on structural and cultural elaboration would be key, as it would provide a way of understanding how and why things had developed. However, the focus of this study is on the students' agential morphogenesis, with the discussion of SEPs and CEPs in Chapter 6 and 7 serving to deepen the reader's understanding of how the structural and cultural context of the course pairing conditioned agency. "Social elaboration", therefore, is not a focus of this conclusion; rather, the emphasis is on how the students were constrained or enabled in terms of the development of discursive identities of engineering during the NVP/PCS course pairing, which is theorised as agential morphogenesis. I have shown how, for some students, such as Vuyo, Ravi, Angela and Paul, this transformation was enabled by the aspects of the courses that contributed to a synthesis between person and social identity. For Mike, the enabling aspects of the courses lay not in the transformation of identity but in opportunities for reflection on the manner in which he was already enacting the role of engineering entrepreneur. Yasin's experience as a corporate agent during the course pairing empowered him to define his own enactment of the student role, the experience of which he had found during his vacation work to have equipped him for industry. Finally, I explored how Faith's ambivalence regarding whether or not "engineer" was a role to which she wanted to commit

meant that she did not shift from an agent to a social actor as a result of the course pairing.

Through the discussion of the experiences of seven of the NVP/PCS course pairing students, I have provided, in this chapter, insight into the constraints and enablements that these students encountered during their development of discursive identities as engineers, thus answering the third and final research sub-question of this study. Archer's social realism (SR) (and, specifically, her morphogenetic approach) was employed to, in Bhaskar's (1998) terms, develop an explanation of the causal, generative mechanisms that underpinned the NVP/PCS course pairing in the domain of the real. My analysis showed that, where the Electrical Engineering Department (with the sanctioning of the EBE Faculty) had imposed the ECSA ELOs onto the NVP and PCS courses' curricula without careful consideration of the teaching and learning implications thereof, this had had the effect of constraining the students' development of discursive identities as engineers, since it led to them failing to engage with the material in a deep and critical manner. Here, the very measures introduced by ECSA, as the industry regulatory body, to ensure that the students were adequately prepared for the engineering workplace resulted, in actuality, in the students remaining firmly rooted in academic discourse (as opposed to the professional discourse that was this course pairing's focus). This was evident, for example, in the way in which many of the students adopted a surface approach to learning (Ramsden, 2003: 47) in the NVP course, wherein their intention was to simply satisfy task requirements (for example, through memorising the OHS Act in order to pass the test), rather than actually attempting to understand the material and relate what they were learning to their previous knowledge and experiences. Likewise, while the NVP/PCS course pairing had set out to provide the students with an experience of what it would be like to start a new engineering business, the fact that the projects at the centre of both courses were purely hypothetical meant that the stakes were nowhere as high for the students as they would have been for real engineering entrepreneurs. This resulted in the students' experience of

the course pairing being fundamentally inauthentic, leading to a lack of personal connection and investment on their part.

In contrast, I showed that the aspects of the course pairing that enabled the students' development of discursive identities as engineers were those in which they broadened their PEPs, thus learning about themselves and growing as individuals, and the sections in which they were exposed to new ways of thinking about what it means to be a professional engineer that they felt sparked their interest and passion. Neither of these enablements relates to the attainment of decontextualised skills such as "communication skills" or "teamwork", as was embodied in the "employability as possession" perspective of employability that I argued against in Section 2.2.1; rather, they reflect the perspective of employability that I adopted – that of "employability as processual". From this perspective (see Section 2.2.3), employability development is seen as a process of *becoming* whereby academic abilities are integrated with personal, interpersonal and behavioural attributes (Tomlinson, 2012: 421). I would argue that this theoretical conceptualisation aligns with my findings in this chapter, since both lend credence to the centrality of identity development to work-readiness.

The analyses of SEPs and CEPs conducted in Chapters 6 and 7 and the examination in Chapter 8 of how these intertwined with agency in order to explain the ways in which the students did or did not change as a result of the course pairing served to shift my study's explanations concerning the impact of the two courses from the subjective domain of the empirical and the objective domain of the actual. My resultant discussion in these chapters avoids the epistemic fallacy, as it presents an understanding of what occurred in the pairing that moves beyond course descriptions and summaries of the students' responses. In the conclusion to Chapter 2, I quoted Easton (2010: 121) as stating that the most fundamental aim of critical realism (CR) is to answer the question of "what caused these events to happen?". In the preceding three chapters, SR has provided the theoretical tools required to identify and discuss the relevant

structural, cultural and agential generative mechanisms. Now, however, as this dissertation approaches its conclusion, my focus moves towards the implications of these findings for engineering education in general and, more particularly, to the issue of employability skills training for engineering students in higher education.

9. Conclusion

“In literature and in life we ultimately pursue, not conclusions, but beginnings.”

(Tanenhaus, 1986: 67)

The quote above was taken from a book about the classics of world literature and alludes to the way in which finishing an epic novel or a moving piece of fiction can leave a person feeling like her perspective on the world has shifted. Indeed, an impactful work of literature can leave its readers with new ways of thinking about old problems or a wider understanding of the world beyond the realms of their everyday experience. Thus, although the piece of literature in question may have concluded, it has stimulated new beginnings in terms of attitudes, approaches and perspectives on the world. Furthermore, the quote suggests that this is also the case in life, as each completed project, activity or stage of life can be conceived as the beginning of something new.

While the results of a PhD research project may not typically be thought of as a classic of world literature, I would argue that the quote above is also applicable to academic writing, including the content that I have included in this dissertation. This is because this conclusion is not intended to be the final word on employability development in engineering education; rather, in this chapter, I summarise the answers to my research questions and show how these relate to already existing perspectives on employability development in engineering education. I also discuss the implications of my research findings, as well as potential future directions for research into employability development in the discipline of engineering education. Herein lie the “beginnings” mentioned in the quote above, since the objective of this chapter is to show the links between my findings of my research and potential new directions for future practice and research in engineering education.

9.1. Responses to research questions

The main research question of this dissertation was:

In what ways can participation in an undergraduate course pairing prepare electrical engineering students for the workplace?

The research sub-questions were as follows:

- What structural and cultural emergent properties operate at UCT and in the NVP/PCS pairing?
- What are the pedagogic characteristics of the NVP/PCS pairing that condition the development of discursive identities for the students?
- What are the constraints and enablements that students encounter in the development of discursive identities as engineers during the NVP/PCS pairing?

As is evident, these research sub-questions relate specifically to the NVP/PCS course pairing. As such, this section provides brief responses to each of these questions in order to present a strong overview of this study's findings, with a particular focus on the students' experiences of the course pairing itself. Thereafter, in the following section, the focus shifts to a more general discussion of what the implications of these findings may suggest for the development of workplace preparedness for undergraduate engineering education in general²⁸.

²⁸ I am grateful to the external examiner who shared a number of sources relevant to the fields of engineering education and professional communication instruction. Her intention was to aid me in creating linkages between my conclusions outlined in this chapter and existing bodies of knowledge. I have incorporated a number of these sources into this final dissertation and will certainly engage with them further for future publications.

9.1.1. The structural and cultural emergent properties that operated at UCT and in the New Venture Planning/Professional Communication Studies course pairing

The objective of this research sub-question was to begin developing a sense of the context of the course pairing that moved beyond Bhaskar's (1975) domains of the empirical and the actual in order to engage with these courses within the domain of the real. The phrasing of this question reflects that, as a means of doing so, I used Archer's (1995) social realist theoretical and analytical tools of structural emergent properties (SEPs) and cultural emergent properties (CEPs). I approached the question from two perspectives: The first related to the macro-context of the NVP/PCS course pairing, which I discussed in Chapter 6. Here, the main SEPs that I identified were the Engineering Council of South Africa (ECSA), the engineering industry and higher education. The main CEPs that I identified related to students' conceptions of themselves as straddling two different roles concurrently, namely those of senior students and professionals in training. In addition, I showed that the students understood the role of a professional engineer as reflecting qualities that have been associated with the concept of the "new engineer" (Conlon, 2008), including social consciousness, career flexibility and entrepreneurship. The second perspective that I adopted in answering this research sub-question related more specifically to the NVP/PCS course pairing itself - this formed the basis of Chapter 7. Here, the main SEPs I identified were the University of Cape Town's (UCT) Engineering and the Built Environment (EBE) Faculty, the Electrical Engineering Department and the Professional Communication Skills (PCS) Department. The main CEPs that I identified were related to the discourses that underpinned the NVP and PCS courses; these were the "entrepreneur of the self" discourse, the discourse of inevitability and the "one-size-fits-all" discourse.

9.1.2. The pedagogic characteristics of the New Venture Planning/Professional Communication Studies course pairing that conditioned the development of discursive identities for the students

While my hope is that this study will have implications beyond simply the case study course pairing on which it focused, during my research, I found that it was necessary to engage with the specifics of both the NVP and PCS courses in order to better understand the processes that the students underwent. Since the discipline in which my research is located is engineering *education*, I understood the need to engage with the pedagogic characteristics of the NVP/PCS course pairing. I determined this to consist of issues associated with teaching and learning, curriculum and assessment. For the NVP course, teaching occurred through lectures, with minimal interaction taking place between the lecturer and the students. Many students chose not to attend the sessions since they were aware that full notes would be made available on Vula, which meant they would be able to work through them at a later stage. While the curriculum dealt with issues related to engineering entrepreneurship, such as finances, health and safety and intellectual property, there was no overarching logical structure to the course as a whole. The main assessment tasks were the test and exam, for which the students reported cramming material, and the group business plan project. For PCS, the teaching consisted of workshops of one hour and 45 minutes in length that included a great deal of interaction via paired, small-group and whole-group discussion and activities. The curriculum consisted of different topics related to group dynamics and various skills that were deemed important for an engineering entrepreneur, including developing a professional online presence and pitching to potential investors. There was no summative assessment such as an exam; rather, the course mark was made up of different tasks, all of which focussed on the creation of industry-like texts, including e-portfolios, posters and business plan summaries.

9.1.3. The constraints and enablements that students encountered in the development of discursive identities as engineers during the New Venture Planning/Professional Communication Studies pairing

A key conceptual underpinning in my study was a shift away from the understanding of work-readiness as consisting of a host of discrete, decontextualised skills to a view that encompasses significant shifts in identity. To support this shift, I employed Gee's (2008) notion of secondary Discourses as a means of theorising the development of professional identities – in this case, those of engineers. Thus, I argued that, were the NVP/PCS course pairing to fulfil its aim of preparing students for the workplace, students would leave the courses having acquired discursive identities as engineers. Using Archer's (1995, 2000) theory of the morphogenesis of agency, I reasoned that the students could be said to have acquired discursive identities as engineers at the point at which they emerged as social actors, having decided that “engineer” was a worthwhile role to invest themselves in and to uniquely personify. As a way of answering this research sub-question, I analysed the experiences of seven of the participants in this course pairing. This led to the argument in Chapter 8 that the process of discursive identity transformation was enabled by the elements of the two courses that provided spaces in which the students could develop their own personal emergent powers (PEPs), such as leadership and resilience. In addition, when the students deepened their understanding of the engineering role, this enabled the development of their own discursive identities as engineers. Some constraints to this process included the disjointed NVP curriculum, the students' reliance on rote-learning for the NVP test and exam and the fact that both courses were based on a hypothetical new venture, meaning that the students did not perceive the related tasks as being authentic.

9.2. Ways in which participation in an undergraduate course pairing prepares electrical engineering students for the workplace

Having presented an overview of the answers to each research sub-question in the previous section, this chapter now shifts towards a focus on the main research question. Before delving into the answer to this research question, however, it is important to note that implicit in it is the belief that an undergraduate course *should* and *could* prepare electrical engineering students for the workplace. As I discussed in the early chapters of this dissertation, neither of these claims are uncontentious (see Sections 1.1 and 4.3 for a deeper discussion of some of the issues regarding this debate). However, I have shown through my findings that a focus on workplace readiness in engineering is both valid and productive if it is underpinned by Holmes' (2013) understanding of "employability as processual". According to this perspective, which was fundamental to my conceptual framework, workplace readiness is viewed as a process whereby students begin developing identities as professional engineers. In this conceptualisation, higher education can provide a valuable opportunity for students to begin to experiment with their burgeoning identities as professionals through the enactment of secondary Discourses of engineering (Gee, 2008). Should undergraduate courses provide space in which this can occur, they will contribute to the development of workplace readiness through supporting the development of their students' discursive identities as engineers. I showed in my answers to the research sub-questions that there were two particular areas within the NVP/PCS course pairing that enabled this identity development, namely those sections of the courses that promoted deeper understanding of what the role of "engineer" entailed and those that provided spaces in which students could develop their own personal identities, specifically, in Archer's (1995) terms, through the development of their own PEPs.

I showed in my analysis that the sections of these courses that supported the development of this expanded perspective of workplace readiness were often

not part of the formal curriculum in either the NVP or PCS courses: For example, the students did not complete personality assessments such as the Meyer-Briggs type indicator²⁹ or produce any explicitly reflective work. In addition, the guest lecturers in the NVP course were brought in to tell the students more about entrepreneurship, and, while this may have had the unintended consequence of presenting an expanded image of the role of an engineer, this was not their primary function. In fact, it seems that, for the NVP course, the academic choices that were made in terms of pedagogy, curriculum and assessment often resulted in the students remaining firmly rooted in their academic Discourses. After four years of studying, the students had developed their own strategies for managing the large workloads. Most often, this relied on a surface approach to learning (Ramsden, 2003), including memorisation and cramming, with the primary goal being simply to pass each course. A number of the students whom I interviewed for this study reported adopting just such a strategy for the NVP course, with the result being that, while they saw the value in learning more about engineering entrepreneurship, they did not connect with the course material in a deep, personal manner. Even for the business plan, which was focussed on a topic that the students themselves had developed, there was a lack of personal investment in the project given that the students knew it was a hypothetical task with no real implications in terms of risk or reward. In a sense, this view was validated when they were given their marks for the projects without receiving any in-depth feedback, which confirmed their belief that the most important aspect of the project was simply to pass.

While the majority of the PCS course tasks were similarly hypothetical in that they dealt with the same NVP new venture, where they differed was in the opportunity they provided for personal reflection and for the students to practise a range of communicative modes that were unfamiliar to them. For example, creating the e-portfolios gave the students an opportunity to reflect on their experiences to date and to decide how they wished to showcase themselves

²⁹ This is a questionnaire that indicates differing psychological preferences with regard to how people perceive the world around them and make decisions.

to the world in the form of a website. The poster required them to express their products visually and to consider aesthetics and branding for the first time in their engineering degrees. While the students had delivered a 5-minute presentation the previous year during the third-year PCS course, the experience of standing up in front of a group of people and delivering a formal presentation was still unfamiliar and challenging for many. This represented, for the students, a departure from their everyday functioning as electrical engineering students and the academic Discourse, and as such, I would argue that these activities provided opportunities for students to enact their developing discursive identities as engineers.

Thus, to answer the main research question of this study, the potential for an undergraduate course to prepare electrical engineering students for the workplace lies in the opportunities it presents for them to engage in authentic learning experiences. It is my contention that the concept of “authentic learning”, whereby students engage in learning tasks that provide an authentic context that reflects the way knowledge will be used in real life (Herrington, Parker & Boase-Jelinek, 2014), encompasses the most effective aspects of the NVP/PCS course pairing in terms of enabling the development of discursive identities as engineers. This is because the aspects of these courses that promoted the development of the students’ PEPs and deepened their understanding of the engineering role were those that embodied the four aspects that Rule (2006: 2) emphasises as being central to authentic learning:

- Activities involve real-world problems that mimic the work of professionals in the discipline, with presentation of findings to audiences beyond the classroom.
- Open-ended inquiry, thinking skills and metacognition are addressed.
- Students engage in discourse and social learning in a community of learners.
- Students are empowered through choice to direct their own learning in relevant project work.

The NVP course did embody the first aspect above in that the students were required to develop an idea for a new real-world engineering venture. However,

the top-down style of lecturing, which prevented class interaction; the test and the exam, both of which required rote learning; and the lack of scaffolding and feedback on the business plan task that could have stimulated deeper thinking on the topics, meant that students were not required to engage with the content in a deep, authentic way that may result in them making real connections between themselves and the material that was taught. This is reflective of Herrington et al's (2014) assertion that authentic tasks develop over time, meaning that scaffolding and support should be provided at a metacognitive level, not only at the early stages of the task. In contrast, the emphasis on role-play activities and discussions in relation to industry-related issues during PCS sessions and the space that students perceived the assessment tasks as providing to explore and express their own identities meant that they were more likely to experience connections between the enactment of the work and their personal identities. As per the personal concern that I highlighted in the opening paragraph of this section, there is a gap between the university and the workplace. However, my study has shown me that, when workplace readiness initiatives such as the NVP/PCS course pairing provide spaces for students to engage in authentic learning experiences that strengthen their personal identities and deepen their knowledge of the engineering role, this does contribute to preparing students for the workplace.

9.3. Implications of the findings

As was alluded to in the quote that opened this chapter, the aim of human endeavour is not only to reach conclusions but to use these to stimulate new beginnings. In this section, these new beginnings relate to how these findings may be of interest and, ideally, of use to different parties involved in engineering education. In Section 1.4, I expressed my hope that the findings of this study could be used to develop new methods of supporting engineering students as they prepared to move from university to industry. In this section, I offer several ways that this can occur through a focus on ECSA, the Electrical Engineering Department at UCT, and the wider discipline of engineering education in general.

9.3.1. The Engineering Council of South Africa

As has been made clear throughout this dissertation, ECSA plays a significant role with regards to engineering education in South Africa, both through its accreditation of South African tertiary engineering programmes and its function as the regulatory body of the engineering industry. To this end, I would argue that the findings of my research could be used to rework the exit-level outcomes (ELOs) in such a manner that they reflect an acknowledgement of the weaknesses of the skills-based approach to workplace readiness and focus, instead, on creating opportunities for students to begin to develop discursive identities as engineers. For example, rather than including references to workplace “skills”, “methods” and “tools” in a fashion that gives the impression that these are neutral, predetermined and unchangeable, the ELOs should incorporate the goals of developing engineering identities, responding to real-life professional engineering challenges and using engineering Discourse in a manner that does not reflect passive replication but rather critical engagement. ECSA’s current oversight of engineering education does serve to keep the industry functioning; however, my argument is that, by using the ELOs to stipulate the importance of students making connections between what they are studying and their personal identities throughout the years of their degree programmes, ECSA will ensure that not only are the students better prepared to function in industry but are also more driven and focussed to innovate.

The risk exists that engineering faculties at the higher education institutions (HEIs) that ECSA accredits will be ill-prepared to deal with this expanded understanding of workplace readiness and will not know how to enact these ELOs in their curricula. This, however, is already a challenge for HEIs with the current ELOs (see Section 6.1.2). I would argue that the answer does not lie in perpetuating a sub-optimal set of ELOs. I noted a number of times in previous chapters that a large proportion of engineering education research is performed by engineering educators who hail from engineering faculties and therefore have

a natural interest in quantitative, positive research. The rich findings that have emerged from my study attest to the value of qualitative research in engineering education, and ECSA, as having arguably the most powerful influence on engineering education in South Africa, must ensure that its policies are grounded in research that emanates from a variety of different approaches. In this way, ECSA's ELOs will not only be to the benefit of industry in that they contribute to the production of fit-for-purpose graduate engineers but also to the benefit of the students themselves. ECSA could do this by ensuring that the ELOs do not promote rote, uniform labour but rather offer a space in which students are recognised as individuals, supported in their personal growth and encouraged to critically engage with the engineering role in order to potentially contribute to the industry's concerns in innovative ways.

9.3.2. The Electrical Engineering Department at the University of Cape Town

The implications of my research for the Electrical Engineering Department relate to the efficacy of the NVP/PCS course pairing, with particular focus on the shared objective of both courses, which was to prepare students for the workplace. As discussed in Section 9.2 above, a focus on workplace readiness within the electrical engineering degree is both relevant and warranted. However, my findings have led me to believe that the current form of the course pairing is not as effective as it could be: First, the divide between the two courses implies that there is a separation between planning a new venture and enacting professional communication skills, which is in conceptual opposition to the understanding of workplace readiness as discursive identity development that has run through this study. I would argue that new venture planning and communication are intertwined in a number of ways: For example, it would be impossible to launch a new venture without communicating with other people; entrepreneurship itself is a form of communicating with society regarding its needs and possible solutions to its challenges; teamwork, which was covered in both courses, is a core tenet of starting a new business and both a necessity for and signifier of

good communication; and so forth. For this reason, I believe that the way in which the pairing was structured in 2015, when I carried out my research, with two separate course codes, different teaching staff and very little coordination between the courses, was, at best, unwieldy and, at worst, inhibited the students' development of workplace readiness. This is supported by the work of Bergman, Eriksson, Blennow, Groot and Hammarström (2013) who show that where the pairing of disciplinary engineering and communication courses are done in a superficial way, there are significant risks to the success. First, disciplinary experts often assume that students will be able to enact the communicative tasks (which is not always the case), and second, communication teachers may not have sufficient engineering knowledge to be deemed a trustworthy audience or assessor by the students.

As an approach to improving these weaknesses in subsequent years, I offer two potential solutions: The first would be to combine the NVP and PCS courses into a single course.³⁰ This new course could incorporate the most effective elements of both courses. For NVP, this could include the development of a new venture (although the specifics concerning this task would need to be negotiated so that the task becomes more authentic) and exposure to a range of engineering entrepreneurs. The new course should incorporate PCS pedagogy that emphasises interaction, including discussion and activities. Assessment should be formative in order to prevent students from falling back on rote learning and should include built-in elements of on-going reflection. A course such as this would have a powerful impact on students, as it would provide an opportunity for them to consolidate their learning from the previous years and begin to consider how they will apply this knowledge as professionals in industry.

³⁰ I acknowledge that this could result in issues in terms of credits, given that, instead of receiving two sets of credits towards their degree programmes, the students would only receive one. However, this is not a significant problem, as the newly expanded composite course could be worth more credits, or else students could use the extra available credits to take another non-engineering related course, which was something that a number of the students I interviewed reflected the desire to do.

My second proposed solution is that, rather than bundling employability-focussed content into separate courses such as NVP or PCS, elements pertaining to workplace readiness as it is conceptualised in this study could be incorporated throughout the electrical engineering programme. This would require the adoption of a macro-perspective on the entire curriculum, since, as it currently stands, the fact that ECSA's ELOs relating to workplace readiness are achieved in the NVP/PCS course pairing means that there is no requirement for those teaching the more technical engineering subjects to find means of making their students aware of the ways in which what they are learning will be of relevance once they are working. However, this sets up a false dichotomy for the students, since they may then come to view issues relating to employability as being isolated from their technical engineering knowledge, which is clearly contrary to my conceptualisation of workplace readiness as identity transformation. If my research findings concerning the importance of strengthening students' personal identities and deepening their understanding of the role of the engineer were incorporated into the full four-year degree programme, the process of developing discursive identities as engineers on the part of students could begin in first year. This would mean that, by the time that students finished their degrees, they would be fully "professionalised" (Dannels, 2000) and prepared to enter the engineering workplace. Some of the ways in which this could be achieved could be through providing more input from working engineers throughout the years of the degree programme, by using reflective writing to assess students' understandings of technical work (as opposed to only summative assessment strategies) and through the adoption of innovative, learner-centred pedagogy, such as the "flipped classroom" model. This model of teaching and learning sees students engage with theoretical material in their own time, with class time being reserved for practical activities that encourage active engagement with and application of knowledge, exploration of issues in a holistic manner and problem solving that encourages the "open-ended inquiry, thinking skills and metacognition" (Rule, 2016: 2) that were discussed in Section 9.2 as core aspects of authentic learning. Each of these pedagogic actions could be carried out whilst still acknowledging Dannels's (2000: 28) assertion that

“school will never be the workplace; it will always be school”. She recommends explicitly incorporating reflection on the connections and contradictions between the academic/workplace contexts into engineering teaching in order to bring them to the fore for students, rather than pretending they do not exist. Similarly, Paretto (2008) suggests that being explicit and open about the needs, constraints and goals of each context can enable instructors to leverage the benefits of situated learning within engineering classrooms.

The benefit of this second proposed solution would not only be that students would be better prepared for the workplace when they graduate, as it would also produce a new, innovative degree programme that shows itself to be responsive to the needs of society without compromising on core technical engineering knowledge. However, both of my proposed solutions represent responses to Wolff’s (2013: 92) call that given the epistemological and discursive complexities involved in multidisciplinary engineering practice in the twenty-first century, those looking to create educational spaces in which students can explicitly integrate different forms of knowledge need to broaden their “conceptualisation of collaboration”.

9.3.3. The discipline of engineering education

The implications of my findings for the discipline of engineering education relate to two aspects: pedagogy and further research. With regards to pedagogy, my findings indicate that the development of discursive identities of engineers on the part of students should be a priority for tertiary engineering programmes. This implies that engineering programmes should not only focus on technical material to the detriment of encouraging holistic growth in the students. In this study, I employed Archer’s (1995) analytical dualism as a way to track structure, culture and agency throughout the morphogenetic cycle under examination, which was the NVP/PCS course pairing during the first semester of 2015. My analysis led me to conclude that engineering education would benefit from a more explicit focus on promoting student agency in the formulation of

curriculum, assessment methods and pedagogic strategies. This is because, while my findings in Chapter 8 described how some of the students did become social actors through the NVP/PCS course pairing and demonstrated acceptance and embodiment of the engineering role, when this occurred, it was largely a by-product of the formal curriculum.

It is my belief that including the development of discursive identities as engineers on the part of students as a core objective of engineering programmes could result in students being encouraged to find ways of actively balancing their primary Discourses with the different secondary Discourses that they encounter during their studies, such as student, engineer-in-training, professional, entrepreneur, social innovator and so on. This would mean that on-going identity work would be integrated in engineering programmes, making it a fundamental part of the students' experience, as opposed to a superficial add-on that is perceived as being less important than the technical engineering material. There are various ways that this could be integrated into engineering programmes. Some of these include mentorship programmes; peer support groups; on-going reflective processes, which could include, but are not limited, to writing activities; and a greater degree of interaction with industry through site visits and guest lecturers. The aim of these types of pedagogic initiatives would be to make the Discourse of engineering explicit to the students and to encourage them to critically assess this so that they are aware that there is space for critique and innovation.

My study opens up many possibilities with regards to further engineering education research: First, while this study has developed understandings concerning how the students studied developed discursive identities as engineers during the NVP/PCS course pairing, it could be valuable to conduct follow-up research on the same cohort of participants, who would likely have graduated and entered the workforce by the time of writing. The purpose of such research would be to understand the ways in which my findings concerning whether or not they developed identities as social actors correspond to the paths

that they have followed in their lives and careers subsequent to graduation. If those students whom I concluded had adopted discursive identities as engineers were strongly embodying this role in industry, it could serve to support my argument concerning the centrality of identity development in employability development. If this were found to not be the case, such future research could offer insight into what may have provided them with more support while they were at university. Another way of extending my study could be by conducting research based on the transition from higher education into the workplace. Whereas the morphogenetic cycle under consideration in my study was the NVP/PCS course pairing, a future study could span the middle of the final year to the middle of the first year of work in order to obtain greater insight into the experiences that students have as they make the transition from university to industry.

Second, Lucena, Downey and Amery (2006: 9) show that there is a direct link between particular countries' images of what constitutes progress and "what comes to count as an engineer in a particular location". This, in turn, impacts on the shape of engineering education in different national settings. While my dissertation presents a number of recommendations for engineering education in South Africa (via ECSA) and at UCT specifically, I will need to ensure that these are in line with the country's "locally specific ideas of societal development and progress" (Lucena et al, 2006: 12). There is thus significant scope for future research into how the engineering profession in South Africa both reflects and effects the country's developmental priorities, and the impact that potential shifts in engineering education in the country could have on both the profession and the national context.

Third, while this study dealt with workplace readiness for students enrolled for a BSc degree at a traditional university, similar studies could be carried out for students studying towards national diplomas and BTech degrees at other HEIs in

South Africa. As engineering technicians and technologists³¹, such graduates will also play an important part in the engineering industry, and, as such, it is also vital to understand how they are prepared to make the transition from their HEIs to the workplace. Finally, in terms of research methodology, it is clear from my study that the qualitative approach to the research that I adopted, as well as Bhaskar's critical realism (CR) and Archer's social realism (SR), led to the development of rich descriptive explanations and analytical narratives that would not have been possible using the more positivist, quantitative research paradigm that is more commonly employed for research in engineering education. Particularly in light of my conclusion regarding the importance of a more explicit focus on student agency in engineering education pedagogy, I would argue that it is imperative that qualitative research grounded in strong theory continues to be a focus of engineering education due to the potential it holds to shed light on students' experiences in a manner that reflects the nuance, complexity and dynamism of the higher education space.

9.4. Not conclusions, but beginnings

As was indicated by the quote with which this chapter opened, conclusions have the power to spark new beginnings. I have shared in this chapter a number of ways in which the conclusions that I have drawn from this study could be used, including to inform ECSA accreditation policy and to improve workplace readiness development in UCT's Electrical Engineering Department. In addition, in a more general sense, I have discussed some potential new beginnings for the engineering education discipline in terms of pedagogy and research. I choose to end this dissertation, however, with a brief word on the ways in which this study has impacted my own new beginnings, both as a researcher and as an educator.

In terms of my experience as a researcher, engaging with CR and SR has been both challenging and empowering. The challenge lay in the experience of working my way through unfamiliar terminology and concepts and piecing together

³¹ See Section 4.2.3 for a discussion of the difference between these roles.

different strands of theories and concepts until I developed a composite conceptual framework that was theoretically sound and served the objectives of my study. Herein lay the aspect of empowerment, for, in finding ways to apply the theory in order to support my needs (whilst also maintaining its integrity), I realised that the real power of social theories such as CR and SR lies in the way in which they are applied by a researcher and the knowledge to which they provide access. While my dissertation may have concerned identity change in engineering students, I recognise that I myself underwent a process of identity development as a researcher during the course of this study. This development was enabled by the process of engaging with complex social theories that, in changing the way I saw the world, ended up changing me. This, I believe, is something that I will carry into all my research in the future.

With regards to my role as an educator, I began this dissertation by explaining that this PhD study emerged as a response to my personal struggle to reconcile the complex intellectual, and often emotional, challenges that I experienced in my role as a PCS lecturer. With regards to this personal objective, my conclusions indicated, on the one hand, that the PCS course provided a space in which students could grow as individuals and experiment with the discursive identity of being engineers, thereby enabling identity transformation and, ultimately, workplace preparedness. This was validating to my teaching practice, since I am now more convinced that what we teach in the department has impacted the students in a manner that is not only useful for industry but also serves to empower them as they transition from university to the workplace.

However, on the other hand, the conclusions of my study have also served to heighten my awareness of the ways in which this aspect of engineering education could still be improved upon within the context in which I teach. My findings in Section 7.1.3 showed that there is scope for morphogenesis in the relationships that exist between PCS and the EBE Faculty and PCS and the Electrical Engineering Department. However, while I can share my findings with my colleagues and other engineering educators through presentations, publications

and discussions, I am aware that, as a part-time lecturer, I do not have the agency necessary to implement the wide-ranging suggestions that I described in Section 9.3.2. Nevertheless, I realise that I can incorporate some of these aspects into my teaching at the micro-level of my classroom interactions. This is supported by Paretti's (2008) assertion that instructors play a critical role in helping students enact professional practices. For example, instead of telling the students what constitutes "professionalism", I can encourage them to reflect on the concept and probe their understandings so that they come to see that it is a construct that is open to interpretation and alternative enactments, not a *fait accompli*. Similarly, I can make space for communication in languages other than English in my classroom, so that students can realise that, while English may be the commonly accepted language of business in South Africa for the moment, this is not the only way things can be and that they, as the engineers of the future, have the power to shape how things are done in industry. Other suggestions made by Paretti (2008: 500) include designing assignments that meet real faculty and student needs; making these needs explicit within the assignment descriptions and rubrics; and engaging students in the process of designing appropriate texts rather than simply fulfilling prescribed formats. As she explains, the role of an educator is to help students understand the "why" of communication, because only then can they begin to grasp the "how" (Paretti, 2008: 500). Following the research undertaken in the development of this dissertation, I feel better equipped to enact these critical pedagogical "moves" in my classes.

Relatively small shifts in my teaching practice such as those described above will ensure that the students in my classes are stimulated to think critically, envision new possibilities, and enter the workplace ready to make the "transformations" that ECSA deems so important as to include in its vision statement: "Engineering excellence, transforming the nation" (ECSA, n.d.). As an educator, therefore, my teaching will contribute (in a very small way) to the fulfilment of the objectives of the current engineering industry in South Africa. However, more importantly for me, I will be creating a space in which my students can engage with the role of being an engineer in a manner that empowers them to realise the agency that

they can enact in their embodiment of this role. In this way, I will know that I have helped to prepare them for an industry in which they will no longer be passive reproducers of the status quo but active agents with the power to shape the world around them through their application of engineering knowledge to society's problems. My new beginning as an educator is therefore one in which the focus of my practice will shift from a set of discrete, pre-defined workplace skills to the development of my students' discursive identities as engineers. I believe that this will lead to the students I teach leaving university more resolute in their choice of engineering as a career, more personally invested in the engineering role and, ultimately, better prepared for the challenges of the contemporary engineering workplace.

References

- Africa: Culture, Identity and Globalisation (AXL1200S)* | Centre for African Studies, UCT. 2016. Available: <http://www.africanstudies.uct.ac.za/cas/academic/undergrad/axl1200s> [2017, October 05].
- Akoojee, S. & Nkomo, M. 2007. Access and quality in South African higher education: the twin challenges of transformation. *South African Journal of Higher Education*. 21(3):385–399.
- Albee, E. 1962. *“The zoo story” and other plays*. London: Jonathan Cape.
- Allais, S. 2014. *Selling out education: national qualifications frameworks and the neglect of knowledge*. The Netherlands: Sense Publishers.
- Allie, S., Armien, M.N., Burgoyne, N., Case, J.M., Collier-Reed, B.I., Craig, T.S., Deacon, A., Fraser, D.M., et al. 2009. Learning as acquiring a discursive identity through participation in a community: improving student learning in engineering education. *European Journal of Engineering Education*. 34(4):359–367.
- Archer, M.S. 1995. *Realist social theory: the morphogenetic approach*. Cambridge; New York: Cambridge University Press.
- Archer, M.S. 2000. *Being human: the problem of agency*. Cambridge; New York: Cambridge University Press.
- Archer, M.S. 2003. *Structure, agency, and the internal conversation*. Cambridge: Cambridge University Press.
- Ashwin, P. 2008. Accounting for structure and agency in ‘close-up’ research on teaching, learning and assessment in higher education. *International journal of educational research*. 47(3):151–158.
- Bacchi, C. 2000. Policy as discourse: What does it mean? Where does it get us? *Discourse*. 21(1):45–57.
- Bacchi, C. 2005. Discourse, discourse everywhere: subject “agency” in feminist discourse methodology. *Nordic journal of women’s studies*. 13(03):198–209.

- Bacchi, C. 2009. *Analysing policy: What's the problem represented to be?* NSW, Australia: Pearson.
- Baldry, K. 2016. Graduate unemployment in South Africa: social inequality reproduced. *Journal of Education and Work*. 29(7):788–812.
- Barnett, R. 1990. *The idea of higher education*. Philadelphia: Society for Research into Higher Education Open University Press.
- Barnett, R. 1997. *Higher education: a critical business*. Buckingham England; Bristol, PA: Open University Press.
- Barnett, R. 2000. University knowledge in an age of supercomplexity. *Higher Education*. 40(4):409–422.
- Basart, J.M., Farrús, M. & Serra, M. 2015. New ethical challenges for today engineering and technology. *Telematics and Informatics*. 32(2):409–415.
- Beach, K. 1999. Consequential transitions: a sociocultural expedition beyond transfer in education. *Review of Research in Education*. 24(1):101–139.
- Beach, K. 2003. Consequential transitions: a developmental view of knowledge propagation through social organizations. In *Between school and work: new perspectives on transfer and boundary-crossing*. 1st Edition. (Advances in Learning and Instruction Series). Amsterdam; Boston: JAI Press.
- Bennett, N., Dunne, E. & Carré, C. 2000. *Skills development in higher education and employment*. Buckingham: Society for Research into Higher Education & Open University Press.
- Bergman, B., Eriksson, A.M., Blennow, J., Hammarström, T. & Groot, J. 2013. Reflections on an integrated content and language project-based design of a technical communication course for electrical engineering students. *Journal of Academic Writing*. 3(1): 1-14.
- Bertha Centre: Becoming a changemaker - Introduction to Social Innovation Course*. n.d. Available: <http://www.gsb.uct.ac.za/bc-edu-mooc> [2017, October 30].
- Bhaskar, R. 1975. *A realist theory of science*. Leeds: Leeds Books Ltd.

- Bhaskar, R. 1998. Philosophy and social realism. In *Critical realism: Essential readings*. M. Archer, R. Bhaskar, A. Collier, T. Lawson, & A. Norrie, Eds. New York: Routledge. 16–48.
- Billett, S. 2013. Recasting transfer as a socio-personal process of adaptable learning. *Educational Research Review*. 8:5–13.
- von Blottnitz, H., Case, J.M. & Fraser, D.M. 2015. Sustainable development at the core of undergraduate engineering curriculum reform: a new introductory course in chemical engineering. *Journal of Cleaner Production*. 106:300–307.
- Boden, R. & Nedeva, M. 2010. Employing discourse: universities and graduate ‘employability’. *Journal of Education Policy*. 25(1):37–54.
- Booi, M., Vincent, L. & Liccardo, S. 2017. Counting on demographic equity to transform institutional cultures at historically white South African universities? *Higher Education Research & Development*. 36(3):498–510. DOI: 10.1080/07294360.2017.1289155.
- Borrego, M., Douglas, E.P. & Amelink, C.T. 2009. Quantitative, qualitative, and mixed research methods in engineering education. *Journal of Engineering education*. 98(1):53–66.
- Bozalek, V. & Boughey, C. 2012. (Mis) framing higher education in South Africa. *Social Policy & Administration*. 46(6):688–703.
- Brannick, T. & Coghlan, D. 2007. In defense of being “native”: the case for insider academic research. *Organizational Research Methods*. 10(1):59–74. DOI: 10.1177/1094428106289253.
- Bridges, D. 1993. Transferable skills: a philosophical perspective. *Studies in Higher Education*. 18(1):43–51.
- Brinkmann, S. 2013. Conversations as research: philosophies of the interview. *Counterpoints*. 354:149–167.
- Brown, B.A., Reveles, J.M. & Kelly, G.J. 2005. Scientific literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education*. 89(5):779–802.
- Calhoun, C. 2006. The university and the public good. *Thesis Eleven*. 84(1):7–43.

- Carter, B. & New, C. 2004. Realist social theory and empirical research. Paper presented to ESA Social Theory Conference, Paris, 15-17 September.
Available:
<https://pdfs.semanticscholar.org/e1ea/7fd6e99288c47ccd6d3fa36ef59243677988.pdf> [2017, November 27].
- Case, J.M. 2006, Issues facing engineering education in South Africa. In *3rd African Regional Conference on Engineering Education*. Pretoria, South Africa. pp. 26-27.
- Case, J.M. 2013. *Researching student learning in higher education: a social realist approach*. London: Routledge.
- Case, J.M. 2015. A social realist perspective on student learning in higher education: the morphogenesis of agency. *Higher Education Research & Development*. 34(5):841–852.
- Case, J.M. & Light, G. 2014. Framing qualitative methods in engineering education research: established and emerging methodologies. In *Cambridge handbook of engineering education research*. A. Johri & B.M. Olds, Eds. New York: Cambridge University Press. 535–550.
- Case, J.M., Heydenrych, H., Kotta, L., Marshall, D., McKenna, S. & Williams, K. 2017. From contradictions to complementaries: a social realist analysis of the evolution of academic development within a department. *Studies in Higher Education*. 42(2):278–291.
- Clegg, S. 2011. Cultural capital and agency: connecting critique and curriculum in higher education. *British Journal of Sociology of Education*. 32(1):93–108.
- CMoloi, K., Makgoba, M.W. & Ogutu Miruka, C. 2017. (De)constructing the #FeesMustFall campaign in South African higher Education. *Contemporary Education Dialogue*. 14(2):211–223. DOI: 10.1177/0973184917716999.
- Collier, A. 1994. *Critical realism: an introduction to Roy Bhaskar's philosophy*. London, New York: Verso.
- Collini, S. 2012. *What are universities for?* London, New York: Penguin.

- Conlon, E. 2008. The new engineer: between employability and social responsibility. *European Journal of Engineering Education*. 33(2):151–159.
- Cousin, G. 2013. Getting to the bottom of the well: the value of qualitative research into teaching and learning. *Critical Studies in Teaching and Learning*. 1(1):123–136.
- Cruickshank, J. Ed. 2003. *Critical realism: the difference it makes*. (Routledge studies in critical realism no. 6). London; New York: Routledge.
- Cruickshank, J. 2004. A tale of two ontologies: an immanent critique of critical realism. *The Sociological Review*. 52(4):567–585. DOI: 10.1111/j.1467-954X.2004.00496.x.
- Cruickshank, J. 2010. Knowing social reality: a critique of Bhaskar and Archer's attempt to derive a social ontology from lay knowledge. *Philosophy of the social sciences*. 40(4):579–602.
- Dall'Alba, G. & Barnacle, R. 2007. An ontological turn for higher education. *Studies in Higher Education*. 32(6):679–691.
- Danermark, B., Ekström, M., Jakobsen, L. & Karlsson, J.C. 2002. *Explaining society: critical realism in the social sciences*. London, New York: Psychology Press.
- Dannels, D.P. 2000. Learning to be professional: technical classroom discourse, practice, and professional identity construction. *Journal of Business and Technical Communication*. 14(1): 5-37.
- Davies, B. & Bansel, P. 2007. Neoliberalism and education. *International Journal of Qualitative Studies in Education*. 20(3):247–259. DOI: 10.1080/09518390701281751.
- Department of Electrical Engineering. 2015. NVP course handout. UCT, unpublished.
- Department of Electrical Engineering. n.d. *Undergraduate programmes*. Available: <http://www.ee.uct.ac.za/undergraduate-programmes> [2017, October 23].
- Department of Professional Communication Studies. 2015a. PCS course evaluations. UCT, unpublished.

- Department of Professional Communication Studies. 2015b. PCS course handout. UCT, unpublished.
- Department of Professional Communication Studies. 2015c. *Professional online presence and CVs*. Lecture slides. Professional Communication Studies EEE406F. Delivered 17 Feb 2015.
- DHET. 2013. *White paper for post-school education and training*. Pretoria, South Africa: Department Higher Education and Training. Available: <http://www.che.ac.za/sites/default/files/publications/White%20Paper%20-%20final%20for%20web.pdf> [2014, June 04].
- DHET. 2017. *Research agenda 2017-2020*. Pretoria, South Africa: Department of Higher Education and Training. Available: http://www.dhet.gov.za/Planning%20Monitoring%20and%20Evaluation%20Coordination/DHET%20RESEARCH%20AGENDA%20VERSION_20170502.pdf [2017, November 21].
- Dill, D.D. 2005. The public good, the public interest, and public higher education. In *conference 'Recapturing the "Public" in Public and Private Higher Education*. V. 22. Available: http://www.researchgate.net/publication/228986325_The_public_good_the_public_interest_and_public_higher_education/file/3deec526f2c4f65538.pdf [2014, June 04].
- Donnelly, K. 2007. Australia's adoption of outcomes based education: a critique. *Issues in Educational Research* 17(2): 183.
- Du Toit, R. & Roodt, J. 2009. *Engineers in a developing country: the profession and education of engineering professionals in South Africa*. Cape Town, South Africa: HSRC Press.
- Durrheim, K. & Kelly, K. 2006. Research design. In *Research in practice: applied methods for the social sciences*. 2nd ed. M. Terre Blanche, K. Durrheim, & D. Painter, Eds. Cape Town: University of Cape Town Press. 34-59.
- Easton, G. 2010. Critical realism in case study research. *Industrial Marketing Management*. 39(1):118-128.

- EBE. 2016. *EBE Research Report 2015-2016*. Available:
http://www.research.uct.ac.za/sites/default/files/image_tool/images/307/ResearchReport2015-16/EBE_Final.pdf [2017, November 10].
- EBE. n.d. *Welcome to the Faculty of Engineering and the Built Environment | Faculty of Engineering & the Built Environment*. Available:
<http://www.ebe.uct.ac.za/ebe/about/profile> [2017a, August 18].
- EBE. n.d. *Research Groups | Department of Electrical Engineering*. Available:
<http://www.ee.uct.ac.za/research-groups> [2017b, October 09].
- EBE. n.d. *Why choose UCT | Faculty of Engineering & the Built Environment*. Available: <http://www.ebe.uct.ac.za/ebe/about/whyebe> [2017c, November 21].
- EBE. n.d. *Committed to transformation | Faculty of Engineering & the Built Environment*. Available:
<http://www.ebe.uct.ac.za/ebe/about/transformation> [2017e, October 31].
- ECSA. 2010. *Engenius, a campaign to grow and transform the engineering profession*. Available:
https://www.ecsa.co.za/news/Bulletins/241110_Engenius.pdf [2017, August 03].
- ECSA. 2012. *Qualification standard for Bachelor of Science in Engineering (BSc(eng))/Bachelors of Engineering (BEng): NQF Level 8*. Available:
https://www.ecsa.co.za/RegisterDocuments/DocIndex/EngineeringProgrammes/E-02-PE_Whole_Qualification_Standard_R3.pdf [2017, October 14].
- ECSA. 2014a. *Criteria for accreditation of engineering programmes meeting stage 1 requirements*. Available:
<https://www.ecsa.co.za/education/EducationDocs/E-03-P.pdf> [2017, November 22].
- ECSA. 2014b. *Background to Accreditation of Engineering Education Programmes*. Available:
https://www.ecsa.co.za/education/EducationDocs/E-01-P_Background_To_Accreditation.pdf. [2017, November 15]

- ECSA. 2014c. *Qualification Standard for Bachelor of Science in Engineering (BSC(Engs))/Bachelors of Engineering (BEng): NQF Level 8*. Available: <https://www.ecsa.co.za/education/EducationDocs/E-02-PE.pdf> [2017, June 02].
- ECSA. 2016. *Annual report 2015/2016*. Available: https://www.ecsa.co.za/news/Annual%20Reports/Annual_Report_2015-2016.pdf [2017, August 03].
- ECSA. 2017. *Code of conduct for registered persons*. Available: https://www.ecsa.co.za/regulation/RegulationDocs/Code_of_Conduct.pdf [2017, August 18].
- ECSA. n.d. *The engineering skills pipeline*. Available: https://www.ecsa.co.za/news/Bulletins/241110_Engineering_Skills_Pipeline.pdf [2017a, November 22].
- ECSA. n.d. *About ECSA - Mission and Vision*. Available: <https://www.ecsa.co.za/about/SitePages/Mission%20and%20Vision.aspx> [2017b, April 16].
- ECSA. n.d. *ECSA Brochure*. Available: <https://www.ecsa.co.za/news/Brochure/ECSA%20Brochure.doc>. [2017c, August 28].
- ECSA. n.d. *Register - Why Register*. Available: <https://www.ecsa.co.za/register/SitePages/Why%20Register.aspx> [2017d, August 30].
- ECSA. n.d. *Education & Accreditation - Accreditation*. Available: <https://www.ecsa.co.za/education/SitePages/Accreditation.aspx> [2017e, August 30].
- Edu-surveys. 2013. *National engineering skills survey (ECSA)*. Available: https://www.ecsa.co.za/news/Surveys%20PDFs/200215_ECSA_National_Engineering_Skills_Survey_Report_April_2014.pdf [2017, July 23].
- Eliot, M. & Turns, J. 2011. Constructing professional portfolios: sense-making and professional identity development for engineering undergraduates. *Journal of Engineering Education*. 100(4):630–654.

- Erdil, N.O., Harichandran, R.S., Collura, M.A., Nocito-Gobel, J. & Adams, D.J. 2016. Preliminary assessment of and lessons learned in PITCH: an integrated approach to developing technical communication skills in engineers. New Orleans, Louisiana. DOI: 10.18260/p.25944.
- Evetts, J. 2012. Professionalism in turbulent times: changes, challenges and opportunities. In *Propel International Conference Stirling*. 1–33. Available: <https://www.stir.ac.uk/media/schools/sass-ed/propel/2012/JuliaEvetts-FullPaper.pdf> [2017, April 16].
- Fairclough, N. 1992. *Discourse and social change*. Cambridge: Polity Press.
- Fenwick, T. 2013. Understanding transitions in professional practice and learning. *Journal of Workplace Learning*. 25(6):352–367.
- Ferguson, J. 2010. The uses of neoliberalism. *Antipode*. 41:166–184. DOI: 10.1111/j.1467-8330.2009.00721.x.
- Finch, H. & Lewis, J. 2003. Focus groups. In *Qualitative research practice: a guide for social science students and researchers*. J. Ritchie & J. Lewis, Eds. London, Thousand Oaks, New Delhi: SAGE Publications.
- Fisher, G. 2011. *Improving throughput in the engineering Bachelors degree*. Bruma: ECSA.
- Floyd, C., Johnson, K., & Rabb, R. 2007 Engineering internships - individual and program assessment. In *American Society of Engineering Education Zone II Conference*. San Juan, Puerto Rico.
- Flyvbjerg, B. 2005. Five misunderstandings about case study research. *Qualitative Inquiry*. 12(2):219–245. DOI: 10.1177/1077800405284363.
- Foucault, M. 1973. *The archeology of knowledge*. USA: Vintage Books.
- Froyd, J.E., Wankat, P.C. & Smith, K. 2012. Five major shifts in 100 years of engineering education. *Proceedings of the IEEE*. 100(Special Centennial Issue):1344–1360.
- Galloway, P.D. 2008. *The 21st century engineer: a proposal for engineering education reform*. Virginia: ASCE Press.
- Gedye, S., Fender, E. & Chalkley, B. 2004. Students' undergraduate expectations and post-graduation experiences of the value of a degree. *Journal of Geography in Higher Education*. 28(3):381–396.

- Gee, J.P. 2008. *Social linguistics and literacies: ideology in discourses*. 3rd ed. London, New York: Routledge.
- Gee, J.P. 2014. *An introduction to discourse analysis: theory and method*. 4th ed. Oxon, New York: Routledge.
- Genever, S. 2016. Graduate begs for job in traffic, lands Sasol interview. *SA Breaking News*. 19 May. Available: <http://www.sabreakingnews.co.za/2016/05/19/graduate-begs-for-job-in-traffic-lands-sasol-interview/> [2017, November 20].
- Govinder, K.S., Zondo, N.P. & Makgoba, M.W. 2013. A new look at demographic transformation for universities in South Africa. *South African Journal of Science*. 109(11):1-11.
- Grasso, D. & Burkins, M. 2010. *Holistic engineering education: beyond technology*. New York, Dordrecht, Heidelberg, London: Springer Science & Business Media.
- Griesel, H. & Parker, B. 2009. *Graduate attributes: a baseline study on South African graduates from the perspective of employers*. Pretoria, South Africa: Higher Education South Africa.
- Grimson, J. 2002. Re-engineering the curriculum for the 21st century. *European Journal of Engineering Education*. 27(1):31-37. DOI: 10.1080/03043790110100803.
- Hager, P. & Hodgkinson, P. 2009. Moving beyond the metaphor of transfer of learning. *British Educational Research Journal*. 35(4):619-638.
- Hammersly, M. 1993. Introducing ethnography. In *Researching language and literacy in social context: a reader*. Clevedon: Multilingual Matters Ltd. 1-17.
- Hanrahan, H.E., Beute, N., Fraser, D.M., Gosling, J., Lawless, A. & Jandrell, I.R. 2006. Engineering education in South Africa: in fragile good health, denial or crisis? Pretoria, South Africa.
- Harker, R. 2011. *Flavours of engineering*. Available: <http://www.ee.co.za/article/mark-b-320-08-flavours-of-engineering.html> [2017, December 03].

- Harvey, L. 2000. New realities: The relationship between higher education and employment. *Tertiary Education & Management*. 6(1):3–17.
- Harwood, J. 2006. Engineering education between science and practice: rethinking the historiography. *History and Technology*. 22(1):53–79. DOI: 10.1080/07341510500497210.
- Herrington, Parker and Boase-Jelinek. Connected authentic learning: reflection and intentional learning. *Australian Journal of Education*. 58(1): 23-35,
- Hinchliffe, G.W. & Jolly, A. 2011. Graduate identity and employability. *British Educational Research Journal*. 37(4):563–584.
- Hoel, C. 2010. Morphogenetic approaches to religion: understanding religion from the perspective of Margaret Archer. University of Agder. Available: http://brage.bibsys.no/xmlui/bitstream/handle/11250/139559/MASTER_OPPGAVE%20HOEL.pdf?sequence=1 [2014, June 03].
- Holmes, L. 2013. Competing perspectives on graduate employability: possession, position or process? *Studies in Higher Education*. 38(4):538–554.
- Hurston, Z.N. 1942. *Dust tracks on a road*. Canada: Proofreaders Canada. Available: <http://www.fadedpage.com/link.php?file=20170216-a5.pdf> [2017, November 28].
- Hyett, N., Kenny, A. & Dickson-Swift, V. 2014. Methodology or method? A critical review of qualitative case study reports. *International Journal of Qualitative Studies on Health and Well-being*. 9(1):23606. DOI: 10.3402/qhw.v9.23606.
- Jawitz, J. 2001. Priorities for the new engineering education movement in South Africa. *Australasian Journal of Engineering Education*. 9(2).
- Jawitz, J. & Case, J.M. 1998. Exploring the reasons South african students give for studying engineering. *International Journal of Engineering Education*. 14(4):235–240.
- Jordan, A., Carlile, O. & Stack, A. 2008. *Approaches to learning: a guide for teachers*. Maidenhead: Open University Press.
- Kelly, K. 2006. From encounter to text: collecting data in qualitative research. In *Research in practice: applied methods for the social sciences*. 2nd ed. M.

- Terre Blanche, K. Durrheim, & D. Painter, Eds. Cape Town: University of Cape Town Press. 283–319.
- Kelly, K. & Bowe, B. 2011. Qualitative research in engineering education. Vancouver, Canada. Available:
<http://arrow.dit.ie.ezproxy.uct.ac.za/cgi/viewcontent.cgi?article=1171&context=engscheleart> [2017, November 28].
- Kemp, S. 2005. Critical Realism and the limits of philosophy. *European Journal of Social Theory*. 8(2):171–191. DOI: 10.1177/1368431005051762.
- Kilian, A. 2017. *Taking ECSA, Minister to court was a 'last resort', says Saice*. Available: http://www.engineeringnews.co.za/article/ecsa-2017-03-14/rep_id:4136 [2017, October 30].
- King, A. 1999. Against structure: a critique of morphogenetic social theory. *The Sociological Review*. 47(2):199–227. DOI: 10.1111/1467-954X.00170.
- Kinsella, S. 2010. *Ideas are free: the case against intellectual property*. Available: <https://mises.org/library/ideas-are-free-case-against-intellectual-property> [2017, October 29].
- 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.
- Knight, P.T. & Yorke, M. 2003. Employability and good learning in higher education. *Teaching in Higher Education*. 8(1):3–16.
- Koro-Ljungberg, M. & Douglas, E.P. 2008. State of qualitative research in engineering education: Meta-analysis of JEE articles, 2005-2006. *Journal of Engineering Education*. 97(2):163.
- Koro-Ljungberg, M., Douglas, E.P., McNeill, N.J., Therriault, D.J., Lee, C.S. & Malcolm, Z. 2017. Academic problem-solving and students' identities as engineers. *The Qualitative Report*. 22(2):456–478.
- Kruss, G. 2004. Employment and employability: expectations of higher education responsiveness in South Africa. *Journal of Education Policy*. 19(6):673–689.

- Lange, L. 2017. 20 Years of higher education curriculum policy in South Africa. *Journal of Education*. 0(68):31–57.
- Lillis, T. 2008. Ethnography as method, methodology, and “deep theorizing”: closing the gap between text and context in academic writing research. *Written Communication*. 25(3):353–388.
- Lombardi, M.M. 2007. Authentic learning for the 21st century: an overview. *Educause learning initiative*. 1(2007):1–12.
- Lucena, J.C., Downey, G.L. & Amery, H.A. 2006. From region to country: engineering education in Bahrain, Egypt and Turkey. *IEEE Technology and Society Magazine*. 25(2): 4-11.
- Luckett, K. 2012. Working with ‘necessary contradictions’: a social realist meta-analysis of an academic development programme review. *Higher Education Research & Development*. 31(3):339–352.
- Madibogo, J. 2016. Another chemical engineering graduate is begging for a job at robots. *Times Live*. 19 May. Available: <https://www.timeslive.co.za/news/south-africa/2016-05-19-another-chemical-engineering-graduate-is-begging-for-a-job-at-robots/> [2017, November 20].
- Maharajh, R., Motala, E. & Scerri, M. 2011. South Africa: reforming higher education and transforming the National System of Innovation. In *Universities in transition: the changing role and challenges for academic institutions*. B. Göransson & C. Brundeis, Eds. New York, Dordrecht, Heidelberg, London: Springer. 193–218.
- Martins, P. 2015. *Blue ocean strategy*. Lecture slides. New Venture Planning EEE4051F UCT. Delivered 3 March 2015.
- Mason, G., Williams, G. & Cranmer, S. 2009. Employability skills initiatives in higher education: what effects do they have on graduate labour market outcomes? *Education Economics*. 17(1):1–30.
- Maxwell, J.A. 2012. *A realist approach for qualitative research*. Thousand Oaks: SAGE Publications.

- Maxwell, J.A. 2013. *Qualitative research design: an interactive approach*. 3rd ed. (Applied social research methods no. 41). Thousand Oaks, Calif: SAGE Publications.
- May, T. 2011. *Social research: issues, methods and process*. 4th ed. Maidenhead, Berkshire: Open University Press.
- McArdle-Clinton, D. 2008. *The consumer experience of higher education: the rise of capsule education*. London, New York: Continuum.
- McDonald, D. 2015. SA spends R35m on Cuban engineers amid criticism. *Fin24*. 19 February. Available: <https://www.fin24.com/Economy/SA-spends-R35m-on-Cuban-engineers-amid-criticism-20150219> [2017, December 07].
- Mercer, J. 2007. The challenges of insider research in educational institutions: wielding a double-edged sword and resolving delicate dilemmas. *Oxford Review of Education*. 33(1):1–17.
- Metcalf, S. 2017. Neoliberalism: the idea that swallowed the world. *The Guardian*. 18 August. Available: <http://www.theguardian.com/news/2017/aug/18/neoliberalism-the-idea-that-changed-the-world> [2017, November 01].
- Minogue, K.R. 2005. *The concept of a university*. New Brunswick, N.J: Transaction Publishers.
- Mohd-Yusof, K., Phang, F.A. & Helmi, S.A. 2014. How to develop engineering students' problem solving skills using cooperative problem based learning (CPBL). *QScience Proceedings*. 2014(3):30. DOI: 10.5339/qproc.2014.wcee2013.30.
- Moll, I. 2004. Curriculum responsiveness: the anatomy of a concept. In *Curriculum responsiveness: case studies in higher education*. H. Griesl, P. Fish, & I. Moll, Eds. Pretoria: South African Universities Vice-Chancellors Association. 1–14.
- Moore, A. 2017. *Intellectual property and information control: philosophic foundations and contemporary issues*. London, New York: Routledge.
- Mungai, C. 2015. Students give it their best, but in the end employers find they are still not good enough. *The M&G Online*. 27 March. Available:

- <https://mg.co.za/article/2015-03-27-00-students-give-it-their-best-but-in-the-end-employers-find-they-are-still-not-good-enough/> [2017, November 19].
- Mutereko, S. 2017. Analysing the accreditation of engineering education in South Africa through Foucault's panopticon and governmentality lenses. *Assessment and Evaluation in Higher Education*. 1-13.
- National Academy of Engineering of the National Academies. 2005. *Educating the engineer of 2020: adapting engineering education to the new century*. Washington: National Academies Press.
- Nguyen, T. 2016. Employers lament lack of soft skills in graduates - University World News. 22 January. Available: <http://www.universityworldnews.com/article.php?story=20160119123408402> [2017, November 19].
- Nixon, J. 2008. *Towards the virtuous university: the moral bases of academic practice*. New York, London: Routledge.
- Nudelman, G. 2017a. Working with data and research methodologies. In *Professional communication: deliver effective written, spoken and visual messages*. 4th ed. J. English, Ed. Cape Town, South Africa: Juta and Company Ltd. 344-362.
- Nudelman, G. 2017b. "It's not just working on a plant for 20 years": students' perceptions of engineering professionalism. In *Fourth Biennial SASEE Conference*. Cape Town. 232-240.
- Nudelman, G. 2017c. Engineering identity: analysing e-portfolios in a professional communications course. *SAJHE*. 31(2):211-225.
- Oria, B. 2012. Enhancing higher education students' employability: a Spanish case study. *International Journal of Technology Management & Sustainable Development*. 11(3):217-230.
- Ornellas, A., Martínez-Román, M.-A., Tortosa-Martínez, J., Casanova, J.L., das Dores Guerreiro, M. & Engelbrecht, L.K. 2017. Neoliberalism and austerity in Spain, Portugal and South Africa: the revolution of older persons. *Journal of Gerontological Social Work*. 60(6-7):535-552. DOI: 10.1080/01634372.2017.1324935.

- Paretti, M.C. 2008. Teaching communication in capstone design: the role of the instructor in situated learning. *Journal of Engineering Education*. 97(4): 491-503.
- Pennington, A., Mokose, M., Smith, M.N. & Kawanu, Z. 2017. Neoliberalism and the crisis in higher education in South Africa. *New Agenda: South African Journal of Social and Economic Policy*. (64):28–32.
- PPS. 2013. SA engineering degree insufficient, say engineers - survey. Available: <https://www.pps.co.za/portal/docs/SA%20Engineering%20Degree%20insufficient%20say%20Engineers%20-%20survey.pdf> [2017, August 30].
- Professional Engineering Registration | SAIEE*. 2008. Available: <https://www.saiie.co.za/cms/content/100-professional-engineering-registration> [2017, August 04].
- Qu, S.Q. & Dumay, J. 2011. The qualitative research interview. *Qualitative Research in Accounting & Management*. 8:238–264. DOI: 10.1108/11766091111162070.
- Radio 702. 2016. *Graduate lands interview after “begging” for a job at traffic lights*. Available: <http://ewn.co.za/2016/05/18/Graduate-lands-interview-after-begging-for-a-job-at-traffic-light> [2017, August 31].
- Ramsden, P. 2003. *Learning to teach in higher education*. 2nd ed. London, New York: Routledge/Falmer.
- Reddy, T. 2004. *Higher education and social transformation: South Africa case study*. Council on Higher Education. Available: http://www.che.ac.za/sites/default/files/publications/HEandSocialTransformationReport_25Feb2004.pdf.
- Rhodes University. 2016. *A guide for Masters and Doctoral students at Rhodes University*. Available: <https://www.ru.ac.za/media/rhodesuniversity/content/research/documents/HDG%20Final%20July%202016.pdf> [2017, November 22].
- Riley, D., Slaton, A.E. & Pawley, A.L. 2014. Social justice and inclusion: women and minorities in engineering. In *Cambridge handbook of engineering education research*. A. Johri & B.M. Olds, Eds. New York: Cambridge University Press. 335–356.

- Ruddin, L.P. 2006. You can generalize stupid! Social scientists, Bent Flyvbjerg, and case study methodology. *Qualitative Inquiry*. 12(4):797–812. DOI: 10.1177/1077800406288622.
- Rule, A.C. 2006. Editorial: The components of authentic learning. *Journal of Authentic Learning*. 3(1):1–10.
- SAQA. 2000. *The National Qualifications Framework and curriculum development*. South African Qualifications Authority. Available: http://www.saqa.org.za/structure/nqf/docs/curriculum_dev.pdf [2013, November 05].
- Sawyer, R.K. 2002. A discourse on discourse: an archeological history of an intellectual concept. *Cultural studies*. 16(3):433–456.
- Saunders, B., Kitzinger, J. & Kitzinger, C. 2015. Anonymising interview data: challenges and compromises in practice. *Qualitative Research*. 15(5) 616–632.
- Sayer, A. 2000. *Realism and social science*. London, Thousand Oaks, New Delhi: SAGE Publications.
- Scott, D. 2005. Critical realism and empirical research methods in education. *Journal of philosophy of education*. 39(4):633–646.
- Scott, I., Yeld, N. & Hendry, J. 2007. *Higher education monitor: A case for improving teaching and learning in South African higher education*. Council on Higher Education Pretoria. Available: http://www.che.ac.za/sites/default/files/publications/HE_Monitor_6_ITLS_Oct2007_0.pdf [2017, March 12].
- Seely, B.E. 2005. Patterns in the history of engineering education reform: a brief essay. In *Educating the engineer of 2020: adapting engineering education to the new century*. National Academy of Engineering, Ed. Washington: The National Academies Press. 114–130.
- Schoole, C. (2006). Internationalisation of higher education in South Africa: a historical review. *Perspectives in Education: Internationalisation of higher education: Global challenges, regional impacts and national responses: Special Issue 4*. 24: 1-13.

- Schoole, C. 2013. *Democratising higher education policy: constraints of reform in post-apartheid South Africa*. New York, Oxon: Routledge.
- Selema, P. 2016. Why are graduates unemployed? Available: <http://www.news24.com/MyNews24/why-are-graduates-unemployed-20160426> [2017, August 31].
- Shay, S., Ashwin, P. & Case, J. 2009. A critical engagement with research into higher education. *Studies in Higher Education*. 34(4). DOI: 10.1080/03075070902771879.
- Sheppard, S.D., Macatangay, K., Colby, A. & Sullivan, W.M. 2009. *Educating engineers: Designing for the future of the field*. San Francisco: Jossey-Bass.
- Shrivastava, M. & Shrivastava, S. 2014. Political economy of higher education: comparing South Africa to trends in the world. *Higher Education; Dordrecht*. 67(6):809–822. DOI: <http://dx.doi.org.ezproxy.uct.ac.za/10.1007/s10734-013-9709-6>.
- Singh, M. 2001. Re-inserting the “public good” into higher education transformation. *KAGISANO Higher Education Discussion Series*. 1:8–18.
- Sithole, J. 2006. Career cognitions of black engineers in South Africa. MBA research report. University of Pretoria.
- Slabbert, A. 2010. *Engineers in bitter racism row*. Available: <http://www.fin24.com/Business/Engineers-in-bitter-racism-row-20100808> [2017, October 30].
- Smith, C. 2015. *Intellectual property*. Lecture slides. New Venture Planning EEE4051F UCT. Delivered 19 May 2015.
- South Africa. 2008. *National Qualifications Framework Act 67 of 2008*. Pretoria. Available: <http://www.saqa.org.za/docs/legislation/2010/act67.pdf> [2015, November 5].
- Stapleton, K. & Wilson, J. 2004. Gender, nationality and identity: a discursive study. *European Journal of Women’s Studies*. 11(1):45–60.
- Statistics South Africa. 2012. *Census 2011: Census in Brief*. (03-01-41). Pretoria: Statistics South Africa. Available:

- http://www.statssa.gov.za/Census2011/Products/Census_2011_Census_in_brief.pdf. [2015, February 9].
- Tanenhaus, S. 1984. *Literature unbound: a guide for the common reader*. New York: Ballantine Books.
- Terre Blanche, M., Durrheim, K. & Kelly, K. 2006. First steps in qualitative data analysis. In *Research in practice: applied methods for the social sciences*. 2nd ed. M. Terre Blanche, K. Durrheim, & D. Painter, Eds. Cape Town: University of Cape Town Press. 321–344.
- The New Age. 2016. *Many graduates at home, unemployed*. Available: <http://www.thenewage.co.za/many-graduates-at-home-unemployed/> [2017, August 31].
- Theron, M., Barkhuizen, N. & du Plessis, Y. 2014. Managing the academic talent void: investigating factors in academic turnover and retention in South Africa. *SA Journal of Industrial Psychology*. 40(1): 1-14.
- Tomlinson, M. 2012. Graduate employability: a review of conceptual and empirical themes. *Higher Education Policy*. 25(4):407–431.
- Tonso, K.L. 2006. Student engineers and engineer identity: campus engineer identities as figured world. *Cultural Studies of Science Education*. 1(2):273–307.
- Tonso, K.L. 2014. Engineering identity. In *Cambridge Handbook of Engineering Education research*. A. Johri & B.M. Olds, Eds. New York: Cambridge University Press.
- Trepanier, L. 2013. A philosophy of prudence and the purpose of higher education today. In *The relevance of higher education: exploring a contested notion*. Plymouth UK: Lexington Books. 1–24.
- Trowler, P. 2011. Researching your own institution: higher education. *British Educational Research Association online resource*. Available: http://bera.dialsolutions.net/system/files/Researching%20your%20own%20institution%20Higher%20Education_0.pdf [2014, May 28].
- Trowler, P. 2016. *Doing insider research in universities*. CreateSpace Independent Publishing Platform.

- Tryggvason, G. & Apelian, D. 2006. Re-engineering engineering education for the challenges of the 21st century. *JOM, Journal of the Minerals, Metals and Materials Society*. 58(10):14–17.
- Tsilipakos, L. 2012. The poverty of ontological reasoning. *Journal for the Theory of Social Behaviour*. 42(2):201–219. DOI: 10.1111/j.1468-5914.2012.00486.x.
- UCT. 2015. *Faculty of Engineering and the Built Environment (Undergraduate) 2015*. Available:
<http://www.students.uct.ac.za/downloads/uct.ac.za/apply/handbooks/Handbook%207A%20EBE%20Undergraduate%20Studies2015.pdf> [2017, October 28].
- UCT. 2016a. *Annual report for 2016 of the University of Cape Town*. Available:
http://www.uct.ac.za/sites/default/files/image_tool/images/328/about/finance/reports/afs2016.pdf [2017, October 26].
- UCT. 2016b. "About UCT" factsheet. Available:
http://www.news.uct.ac.za/images/userfiles/files/publications/factsheets/UCT_FactSheet_01_AboutUCT.pdf [2017, October 25].
- UCT. 2016c. *Research & Innovation 2015-16*. Available:
<https://www.paperturn-view.com/uctresearchoffice/research-innovation-2015-16?pid=NzQ7466> [2017, October 11].
- UCT. 2016d. "Welcome to EBE" factsheet. Available:
http://www.uct.ac.za/usr/news/downloads/faculty_brochures/UCT_FactSheet_02_EBE.pdf [2017, October 11].
- UCT. 2016e. *VC Desk: austerity measures at UCT*. Available:
<http://www.news.uct.ac.za/article/-2016-03-14-vc-desk-austerity-measures-at-uctreleased-10h30-14-march-2016> [2017, October 07].
- UCT. n.d. *Glossary | Institutional Planning*. Available:
<http://www.institutionalplanning.uct.ac.za/glossary#mature> [2017a, November 29].
- UCT. n.d. *Transformation at UCT | University of Cape Town*. Available:
<http://www.uct.ac.za/main/explore-uct/transformation> [2017b, October 31].

- Valentine, A., Belski, I. & Hamilton, M. 2016. Engaging engineering students in creative problem solving tasks: how does it influence future performance? In *44th SEFI Conference: Engineering Education on Top of the World: Industry University Cooperation*. European Society for Engineering Education. 1–9. Available: https://www.researchgate.net/profile/Andrew_Valentine2/publication/308079777_Engaging_engineering_students_in_creative_problem_solving_tasks_How_does_it_influence_future_performance/links/57d9655d08ae0c0081efae13.pdf.
- van Broekhuizen, H. 2016. *Graduate unemployment and higher education institutions in South Africa*. University of Stellenbosch; Bureau for Economic Research.
- Waghid, Y. 2008. The public role of the university reconsidered. *Perspectives in Education*. 26(1):19–24.
- Ward, C. & Moser, C. 2008. E-portfolios as a hiring tool: Do employers really care? *Educause Quarterly*. 31(4):13–14.
- Wassenaar, D.R. 2006. Ethical issues in social science research. In *Research in practice: applied methods for the social sciences*. M. Terre Blanche, K. Durrheim, & D. Painter, Eds. University of Cape Town Press. 60–79.
- Welch, C. & Piekkari, R., 2006. Crossing language boundaries: qualitative interviewing in international business. *Management International Review*, 46(4): 417-437.
- Williams, K. 2012. Rethinking ‘learning’ in higher education: viewing the student as social actor. *Journal of Critical Realism*. 11(3):296–323.
- Winberg, C., Engel-Hills, P., Garraway, J. & Jacobs, C. 2013. Professionally-oriented knowledge and the purpose of professionally-oriented higher education. *Kagisano*. 98–119.
- Wood, D., Bruner, J.S. & Ross, G. 1976. The role of tutoring in problem solving. *Journal of child psychology and psychiatry*. 17(2):89–100.
- Wolff, K.E. 2013. ‘Reservoirs’ and ‘repertoires’: epistemological and discursive complexities in multidisciplinary engineering practice. *Journal of Academic Writing*. 3(1): 84-94.

Appendix 1: Engineering Council of South Africa Exit-level Outcomes

Extract from ECSA (2012: 4-6)

Exit-level Outcome 1: Problem solving

Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.

Level Descriptor: Complex Engineering Problems:

- a) require in-depth fundamental and specialized engineering knowledge; and have one or more of the characteristics:
- b) are ill-posed, under- or overspecified, or require identification and refinement;
- c) are high-level problems including component parts or sub-problems;
- d) are unfamiliar or involve infrequently encountered issues; and their solution have one or more of the characteristics:
- e) are not obvious, require originality or analysis based on fundamentals;
- f) are outside the scope of standards and codes;
- g) require information from variety of sources that is complex, abstract or incomplete;
- h) involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

Exit-level Outcome 2: Application of scientific and engineering knowledge

Apply knowledge of mathematics, natural sciences, engineering fundamentals

and an engineering speciality to solve complex engineering problems.

Level descriptor: Knowledge of mathematics, natural sciences and engineering sciences is characterized by:

- A systematic, theory-based understanding of the natural sciences applicable to the discipline;
- Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline;
- A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline;
- engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

Mathematics, natural science and engineering sciences are applied in formal analysis and modelling of engineering situations, and for reasoning about and conceptualizing engineering problems.

Exit-level Outcome 3: Engineering Design

Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes.

Range Statement: Design problems used in exit-level assessment must conform to the definition of a complex engineering problem, defined under Exit-level Outcome 1. A major design problem should be used to provide evidence. The design knowledge base and components, systems, engineering works, products or processes to be designed are dependent on the discipline or practice area.

Exit-level Outcome 4: Investigations, experiments and data analysis

Demonstrate competence to design and conduct investigations and experiments.

Range Statement: The balance of investigation and experiment should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline.

Note: An investigation differs from a design in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Exit-level Outcome 5: Engineering methods, skills and tools, including Information Technology

Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.

Range Statement: A range of methods, skills and tools appropriate to the disciplinary designation of the program including:

1. Discipline-specific tools, processes or procedures;
2. Computer packages for computation, modelling, simulation, and information handling;
3. Computers and networks and information infrastructures for accessing, processing, managing, and storing information to enhance personal productivity and teamwork;
4. Basic techniques from economics, business management;
5. Health, safety and environmental protection appropriate to the discipline;
6. Risk assessment and management;
7. Project management.

Exit-level Outcome 6: Professional and technical communication

Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.

Range Statement: Material to be communicated is in an academic or simulated

professional context. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Written reports range from short (300-1000 word plus tables diagrams) to long (10 000 to 15 000 words plus tables, diagrams and appendices), covering material at exit-level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

Exit-level Outcome 7: Impact of Engineering Activity

Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment.

Range Statement: The combination of social, workplace (industrial) and physical environmental factors must be appropriate to the discipline or other designation of the qualification. Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability

Exit-level Outcome 8: Individual, Team and Multidisciplinary Working

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments.

Range Statement: Multidisciplinary tasks require co-operation across at least one disciplinary boundary. Co-operating disciplines may be engineering disciplines with different fundamental bases other than that of the programme or may be outside engineering.

Exit-level Outcome 9: Independent Learning Ability

Demonstrate competence to engage in independent learning through well developed learning skills.

Range Statement: Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative, accurately self-evaluate and take

responsibility for learning requirements; be aware of social and ethical implications of applying knowledge in particular contexts.

Exit-level Outcome 10: Engineering Professionalism

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence.

Range Statement: Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate. The contextual knowledge profile specified in the range statement of Exit Level outcome 7 is applicable here.

Appendix 2: Participants in each focus group interview

Focus group interview 1 (5/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Sami	Male	27	Coloured	South Africa	ECE
Ali	Male	22	Coloured	South Africa	Mechatronics
Yasin	Male	23	Coloured	South Africa	Mechatronics

Focus group interview 2 (11/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Senty	Female	23	Black	Swaziland	Electrical engineering
Kelly	Female	28	Black	Rwanda	Electrical engineering
Mary	Female	23	Black	Zimbabwe	ECE

Focus group interview 3 (12/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Mike	Male	27	White	South Africa	Electrical engineering
Adam	Male	28	White	South Africa	Mechatronics
Ken	Male	22	Black	Namibia	Mechatronics
Laurie	Male	24	White	South Africa	ECE

Focus group interview 4 (24/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Nosipho	Female	25	Black	South Africa	Electrical engineering
Basil					
Ravi	Male	23	Coloured	South Africa	ECE
Vuyo	Male	23	Black	South Africa	Electrical engineering

Focus group interview 5 (25/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Angela	Female	23	Black	Namibia	Mechatronics
Paul	Male	24	Black	South Africa	ECE
Sharone	Female	23	Black	Namibia	Electrical engineering

Focus group interview 6 (27/3/2015):

Name	Gender	Age	Race	Country of origin	Electrical engineering programme
Faith	Female	24	Black	Kenya	ECE
Thina	Female	22	Black	South Africa	Electrical engineering
Mary	Female	22	Black	South Africa	Electrical engineering

Appendix 3: Focus group interview guide

INTRODUCTION

- **Welcome**
- **Statement of purpose**
- The purpose of this focus group interview is to determine your ideas and opinions about your roles and experiences as fourth year engineering students and how these relate to your future careers.
- **Interview guidelines**

1. WARM-UP

- Can we go around the circle and each person, briefly, explain how it was that you decided to study electrical engineering here at UCT?

2. CLARIFICATION OF TERMS

Higher education refers to a post-school education system. In your case, we're referring to university, but more generally it can refer to any kind of tertiary institution.

3. INTRODUCTORY QUESTIONS

- If you had to pick a word to describe being an electrical engineering student, what would that word be and why?
- What academic activities do electrical engineering students spend most of their time on?
- What do you understand by the term “workplace readiness”?

4. KEY QUESTIONS

- What are the most important skills or knowledge that you've learnt in your degree that you'll use once you're in the workplace?
- What are some of the concerns facing electrical engineering students when they consider their futures as professionals?
- The NVP and PCS pairing is very much focussed on developing real-world skills. How important is this kind of course for an undergraduate electrical engineering student? Why?
- Electrical engineering is known for its large body of very technical material. What is it that motivates you to succeed as students?
- Can you describe your plans for when you graduate?
- What do you think life will be like when you're a qualified engineer?

5. ENDING QUESTIONS

- Considering all the issues discussed this afternoon, what would you say is the most important purpose of an undergraduate degree for an electrical engineering student?
- Finally, if you had one minute with the Head of Department of electrical engineering, what key issue from our discussion today would you highlight?

6. SUMMARY AND MEMBER CHECK

As we close off today's discussion, I'd like to find out how each of you feel about some of the key discussion points. At this point, I'm not looking for further discussion, just a general idea of how many of you feel a certain way.

- How many of you feel that the main function of higher education should be to prepare students for the workplace?

- How many of you have a clear idea of what you want to achieve once you graduate?

7. CLOSING STATEMENTS

- Review of issues around privacy and confidentiality
- Thanks

Appendix 4: Individual interview guide

1. INTRODUCTION

- **Statement of purpose**
- The purpose of this individual interview is to determine the ways that your experience of the fourth year NVP and PCS collaboration has impacted on your development as engineers.
- **Interview guidelines**

2. WARM-UP

- A word to describe their experience of NVP/PCS and briefly explain why they chose that word.

3. INTRODUCTORY QUESTIONS

- What do you think was the goal of NVP/PCS? Was this goal achieved?
- What were the main skills or competencies that you learnt on NVP/PCS?
- Was the way you approached the tasks during NVP/PCS different from the way you approach other university courses? In what ways?

4. KEY QUESTIONS

- What did NVP and PCS teach you about being a professional engineer?
- There seemed to be an emphasis on group work in these courses. How important do you think this is for engineering students to experience?
- In what way did NVP and PCS shift the way you understand what it means to be a professional engineer?
- Have your own professional goals changed as a result of your participation in NVP and PCS? How?

- Do you feel differently about entering the world of work after your participation in NVP and PCS? Why/why not?

5. ENDING QUESTIONS

- Considering all the issues discussed this afternoon, what would you say is the most important thing you'll take with you from NVP/PCS?
- If you could go back five months and tell yourself something about NVP/PCS course, what would it be?

6. CLOSING STATEMENTS

- Review of issues around privacy and confidentiality
- Thanks

Appendix 5: Nvivo coding categories T1-T4

T1

Name	Sources	References
● A great engineer	2	3
● A professional engineer	10	30
● An entrepreneur	4	5
● Benefits of pressured lear...	6	7
● Different EEE programmes	0	0
● ECE	6	8
● Electrical engineering	7	9
● Mechatronics	5	7
● ECSA	3	4
● Emotionality (and strength)	4	7
● Engineering as problem s...	5	7
● Family connection to engi...	7	8
● Girls and engineering	10	21
● Hobbies and interests - n...	3	4
● Knowledge about eng bef...	3	3
● Learning to think	14	23
● Learning how to learn...	5	9
● People's expectations	2	2
● Reasons for doing engine...	22	28
● Structure of the degree	18	28
● Student experience	0	0
● About international co...	2	2
● Academic positives	5	8
● Bad students	1	1
● Being an older student	1	3
● Being black at uni	2	9
● Competitiveness	5	6
● Complaints ignored	7	9
● Coping mechanisms	5	7
● Curriculum	5	6
● Dealing with failure	3	4
● DP pressures	3	7
● Evaluation procedure	1	1
● Excellence	3	6

● Experience of EEE dept	6	8
● Finding balance	1	1
● Focus not on marks	7	10
● Group work	23	50
● In & out the eng bubble	6	9
● Just studying to pass	13	23
● Learning	4	6
● Deep learning	8	10
● Surface learning	15	20
● Learning to cope over t...	3	3
● Lecturers	1	1
● Bad lecturers	13	47
● Good lecturers	11	19
● Tutors	2	2
● Life skills they've learn...	8	12
● Losing yourself & findi...	1	1
● Making friends	2	2
● Motivation to succeed	18	27
● Nearly quitting	6	9
● Not coming to lectures	12	22
● Of South Africa	0	0
● From foreigners	3	13
● From South Africans	0	0
● Other departments or...	9	13
● Packed curriculum	5	8
● Project work	3	5
● Role-playing being a pr...	4	5
● Sacrifices	2	2
● Self-study	9	16
● Shortest semester	2	2
● Specific courses	0	0
● Courses they'd like t...	6	11
● Non-engineering co...	17	24
● Particular engineeri...	15	21
● Why some courses	4	7

● Studying engineering i...	15	24
● Teaching strategies	9	13
● Things dept to do to im...	2	3
● Things they'd do if the...	2	4
● Time pressure	10	13
● Too much work	16	25
● Tutoring experience	1	1
● Understanding (or not)...	7	11
● University life	4	7
● What happens if you fail	1	1
● What they SHOULD te...	7	12
● With hindsight at end o...	2	2
● Writing subjects	7	16
● The New Engineer	10	16
● Theory vs practical	11	19
● University vs workplace e...	12	22
● Vac work experiences	15	34
● What's professional	3	9

T2 – T3

Name	Sources	References (
● NVP	0	0
● A lot of work	5	6
● Assessment & marks	8	11
● Best product presentat...	1	1
● Business plan	11	29
● Coming up with produc...	10	26
● Quality of the idea	3	4
● Concept proposal	1	1
● Could just outsource	2	2
● Course content	8	20
● ECSA	1	1
● Finances & accounting...	9	15
● Group work	4	7
● Health & safety	7	16
● Intellectual property	3	4
● Just wanting to pass	1	2
● Lecturers	1	1
● Lectures	8	13
● Marketing	4	5
● Need to actually STAR...	2	3
● No tuts	3	4
● Not going to be entrep...	4	6
● Pedagogy	4	6
● Project management	2	3
● Structure	3	4
● Should be longer	3	7
● Should be shorter	1	1
● The exam	8	14
● The product	3	5
● Product description	1	1
● The test	6	8
● Theory vs practical	5	14
● Things that were learnt	0	0
● Business savvy	2	3

● Communicating idea	1	1
● Creativity	1	4
● Good ideas	1	1
● Just awareness	1	3
● Need to be well-rou...	2	2
● Prep for being an en...	10	25
● Preparation	1	1
● Teamwork	2	3
● Wider persp of engi...	1	1
● Value of the course	8	12
● Would need an in-dept...	2	3
● PCS & NVP	0	0
● A lot of work	3	3
● Approaches to	9	12
● Creativity	2	3
● Goals	0	0
● Goals of the courses	9	14
● Students' profession...	7	11
● Groupwork experiences	11	37
● Identity change	2	2
● Out of engineering bub...	6	12
● Prep for being a profes...	11	23
● Things that were learnt	0	0
● Communication skills	3	3
● Getting the job	3	4
● Group work	5	14
● Leadership	2	2
● Look for opportunities	2	2
● Mutual respect	1	1
● NBance of skills	2	2
● Personal growth	1	1
● Planning within unce...	1	1
● Prep for being an en...	5	5
● Structure	1	2
● Taking on a role	7	8

● Time management	4	4
● What to expect in w...	3	3
● Together or separate	6	16
● Writing tasks	4	8
● PCS 2015	1	1
● Approach to PCS	7	14
● Assessment	7	12
● CV	7	19
● Deadlines	2	2
● EPortfolio	10	24
● Ethics	8	13
● Executive summary	1	2
● General responses	6	10
● Going into the workplace	4	5
● Job interview	5	6
● lectures	7	9
● Louise	6	20
● Negotiation	2	3
● Poster	7	8
● PowerPoint	4	4
● Presentations in general	10	33
● Presentation final	4	6
● Presentation rehear...	6	11
● Project-based	1	1
● Structure of the course	1	2
● Things that were learnt	0	0
● Communication skills	5	6
● Creativity	2	3
● Dealing with people	2	3
● How to be heard	1	1
● How to be professio...	4	9
● How to get a job	1	1
● How to present your...	4	5
● Interaction with the...	1	1
● Leadership experien...	1	1

● Rules	1	1
● Targetting an audien...	1	4
● Teamwork	1	3
● Thinking about aims	1	3
● Useful guidelines	4	6
● Writing skills	2	3
● Thinking about identity	2	4

T4

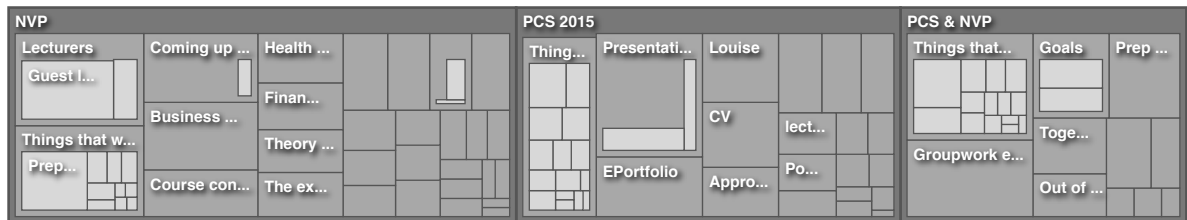
Name	Sources	References
● Career plans	0	0
● Ambivalence over engi...	9	15
● Certainly stay in engin...	14	18
● No plan	4	4
● Starting own business	8	13
● Things influencing care...	3	3
● Concerns for the future	14	21
● Future plans	0	0
● Postgraduate study	7	10
● Travel	3	4
● Want to stay in South...	1	1
● Semester reflections	1	1
● What workplace will be like	23	50

Appendix 6: NVivo hierarchy charts for T1-T4

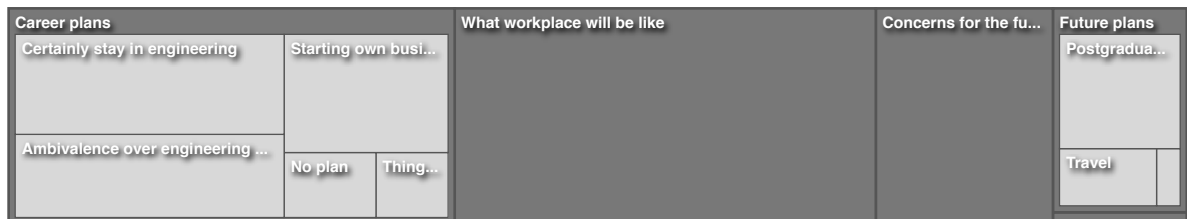
T1



T2-T3



T4



Appendix 7: Research consent form

CONSENT TO PARTICIPATE IN RESEARCH

<p>Engineering discursive transformation: a social realist study of employability skills development in higher education</p>

You are asked to participate in a PhD study by Gabi Nudelman, who is registered with the Centre for Higher Education Research, Teaching and Learning (CHERTL) at Rhodes University. You have been asked to participate because you are enrolled in EEE4051F (New Venture Planning) and EEE4006F (Professional Communication Studies). Your participation in the study is entirely voluntary. You should read the information below, and ask questions about anything you do not understand, before deciding whether or not to participate.

Purposes of the study

The study is designed to theorise the idea of developing employability skills in higher education. Using the NVP and PCS courses as a case study, the aims of study are to understand how:

- employability skills are taught to senior undergraduate electrical engineering students.
- students change over time as a result of participation in these courses.
- students experience “becoming engineers” during these courses.

Procedures

If you agree to participate in this study, you will give permission for Gabi to observe you during NVP and PCS lectures and as you work as a group out of class time. During this time, she will be taking notes and, on occasion, photographs. In addition, your participation in one-hour focus group interviews with your fellow NVP group members may be requested at the beginning and the end of the semester. These interviews will be filmed. The films will be used for analysis purposes only and will not be showed to

anyone. Following this, they will be stored safely for a period of five years before being deleted.

Anticipated benefits of the research

You will not be remunerated for your participation in the research and there are no specific benefits to you aside from the opportunity to share your views and opinions. However, information derived from your participation will be of use to lecturers, planners and researchers involved in preparing students for the workplace while they are in higher education.

Privacy and confidentiality

Your confidentiality will be protected during this study in the following ways:

- Gabi will be moderating focus group interviews herself. No additional PCS or EEE staff will be present.
- The films of the focus group interviews will only be viewed by Gabi.
- Your names will be changed to protect anonymity.
- Gabi will not be present at any PCS meetings in which the NVP course is discussed.

You have the right at any time to view the interview transcripts and drafts of the study, and to challenge the emerging theories or representations.

Participation and withdrawal

Your participation in this research is entirely voluntary. If you choose not to participate, that will not affect your relationship with the Professional Communication Studies department in any way. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without prejudice to your involvement with either NVP or PCS.

Further information

For further information regarding this research, please contact Gabi Nudelman (gabi.r.nudelman@gmail.com). If you have any concerns or complaints regarding the way the research is or has been conducted, contact the EBE Ethics in Research Committee via Zulpha Geyer (zulpha.geyer@uct.ac.za).

Signature of research participant

I have read the information provided above. I have been given an opportunity to ask questions and all of my questions have been answered to my satisfaction.

By signing this form, I willingly agree to participate in the research it describes.

Name

Signature

Date

Appendix 8: University of Cape Town

ethics clearance

	RESEARCH ACCESS TO STUDENTS	DSA 100
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NOTES

- This form must be **FULLY** completed by all applicants that want to access UCT students for the purpose of research.
- Return the fully completed (a) **DSA 100** application form by email, in the same word format, together with your: (b) **research proposal inclusive of your survey**, (c) **copy of your ethics approval letter / proof** (d) **informed consent letter** to: Moonira.Khan@uct.ac.za. Your application will be attended to by the Executive Director, Department of Student Affairs (DSA), UCT.
- The turnaround time for a reply is **approximately 10 working days**.
- NB: It is the responsibility of the researcher/s to apply for and to obtain **ethics approval and to comply with amendments that may be requested**; as well as to **obtain** approval to access UCT staff and/or UCT students, from the following, at UCT, respectively: (a) **Ethics**: Chairperson, Faculty Research Ethics Committee' (FREC) for ethics approval, (b) **Staff access**: Executive Director: HR for approval to access UCT staff, and (c) **Student access**: Executive Director: Student Affairs for approval to access UCT students.
- Note**: UCT Senate Research Protocols requires compliance to the above, **even if prior approval has been obtained from any other institution/agency**. UCT's research protocol requirements applies to **all persons, institutions and agencies from UCT and external to UCT** who want to **conduct research on human subjects for academic, marketing or service related reasons at UCT**.
- Should approval be granted to access UCT students for this research study, such approval is effective for a period of one year from the date of approval (as stated in Section D of this form), and the approval expires automatically on the last day.
- The approving authority reserves the right to revoke an approval based on reasonable grounds and/or new information.

SECTION A: RESEARCH APPLICANT/S DETAILS

Position	Staff / Student No	Title and Name	Contact Details (Email / Cell / land line)
A.1 Student Number	13S8221	Mrs Gabrielle Nudelman	gabi.r.nudelman@gmail.com 082 870 0088 / 021 433 2849
A.2 Academic / PASS Staff No.	01373265		
A.3 Visitor/ Researcher ID No.			
A.4 University at which a student or employee	Student at Rhodes University	Address if <u>not</u> UCT: ** Contract lecturer at UCT	
A.5 Faculty/ Department/School			
A.6 APPLICANTS DETAILS If different from above	Title and Name	Tel.	Email

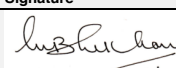
SECTION B: RESEARCHER/S SUPERVISOR/S DETAILS

Position	Title and Name	Tel.	Email
B.1 Supervisor	Prof. Lynn Quinn	046 603 8171	L.Quinn@ru.ac.za
B.2 Co-Supervisor/s	Dr Jo-Anne Vorster	046 603 8171	j.vorster@ru.ac.za

SECTION C: APPLICANT'S RESEARCH STUDY FIELD AND APPROVAL STATUS

C.1 Degree – if applicable	PhD in Higher Education Studies
C.2 Research Project Title	Engineering discursive transformation: a social realist study of employability skills development in higher education
C.3 Research Proposal	Attached: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
C.4 Target population	Fourth year electrical engineering students
C.5 Lead Researcher details	If different from applicant:
C.6. Will use research assistant/s	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <small>If yes- provide a list of names, contact details and ID no.</small>
C.7 Research Methodology and Informed consent:	Research methodology: qualitative research: Focus group interviews. Observation. Informed consent: to be sought prior to commencing the research
C.8 Ethics clearance status from UCT's Faculty Ethics Research Committee (FREC)	Approved by the FREC Yes <input checked="" type="checkbox"/> With amendments: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> (a) Attach copy of your ethics approval. Attached: Yes X (b) State date and reference no. of ethics approval: Date: 1/12/2014 Ref.: UCT EBE -FREC

SECTION D: APPLICANT/S APPROVAL STATUS FOR ACCESS TO STUDENTS FOR RESEARCH PURPOSE (To be completed by the ED, DSA or Nominee)

	Approved / With Terms / Not	* Conditional approval with terms	Applicant/s Ref. No.:
D.1 APPROVAL STATUS	(i) Yes - approved <input checked="" type="checkbox"/> (ii) With terms <input type="checkbox"/> (iii) No <input type="checkbox"/>	(a) Access to students for this research study must only be undertaken <u>after</u> written ethics approval has been obtained. (b) In event any ethics conditions are attached, these must be complied with <u>before</u> access to students.	SA/RU/13S8221/ Mrs Gabrielle Nudelman
D.2 APPROVED BY:	Designation <i>Executive Director Department of Student Affairs</i>	Name <i>Dr Moonira Khan</i>	Signature 
			Date of Approval <i>15 December 2014</i>

EBE Faculty: Assessment of Ethics in Research Projects (Rev2)

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (Zulpha.Geyer@uct.ac.za; Chem Eng Building, Ph 021 650 4791).

NB: A copy of this signed form must be included with the thesis/dissertation/report when it is submitted for examination

This form must only be completed once the most recent revision EBE EIR Handbook has been read.

Name of Principal Researcher/Student: Gabrielle Nudelman

Department: Centre for Higher Education Research, Teaching and Learning (CHERTL), Rhodes University

Preferred email address of the applicant: gabi.r.nudelman@gmail.com

If a Student:

Degree: Phd in Higher Education Studies

Supervisor: Lynn Quinn and Joanne Vorster

If a Research Contract indicate source of funding/sponsorship:

Research Project Title:

Engineering discursive transformation: a social realist study of employability skills development in higher education

Overview of ethics issues in your research project:


Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	YES	NO
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	YES	NO
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	YES	NO
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	YES	NO

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate. Ensure that you refer to the EIR Handbook to assist you in completing the documentation requirements for this form.




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 and signature	Date
Principal Researcher/Student:	 SIGNATURE Gabrielle Nudelman	21 October

This application is approved by:

<p>Supervisor (if applicable):</p>	 Dr Jo-Anne Vorster  Prof Lynn Quinn (HOD of CHERTL)	<p>22 October 2014</p>
<p>HOD (or delegated nominee): <i>Final authority for all assessments with NO to all questions and for all undergraduate research.</i></p>		
<p>Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.</p>	<p>G. Sithole</p> 	<p>1/12/2014</p>

Appendix 9: Rhodes University ethics clearance



RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

CENTRE FOR HIGHER EDUCATION RESEARCH, TEACHING AND LEARNING
P O Box 94, Grahamstown, 6140, South Africa
Email: chertl-admin@ru.ac.za
Tel: +27 (0)46 603 9171/3
Fax: +27 (0)46 622 8587

20 November 2014

To whom it may concern

Approval of PhD proposal and ethical clearance:

Name: Gabrielle Sulcas Nudelman (**Student Number:** 138S221)

Provisional Title: Engineering discursive transformation: a social realist study of employability skills development in higher education

Supervisors: Professor Lynn Quinn and Dr Jo-Anne Vorster

This letter confirms the approval of the above proposal at a meeting of the Faculty of Education Higher Degrees' Committee on 18 September 2014.

In the event that the proposal demonstrates an awareness of ethical responsibilities and a commitment to ethical research processes, the approval of the proposal by the committee constitutes ethical clearance. This was the case with this proposal and the committee thus approved ethical clearance.

Yours sincerely

Prof S. McKenna
Chairperson of Education Higher Degrees Committee
s.mckenna@ru.ac.za

