A CURRICULUM FRAMEWORK FOR AN INTRODUCTORY PROGRAMME IN THE NATIONAL DIPLOMA: ENGINEERING AT THE VAAL UNIVERSITY OF TECHNOLOGY

G. SUTHERLAND

Dissertation presented for the Degree of Doctor of Philosophy
In the Faculty of Education
at Stellenbosch University

Promoter:	**Prof E.M. Bitzer**
Co-promoter:	**Prof C.A. Kapp**

December 2009

Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2009

ABSTRACT

The aim of this study was to develop a curriculum framework for engineering introduction programmes offered at a higher education institution, using a case study design.

The South African government is attempting to redress the social inequalities which prevailed in the education sector during the apartheid era. One of their efforts has involved the widening of access to diverse groups in society in order to increase participation within the higher education sector. However, many students attempting their higher education studies are academically under prepared. This is mainly due to insufficient life skills, communication skills, numeric skills and literacy skills. The lack of these skills has inspired various international and national higher education institutions to develop academic programmes aimed at bridging the gap that exists between secondary schooling and higher education. Introduction programmes for prospective engineering students have to ensure high-quality curriculum development procedures in order to secure these students' academic success throughout their engineering studies. This, in turn, leads to quality graduates and addresses the huge shortage experienced by the industry.

An overview of the contextual and conceptual views on curriculum development is given against the backdrop of the current higher education legislation in South Africa. The overview regarding curriculum development links the introduction programme curriculum to generic learning outcomes specifically set at the National Qualification Framework Level 4. It suggests the application of continuous assessments, in line with outcomes-based education criteria, together with quality assurance in order to fit the Higher Education Quality Committee and the Engineering Council of South Africa's accreditation criteria applicable to higher education institutions.

During the design and methodological stages, it was established, by means of a theoretical investigation, that the first phase of this study determines whether students that successfully completed the introduction programme perform academically better than students entering the diploma programmes directly. The theoretical investigation also established that the second phase of this study

determines if the diploma students dropped out of the programme for reasons other than academic performance.

A triangulation approach was used to increase the validity of the empirical part of the study and to enhance the rigorous use of both quantitative and qualitative data. The study results shed light on the need for introduction programmes. In addition, it proposed a curriculum framework for improved engineering introduction programmes at the Vaal University of Technology.

Keywords: Curriculum Development, Curriculum Framework, Academic Development, Engineering Introduction Programmes, Engineering Education

OPSOMMING

Die doel van hierdie studie was om ’n kurrikulumraamwerk vir ’n oorbruggingsprogram vir ingenieurswese-studente in hoër onderwys te ontwikkel. Die kurrikulumraamwerk is ontwikkel deur middel van ’n gevallestudie wat die implementering van oorbruggingskursusse in die ingenieurswese indringend ondersoek het.

Die huidige Suid-Afrikaanse regering poog om die sosio-politieke wanbalanse as nalatenskap van apartheid, uit te wis. Dit word gedoen deur middel van inisiatiewe waarin onder meer hoër onderwys ’n prominente vennoot is wat aan ’n diverse samelewing gelyke geleenthede bied. Die huidige, meer toeganklike bedeling in hoër onderwys in Suid-Afrika het ’n groot toename van studente uit histories agtergeblewe gemeenskappe tot gevolg gehad. Die meeste studente wat in hierdie konteks die hoëronderwyssektor betree, blyk in ’n groot mate onvoorbereid te wees vir hoër onderwys vanweë hul gebrek aan lewens-, kommunikasie-, numeriese en taalvaardighede. Hierdie tendens kom ook op internasionale vlak voor. Dit het inisiatiewe ten opsigte van akademiese ontwikkeling op nasionale sowel as internasionale vlak genoodsaak. Die doel van akademiese ontwikkeling is primêr om die gaping tussen die skool en hoër onderwys te oorbrug.

Oorbruggingskursusse moet van ’n hoë gehalte wees om sodoende te kan verseker dat voornemende studente vir hoër onderwys, en vir die doel van hierdie studie meer spesifiek ingenieurstudente, van groter akademiese sukses verseker kan wees. Die suksesvolle implementering van oorbruggingskursusse vir ingenieurswese-studente behoort in ’n groot mate tot ’n beter gehalte gegradueerde te lei en ’n bydrae te lewer tot die vraag na ingenieurswese-studente vir die nywerheidswêreld.

Kontekstuele en konsepsuele beskouings ten opsigte van kurrikulumontwikkeling in die hoër onderwys in Suid-Afrika word deur generiese leeruitkomste bepaal. Hierdie uitkomste is op vlak 4 van die land se Nasionale Kwalifikasieraamwerk vasgepen. Dit het ook tot gevolg dat alle programme volgens amptelike Departement van Onderwys-dokumente aan deurlopende assessering onderwerp moet word, dat die gehalte van die kursus onderworpe is aan die gehalteversekeringskriteria van die

Hoëronderwys se Gehaltekomitee (‘HEQC’) en dat dit moet voldoen aan die vereistes van die Ingenieursraad van Suid-Afrika.

’n Teoretiese raamwerk is tydens die ontwerp- en metodiekstadium van die studie daargestel. Die doel van hierdie eerste fase van die studie was om te bepaal of diplomastudente wat die oorbruggingskursusse suksesvol voltooi het, akademies beter gepresteer het as daardie studente wat nie die oorbruggingskursus gevolg het nie. Die tweede studiefase het bepaal of die diplomastudente hul studies vir redes gestaak het wat moontlik nie met akademiese sukses verband hou nie.

Die navorsing het van triangulasie gebruik gemaak, ten einde die doeltreffende gebruik van sowel kwantitatiewe as kwalitatiewe data te verhoog. Die resultate van die studie werp lig op en onderstreep die behoefte aan oorbruggingskursusse. Die navorsing beveel ’n kurrikulumraamwerk aan vir die ontwerp van verbeterde oorbruggingskursusse in die ingenieurswese aan die Vaal Universiteit van Tegnologie.

Sleutel woorde: Kurrikulumontwikkeling, Kurrikulumraamwerk, Akademiese Ontwikkeling, Oorbruggingskursusse in Ingenieurswese, Ingenieursonderwys

ACKNOWLEDGEMENTS

I wish to express my gratitude to the Lord, who gave me the ability to undertake this research. In addition, I would like to thank the following individuals who enabled this document to be completed successfully:

- My promoter, Prof Eli Bitzer, for his insight and his knowledge-sharing capabilities. Prof, all the thoughtful and insightful comments were appreciated. I could not have completed a thesis of this academic standard without your valuable inputs. Thank you for providing me the opportunity to work through a co-promoter who was situated on the VUT campus.
- My co-promoter, Prof Chris Kapp, for his willingness to assist me given that I was unable to travel to Cape Town on a regular basis to see my promoter.
- Dr Hans Brits who assisted with the initial phases of the thesis.
- The VUT; Vice-Rector, Academic; the Executive Dean, Faculty of Engineering and Technology; and the Head of Department, EDSU, for the opportunity of completing this research.
- My language editor, Dr Ayesha Bevan-Dye for her time and constant motivation to complete the study.
- The Skills Development Committee who partially supported the study financially.
- Mr Yegash Naidu for his time and efforts in extracting the necessary data from the VUT's ITS system.
- Dr Joanne Habig for her willingness to assist with the statistical analysis of the study.
- Last, but not least, all my colleagues within the EDSU who played a vital part in the completion of this study.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ABET	Adult Basic Education and Training
AD	Academic Development
ADP	Academic Development Programme
ANC	African National Congress
ASPECT	Academic Support Programme for Engineering in Cape Town
ATN	Australian Technology Network
B Tech	Baccalaureus Technologia
BSc	Bachelor of Science
CAML	Community Access to Mainstream Learning
CAT	Credit Accumulation and Transfer
CBE	Council for the Built Environment
CDTL	Centre for Development of Teaching and Learning
CHE	Council on Higher Education
CHET	Centre for Higher Education Transformation
COE	Council for Opportunity in Education
CORE	China Open Resources for Education
CPUT	Cape Peninsula University of Technology
CTP	Committee of Technikon Principles
D Tech	Doctor Technologiae
DAD	Direct Access Development
DIT	Durban Institution of Technology
DoE	Department of Education
DUT	Durban University of Technology
ECSA	Engineering Council of South Africa
EFP	Engineering Foundation Programme
EIP	Engineering Introduction Programme

ETQA	Education Training Quality Assurance
FET	Further Education and Training
FHEQ	Framework for Higher Education Qualification
FP	Foundation Programme
HEQC	Higher Education Quality Committee
HEQF	Higher Education Qualification Framework
HESA	Higher Education South Africa
IAU	International Association of Universities
Intro Eng	Introduction to Engineering
Intro SET	Introduction to Science, Engineering and Technology
ITS	Integrated Tertiary System
M Tech	Magister Technologiae
MoE	Minister of Education
NACI	National Advisory Council on Innovation
NAP	New Academic Policy
NCHE	National Commission on Higher Education
NCIHE	National Committee of Inquiry into Higher Education
NEPI	National Education Policy Investigation
NQF	National Qualification Framework
NWG	National Working Group
OBE	Outcomes Based Education
PBL	Problem-Based Learning
PrCert Eng	Professional Certificate Engineer
PrEng	Professional Engineer
PrEng Technician	Professional Engineering Technician
PrEng Technologist	Professional Engineering Technologist
QA(A)	Quality Assurance (Agency)
RNCS	Revised National Curriculum Statement

RPL	Recognition of Prior Learning
RSA	Republic of South Africa
SA	South Africa
SACBE	South African Council for the Built Environment
SAEON	South African Environmental Observation Network
SAQA	South African Qualification Authority
SAT	Scholastic Aptitude Test
SATN	South African Technology Network
SAUVCA	South African Universities Vice-Chancellors Association
SCER	Select Committee of Education and Recreation
SETA	Sector Education and Training Authorities
SFP	Science Foundation Programme
TAP	Technology Access Programme
TBVC	Transkei, Bophuthatswana, Venda and Ciskei
TUT	Tshwane University of Technology
UCT	University of Cape Town
UDUSA	Union of Democratic University Staff
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UL	University of Limpopo
UNAM	University of Namibia
UoT	University of Technology
UP	University of Pretoria
US	University of Stellenbosch
USA	United States of America
UTP	Universiti Teknologi Petronas
VUT	Vaal University of Technology
WENR	World Education and News Report

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

The history of South Africa has been characterised by political conflict and socio-cultural divisions along race and class lines. The well-documented South African education system of the apartheid era has been described as racist, Euro-centred, sexist, authoritarian, prescriptive, unchanging, context blind and discriminatory (Turner, Myers & Creswell, 1998: 33; Jansen & Christie, 1999: 4; Tisani, 2004: 175). The educational legacy of this era was a divided higher education sector of uneven socio-structural equality. A challenge for the South African government was to progress beyond the apartheid legacy as well as beyond the multitude of enduring problems and weaknesses in higher education, and to create a new landscape that meets economic and social development needs through the production of quality graduates (De Jager & Nassimbeni, 2005: 33).

Post-apartheid legislation focused on expanding participation into higher education as a means of reducing the stratified race and class structure of the country (Fraser & Killen, 2005: 26). Internationally, it is recognised that with this expansion of access has come a shift from the heterogeneity structure to one of diverse participation that is reflected in language, socio-economic backgrounds, cultures, race and mass higher education (Northedge, 2003a: 169-180; Reay, David & Ball, 2005; Asmar, 2006: 9-20).

The South African higher education system has been greatly influenced by global movements, including concerns about the nature of skills required for the knowledge economy, employability of graduates and demands for greater accountability (De Jager & Nassimbeni, 2005: 33). The progress of Academic Development (AD) in South Africa has generally run parallel to the transformation of the higher education sector and, in particular, parallel to the expansion and broadening of access to this sector (Pandor, 2006: 1-6). AD has played an important role in the broadening

access to higher education through, among others, the development of alternative admissions and placement processes (Pandor, 2006: 1-6).

1.2 BACKGROUND TO THE STUDY

In South Africa, many of the students entering higher education programmes are under prepared because of insufficient life skills input at school level, which leads to valuable losses in human potential (Rooth, 1997; Sutherland & Waetzel, 2005: 1). Life skills are specified skills that should be mastered and applied successfully to enable an individual to cope with general and complex problem situations and to make correct and meaningful decisions (Raijmakers, 1993). Life skills that are vital in the changing higher education environment include assertiveness, time management skills, communication skills, planning skills and listening skills (Hamburg & Takanishi, 1989: 825; Lodder, 1993; Takanishi, 1995; Sutherland, 2004: 120). Factors that could possibly be attributed to the difficulties experienced by higher education students include diversity within the school curricula, a lack of teaching quality, and a lack of interpersonal and intra personal life skills orientation (Antonovsky, 1987; McFarlane, 1998; Asmal, 2000a; Vermeulen, 2002). Higher education in South Africa could face a bleak future should the secondary school sector not perform at adequate levels (Shay, Bond & Hughes, 1994: 21; Taylor & Vinjevold, 1999: 139; Park, 2003: 5-8; Fraser, Killen & Nieman, 2005: 235). This situation places higher education institutions under further pressure in their quest to continue providing quality graduates to their customers. The challenge is how this should be achieved (Arcaro, 1995: 56-57). The specific influence of these factors, with respect to the higher education sector, is discussed next.

Diversity within the school curricula is the first possible factor that may contribute to the difficulties experienced by higher education students. Each province has its own curriculum that schools work from, but the National Senior Certificate examinations are based on a central curriculum (Asmal, 2000a). Pandor (2008: 2) agrees that different approaches (to overcome these inequalities) are required to ensure greater participation in or access to higher education. With regard to the second influencing factor, lack of teaching quality, Asmal (2000b) states that the majority of school learners only have access to a poor quality education. Pandor (2007: 2) acknowledges progress in this regard, but stresses that more has to be done to

improve quality within the education system. McFarlane's (1998) studies on the third possible influencing factor, recognises that secondary variables (intra personal skills, personal growth of students and subject content) had an impact on the development and acquisition of certain life skills. Intra personal aspects, such as sense of coherence - feeling of purpose and sense in life - and family well-being, also influence first-year students who are attempting to bridge the gap between their grade 12 and their first-year tertiary level experience (Vermeulen, 2002).

Only a small proportion of school leavers obtain university exemption and, consequently, degrees in South Africa (Barker, 1999; Department of Education (DoE), 2006: 32, 34). Over a decade ago, the South African government anticipated that there would be 1,5 million students in higher education. This, however, did not occur (Pandor, 2008: 1). Higher education has seen immense changes, which have left a permanent imprint on the system, its constituent institutions and their practices. One of these changes and a unique feature of the South African Higher Education Qualifications Framework (HEQF), referred to in the New Academic Policy (NAP) (South Africa (SA), 2002: 37) and again highlighted within the new HEQF document (DoE, 2007: 7), is the articulation column, which provides for diagonal articulation. Diagonal articulation generally implies that a student may be required to undertake additional enrichment learning in a specific target area prior to them being admitted into a higher education programme. It has been proposed by the Council on Higher Education (CHE) that programmes which fall into the articulation column be made up of 60 credits (one semester of full-time study), in order to allow academics to offer short, focused programmes that meet the specific in-service or upgrading needs of students (SA, 2002: 37). The purpose behind this is to facilitate student mobility as well as progression, and can be used to admit those students who do not meet the full entry requirements for their target programmes into the higher education system (McFarlane, Sutherland & Vermeulen, 2004: 98; DoE, 2007: 7).

In the higher education sector, both the policy makers and the academics have come to recognise the need for special AD programmes, in the form of introduction programmes, to facilitate the success of promising, but under-prepared prospective students (Felix, 2002; SA, 2002). Despite the wide variety of and many differences between AD initiatives, one common purpose runs through them all: the need to develop each student's potential optimally. That is, to enable students to learn and

study effectively, to cope with the demands of their studies, and to attain a level of academic performance that matches their abilities and strength of commitment (Scott, 2001). According to the South African Qualification Authority (SAQA), knowledge gained via intervention programmes should add value to the student and, consequently, provide benefits to society and the economy by, amongst other things, the enrichment of the individual and the opening up of access routes to additional education and training (SA, 1995; SA, 2002; DoE, 2007). Pearce (2000a: 1) recognises that the demand for academic support in higher education engineering studies has grown substantially. However, Kluth and Straut (2001: 43-46) advise that in order for introduction programmes to be effective, they should answer the needs of diverse students (Fraser *et al*., 2005: 234). While a critical analysis still needs to be carried out on the full extent and scope of the influence of AD on the transformation of higher education, including its impact on teaching and learning practice, the achievements of the AD programmes over the past years must be acknowledged and applauded (Pandor, 2006: 1-6). However, these AD programmes have to suit the higher education sector in terms of legislative and academic practices.

Many countries, whether industrially developed or newly industrialised, recognise the crucial role of an effective system of education as part of their national plan for social and economic development (Van Dyk, Nel, Van Zyl Loedolff & Haasbroek, 1999: 4). Higher education is involved in enhancing people's ability to think individually and, accordingly, it provides individuals with the opportunities needed for personal enrichment and employment via the acquisition of basic knowledge and skills (Nellmapius, 1996). A fundamental consideration in developing a curriculum for an Engineering Introduction Programme (EIP) is how best to bridge the gap that exists between secondary school studies and first-year higher education engineering studies. Curriculum developers have to take into consideration the academic level of the prospective student entering the EIP, and work towards the academic level required for the first-year higher education engineering study fields. Delpit (1976) states that learning the material is not the problem; rather, the problem is discovering what material needs to be learned.

Bodendorf and Swain (2001: 102) claim that higher education is facing two major challenges; first, a shift to a, supply-orientated view where there is an increasing

demand for new knowledge and skills; secondly, the rapid growth in the amount of information that needs to be mastered, which often becomes archaic just as quickly. The emphasis in South Africa today is on the acquisition of knowledge as a productive force. However, it is not merely any knowledge, but the application of theoretical, codified knowledge that allows individuals to utilise the gained knowledge in such a way that it adds direct value to the economy of the country (Sutherland, McFarlane & Vermeulen, 2002: 21). Higher education institutions must be increasingly efficient and effective in providing their services or they are at risk of losing their place in the educational market (McNealy, 1993: 373). Cultivating more talent of a technical nature across the board makes good business sense (Kelly III, 2008). He further states that the number of workers retiring from the science and engineering fields will most likely mushroom over the next twenty years, aggregating an existing shortage of technical skills that has already left 1,3 million engineering jobs vacant. This statement is supported by Beute (1996), who stated years ago that the long-term need for engineers and scientists is not being adequately addressed.

According to Miller (2001: 1), a new paradigm of education has emerged - one that places greater relevance on the world of work; hence, the importance of including language literacy and communication within the curriculum of an EIP. Even though Miller's (2001: 1) perspective is American, it may equally be valid for the South African context. Furthermore, the EIP curriculum should introduce skills in report writing, note taking, study skills, time management skills, public speaking skills, debating skills and knowledge of current affairs. In terms of the Outcomes Based Education (OBE) approach to education, as accepted by SAQA (SA, 1995; SA, 2002; Revised National Curriculum Statement (RNCS), 2005: 1-6; DoE, 2007), the teaching of languages falls under the learning area of language literacy and communication, where the skills of reading, listening and observing are emphasised. According to Clayton (2000: 103), reading promotes the essential cognitive-development skills one must acquire in order to succeed in adult life. Comprehension is the focal point of the reading process as it involves relating vocabulary to experience; understanding ideas, concepts and processes; recognising relationships; making comparisons; drawing inferences; reflecting, interpreting and 'reading between the lines'. As these skills are mastered, comprehension occurs. This, in turn, fosters the ability to evaluate ideas critically, which is an essential capability within the field of engineering (Pienaar, 2000: 126). This can be interpreted

as the intrinsic value of language as an instrument for problem solving, decision making and creative thinking - critical and evaluative - that needs to be developed across the entire curriculum (Niemann, Swanepoel & Venter, 2000).

Consequently, higher education institutions in South Africa, including the Vaal University of Technology (VUT), have designed engineering intervention programmes in the form of introduction programmes. These programmes have been implemented for different reasons and are designed to meet different needs (Sutherland & Waetzel, 2006: 343). However, questions have arisen regarding the quality of these programmes. The CHE, through its Higher Education Quality Committee (HEQC), has been assigned the responsibility of quality assurance in higher education, which it has started to exercise through the national institutional audits associated with quality improvement and enhancement (De Jager & Nassimbeni, 2005: 33). The aim of an EIP should not merely be to increase the intake of first-year engineering students at higher education institutions. Rather, such programmes should focus on delivering proficient students into the higher education engineering study fields. By doing so, the pass rate and, therefore, the throughput rate of academic programmes of an engineering faculty may be increased.

Various international higher education institutions have EIPs available (Canada, China, Namibia, Omani, Scotland, The United Kingdom, The United States of America). Most of the countries abroad have a central-based foundation department that ensures the quality of the affiliated EIPs offered at their colleges and universities (Reid & Loxton, 2004: 1-5; Grimm, 2005: 1-2; Kelly III, 2008). According to these countries, EIPs provide an ideal pathway to undergraduate studies at colleges and universities.

In order for prospective students to adapt to the demands of higher education engineering studies, the VUT has had to design an EIP to enhance prospective students academically, by providing academic skills and social skills, so that they are able to attempt their engineering diploma studies at VUT successfully (Sutherland & Waetzel, 2006: 341). Education changes as technology changes and the transition (into higher education) should be made as easy as possible for the students. The transition includes spreading the workload and increasing productivity, together with increasing pass rates and, most importantly, throughput rates, without compromising

academic standards. The EIP aims to meet the needs of prospective students who are denied access to study an engineering diploma at the VUT. Hay and Marais, (2004: 60) state that higher education institutions that believe in introduction programmes are obligated to engage in research to prove that such programmes are successful and, therefore, have a place in higher education. To date, no study has been undertaken to provide scientific evidence that an EIP may lead to an increase in engineering graduates and, therefore, an increase in the throughput rate of an engineering faculty. Hence, the main purpose of the study is the development of a sound curriculum framework for an EIP offered at a higher education institution.

According to O'Day and Smith (1992: 25), curriculum frameworks outline the content to be taught in core disciplines and that all elements of the broadly defined education system are linked in a common effort to accomplish common goals. The proposed framework focuses specifically on curriculum development practices, and considers how these practices can be applied to create a sustainable EIP for prospective students in the higher education sector. The proposed framework may be used by any higher education institution for benchmarking, classifying and implementing best sustainable practices.

Benchmarking is recognised as an essential tool for the continuous improvement of quality (Datakumar & Jagadeesh, 2003: 26). Benchmarking goes beyond merely analysing the competition. It includes analysing organisational processes and methods to assess how other higher education institutions achieved their position. The earlier stages of benchmarking developments stressed a process and/or activity orientation. However, the scope of benchmarking has expanded to include strategies and systems (Yasin, 2002: 85).

1.3 STATEMENT OF THE PROBLEM

Given the background of the study, an increase in the engineering diploma programme pass rate of alumni EIP students (Introduction students (Intro students)) over a five-year period (2002 - 2006), together with the identification of the reasons students drop out of the diploma programme, may serve as important indicators of the possible success of the engineering intervention programme. This, in turn, might provide a basis for the formulation of a sound programme framework.

Currently, in terms of a sound basis of curriculum theory, the EIP has not been adequately analysed, nor have the changes in EIP been well documented. Similarly, the performance of students that have proceeded from the EIP into engineering studies has not been sufficiently analysed and described. The gap in curriculum design calls for the development of a proper curriculum framework for EIPs at the Vaal University of Technology. Although the Vaal University of Technology offers an EIP, it does not know whether this programme is effective in rendering potential engineering students better prepared for their higher education engineering studies.

1.4 PURPOSE OF THE STUDY

The focus of the study is on the acquisition of life skills, together with the academic resources necessary to enrich and competently upgrade prospective engineering students with a National Qualification Framework (NQF) Level 4 qualification to an acceptable level for entrance (HEQF Level 5) into the VUT's engineering diploma programmes (HEQF Level 7). The study is positioned within the current South African education and higher education contexts and deals with the challenges of providing equal opportunities for success across the entire system. The study empirically contributes to the body of knowledge in the field of engineering education and its role in student learning. As higher education institutions provide access to a diversity of students, effective measures towards student support and effective student learning have to be maintained, especially among under-prepared students. The findings of this study aspire to provide additional insights into developing teaching and learning strategies, as well as curricula to address these challenges.

The key catalyst for embarking on this study was first-hand experience of the effect of under preparedness on first-year electrical engineering students at the VUT. Following interviews with other first-year engineering lecturers at the VUT, it was determined that first-year students do indeed encounter difficulties with their academic studies due to under preparedness. This led to the researcher initiating an AD programme at the VUT, EIP for prospective engineering students, which targets those students who were rejected for the mainstream engineering diploma studies. The researcher is equipped with 11 years of industrial (engineering) experience, 18 years of lecturing experience and seven years of experience with the AD programme at the VUT. While the researcher's involvement in AD has an unavoidable impact on

all aspects of the study, every effort has been made to ensure the trustworthiness of the study. Throughout this study, the researcher draws on the epistemic knowledge obtained from the literature and on the practical knowledge acquired over the years from working with prospective engineering- and mainstream-engineering diploma students.

1.5 OBJECTIVES OF THE STUDY

In order to simplify and clarify the problem being addressed, the first step of the study was exploratory in nature. This led to the formulation of the research questions which guided the study. It was necessary to investigate these research questions before a curriculum framework for an EIP could be developed. The main objective of the study was the formulation of a sound curriculum framework for an EIP at a higher education institution, with the main research question formulated as:

What comprises a curriculum framework aimed at prospective engineering students at the VUT?

The following sub-questions, which served to answer the main research question, guided the study:

- When compared to students entering the engineering diploma programmes directly (direct students), do Intro students perform better in their academic studies? (Phase 1 of the study)
- In comparison to direct students, do Intro students have a better graduation rate? (Phase 1 of the study)
- In comparison to direct students, do the same number of Intro students drop out of the diploma programmes? (Phase 1 of the study)
- Do engineering diploma students drop out of the programmes due to reasons other than academic performance? (Phase 2 of the study)

The second step of the study was descriptive in nature, and provided a portrayal of the social phenomenon under investigation: EIP at higher education institutions. It also provided insight into similar programmes on offer nationally and internationally. The last step of the study was both descriptive and interpretive, seeking to describe

and interpret the meaning and relevance of the data gathered relating to an EIP for prospective engineering students.

The rationale for the study was therefore to provide evidence that an increase in the pass rate of Intro students over a five-year period, together with the identification of the reasons for students dropping out of the diploma programmes, serve as important indicators of the success of the EIP at the VUT. These indicators, in turn, provide a basis for formulating a sound curriculum framework for an introduction programme.

1.6 RESEARCH DESIGN

The study was located within the empirical-analytic paradigm, using quantitative and qualitative data. The study addressed the research problem, which was articulated by the research question and sub-questions. At first glance, these questions placed the empirical part of the study in the category of implementation evaluation research (a form of applied research). Implementation evaluation research aims to answer the question of whether an intervention programme, theory, policy or strategy, has been properly implemented (process evaluation studies), whether the target group has been adequately covered and whether the intervention was implemented as designed (Mouton, 2001: 158).

However, case study methodology engages in an in-depth, longitudinal examination of a single instance, event or, as in this case, the EIP offered at the VUT. Case studies provide a systematic way of looking at events, collecting data, analysing information and reporting the results. As a result, the researcher may gain a sharpened understanding of why the instance happened as it did, and identify what might be important to look at more extensively in future research (Flyvbjerg, 2006: 219-245).

Yin (2002), on the other hand, suggests that the case study approach should be defined as a research strategy, an empirical enquiry that investigates a phenomenon within its real-life context. According to him, case study research means single and multiple case studies, which can include quantitative evidence, and which relies on multiple sources of evidence and benefits from the prior development of theoretical

propositions. Case studies should not be confused with qualitative research and they can be based on any mix of quantitative and qualitative evidence. Single-subject research provides the statistical framework for making inferences from quantitative case study data (Yin, 2002; Lamnek, 2005).

The descriptive case study for this research was mainly positioned in the positivism paradigm. The target groups for the study included the Intro and direct students at the VUT over a period of five years. A longitudinal perspective implies examining the same group(s) at different time intervals (Welman, Kruger & Mitchell, 2005: 96) within the same bounded context.

Riley (1963: 5-6) asserts that the research process starts with a conceptual model or an organising image of the phenomena to be investigated. According to Mouton and Marais (1990: 139-144), it is through this process of integrating scientific statements into conceptual frameworks that the familiar structure of science, typologies, theories and models are developed. The research questions resulted in the formulation of the conceptual framework, which divided the study into two separate phases. Phase 1 of the study deals with the academic performance of both the Intro and direct students for a period of five years. Phase 2 of the study deals with the reasons (other than academic performance) for dropping out of the diploma programmes.

It is common in implementation evaluation studies to utilise all available modes of observation: both structured (questionnaires, tests, scales) and less structured (focus group interviews, individual interviews, participation observation), as well as analysing existing documentary sources (Mouton, 2001: 159). Data for the study were obtained from the academic examination results of Intro students as well as the direct students (those that were registered within the engineering diploma programmes), and from an administered questionnaire survey of students who have dropped out of the engineering diploma programmes. Both quantitative and qualitative data collection approaches were applied and the results were triangulated with the literature review undertaken.

A detailed description of the methodology for the empirical part of the study is provided in Chapter 4.

1.7 CLARIFICATION OF KEY CONCEPTS

Although the terminology used within the study is known to individuals involved in the education and higher education sectors, there are terms that may cause confusion regarding the different educational sectors. These terms are discussed here to mitigate any potential misconception.

During the study, the term ‘learner’ was used to describe an individual studying within the school sector, while the term ‘student’ refers to an individual studying within the higher education sector. The term ‘learner’ has not been altered within the legislation documentation referred to in the study, but should be interpreted in context.

The term ‘teacher’ was used to describe an educator within the school system, while the term ‘lecturer’ was used to describe an educator within the higher education sector. Both teachers and lecturers are known as academics within their respective fields.

The terms ‘curriculum’ and ‘curriculum development’ are further explored in Chapter 3 and will not be discussed here.

The term ‘framework’ was described in this study as an underlying set of ideas, principles, agreements or rules that provide the basis or outline for an EIP at a higher education institution. In context, it provides the general background to and context for the particular action of curriculum development for an EIP in a higher education institution.

The term ‘EIP’ was described as an AD programme for prospective students, designed to enhance their NQF Level 4 results in order to gain access (HEQF Level 5) to the main diploma engineering programmes (HEQF Level 7) at the VUT. The term ‘EIP’ is further explored and defined in Chapter 3. The term ‘AD’ in engineering is also dealt with in Chapter 3.

1.8 CLASSIFICATION OF THE STUDY

This chapter described the orientation to the study, why it was undertaken, how it was undertaken and when it was undertaken. It also provided a brief overview of the study. In addition, the research questions formulated for the study were outlined. These research questions clarify why the study had to be in line with the South African higher education environment and legislative changes that recently occurred.

Chapter 2 presents a literature review aimed at contextualising the current perspectives on higher education in South Africa. The changes within the higher education system brought by legislation from the DoE are described, together with the effect these changes had on the curriculum development of an EIP.

Chapter 3 comprises a literature review that strives to explain the conceptual perspectives on curriculum design and curriculum development. In addition, this chapter presents an in-depth review of the EIPs for prospective engineering students at various higher education institutions. Both national and international programmes on offer were explored, and the current EIP offered at the VUT was benchmarked against them.

Chapter 4 outlines the research design and methodologies used in the empirical portion of the study. The case study, quantitative and qualitative data, research approaches, methods and procedures are described. The integration of the quantitative and qualitative data findings through a process of triangulation is described. The validity and reliability of the study are also dealt with in this chapter.

The statistical analysis of Phase 1 (academic results) of the study is interpreted in Chapter 5, while the statistical analysis of Phase 2 (reasons for student dropout) is interpreted and described in Chapter 6. The concluding chapter, Chapter 7, draws together all the results of the previous chapters, providing a synthesis of the interpreted findings with the theory that was discussed in the literature study. The chapter closes with the conclusions, recommendations and a curriculum framework for an EIP offered at the VUT.

1.9 CONCLUSION

Since the early 1990s, the South African government has been working towards rectifying the social inequalities that prevailed in the education sector during the apartheid era. One of these efforts involved the widening of access to higher education institutions in order to allow greater participation in higher education by members of South Africa's diverse cultures. However, the gap between the secondary school sector and the higher education sector has resulted in many students being ill equipped to cope with higher education academic studies. This is thought to stem mainly from the students' lack of life skills, communication skills, numeric skills and literacy skills.

The assumed lack of these skills has inspired various higher education institutions to develop academic programmes to bridge the gap between the secondary school sector and the higher education sector. An AD programme for prospective engineering students has to comprise curriculum development procedures to ensure these students' academic success throughout their engineering studies. These AD programmes can lead to participation within the higher education sector and assist in providing high quality graduates. This, in turn, serves to redress the significant work force shortages experienced within the engineering and technology sector. The South African government has provided the higher education system with various changes in legislation throughout the last decade and, consequently, has provided a basis for AD programmes, in the form of EIPs, to be implemented within this sector. Curriculum development of an EIP can only be of a high quality if these legislative changes are taken into consideration.

The next chapter, Chapter 2, deals with the changes in legislation that occurred within the South African higher education sector during the post-apartheid era. In addition, it discusses recent changes within the qualification structures and provides a perspective of the higher education sector in South Africa.

CHAPTER 2

PERSPECTIVES ON HIGHER EDUCATION IN SOUTH AFRICA

2.1 INTRODUCTION

The aim of this chapter is to provide a contextual overview of the South African higher education landscape, higher education legislation and relevant structures, as well as to explore developments in higher education. It is important to differentiate the South African higher education landscape contextually, how the educational system was divided during the apartheid years, and how post-apartheid higher education transformation has influenced the current landscape.

The main emphasis is on the post-apartheid transformation development processes, which were implemented through government legislation. As the research focuses on the development of a curriculum framework towards an introduction programme for prospective engineering students, it is also necessary to explore the role of the Engineering Council of South Africa (ECSA) in higher education institutions.

2.2 THE SOUTH AFRICAN HIGHER EDUCATION LANDSCAPE

South Africa built a strong higher education sector during the apartheid years. There were separate institutions for different race groups, with historically 'White' institutions being the most favourably located and resourced. Race-based inequalities, duplications and inefficiencies were rife (Jansen & Christie, 1999: 4; Tisani, 2004: 175; Study SA, 2007: 1-4). There was a binary system featuring academic universities and vocational technikons (Study SA, 2007: 1-4). The purpose of universities as being primarily academic has been cited by, amongst others, Becher (1989), Pascarella and Terenzini (1995), Habermas (1997: 1-3), Brennan and Lebeau (2002: 4), Chomsky (2003: 278), Du Pré (2004: 24), Harvey (2004: 3-4), Juma (2005: 1-3) and Sharma and Ghista (2008: 1). The name 'technikon' was a unique South African invention [*sic*] and was in use for 25 years (1979-2004) (Du Pré, 2004: 20). The apartheid educational legacy was experienced by many as a binary divide in the higher education sector and not in line with emerging world

trends [*sic*] (Du Pré, 2000; Du Pré, 2004: 19; Tisani, 2004: 175; Study SA, 2007: 1-4).

2.2.1 Historical background

The origins of formal western education can be traced back to the mid seventeenth century and the early eighteenth century respectively (Sehole, 2006: 4). Malherbe (1925) states that the education system in the Cape was a direct replication of institutions in the Netherlands. Education was based on the Dutch system, where students were forced to learn the Dutch language and elements of the Christian religion (Sehole, 2006: 4). In South Africa, the foundation of university education was laid in the second and third quarters of the nineteenth century in the Cape Colony. The first state-aided propriety college was the South African College, which opened in Cape Town in 1829, and then in 1837 it was incorporated as a public institution and students were prepared for the matriculation and higher education examination of the University of London (Sehole, 2006: 6-7). Colleges that followed were Diocesan College, Rondebosch (1848), St Andrew's College, Grahamstown (1855) and Victoria College, Stellenbosch (1866) (Behr, 1988: 183; Sehole, 2006: 6-7). Behr (1988: 183) states that these institutions experienced difficulties mainly with finance and fluctuating student numbers, but they succeeded in preparing their students for admission to European universities.

The University of Cape of Good Hope was established in 1873. Initially, the university did not teach courses but laid down the curricula, conducted examinations and awarded degrees for courses taught by the colleges (Sehole, 2006: 6-7).

The mining industry, with the discovery of diamonds in 1867 in the Kimberley district and gold in 1886 on the Witwatersrand, led to an influx of people from all over Europe to South Africa. In 1894, the first training of mining engineers started at the South African College. The University of the Witwatersrand (1922) had its origins in the Transvaal Technical Institute, which was established in 1903, following the transfer of the School of Mines and Technology from Kimberley to Johannesburg that year (Behr, 1988; Sehole, 2006: 7). During 1918, the South African College became the University of Cape Town and the Victoria College, the University of Stellenbosch, in terms of Act 12 and 13 respectively of 1916 (Sehole, 2006: 7).

Administrative responsibilities for the education of Coloureds and Indians shifted in the period between 1910 and 1983 between provincial and designated central departments. Racial segregation of universities was legislated with the passing of the Extension of University Education Act in 1959 (SA, 2003: 4). By 1968, the administration of education for Africans was decentralised into regions, self-governing territories and, from 1976, into four self-governing African states (Transkei, Bophuthatswana, Venda and Ciskei (TBVC)) (CHE, 2004a: 22-23). The TBVC state governments were responsible for African education. It included higher education, which was provided for by the establishment of African higher education institutions, as part of the introduction of 'African self-government'. Within South Africa, the Minister of Education and Training administered all African education, including higher education institutions designated for Africans (CHE, 2004a: 22-23). All public higher education institutions were designated for a particular race - Whites. Students from other race groups could not be admitted without special permits obtained by the higher education institutions from its administering government department (CHE, 2004a: 23). In the 1970s and 1980s, universities began to open their doors to students of all races (SA, 2003: 4).

The 1983 Constitution divided the national parliament into three chambers with separate representation for White voters (House of Assembly), Coloured voters (House of Representatives) and Indian voters (House of Delegates). There was very limited provision for representatives of Africans. The Constitution drew distinction between general and 'own' affairs, with the latter meant to be matters specific to the cultures and values of different population groups. Education became an own affair for all groups, except for Africans in whose case, education became a general affair vested in the central Department of Education and Training. The Department of National Education assisted the Minister of National Education in determining national education policy (CHE, 2004a: 23). The first cluster of divisions was that between race and ethnic groups; accordingly, the system was splintered and complex.

The divided national parliament, with its separate representations for Whites, Coloureds and Indians, is graphically depicted in Figure 2.1. African education, as a general affair, was vested in the Department of Education and Training

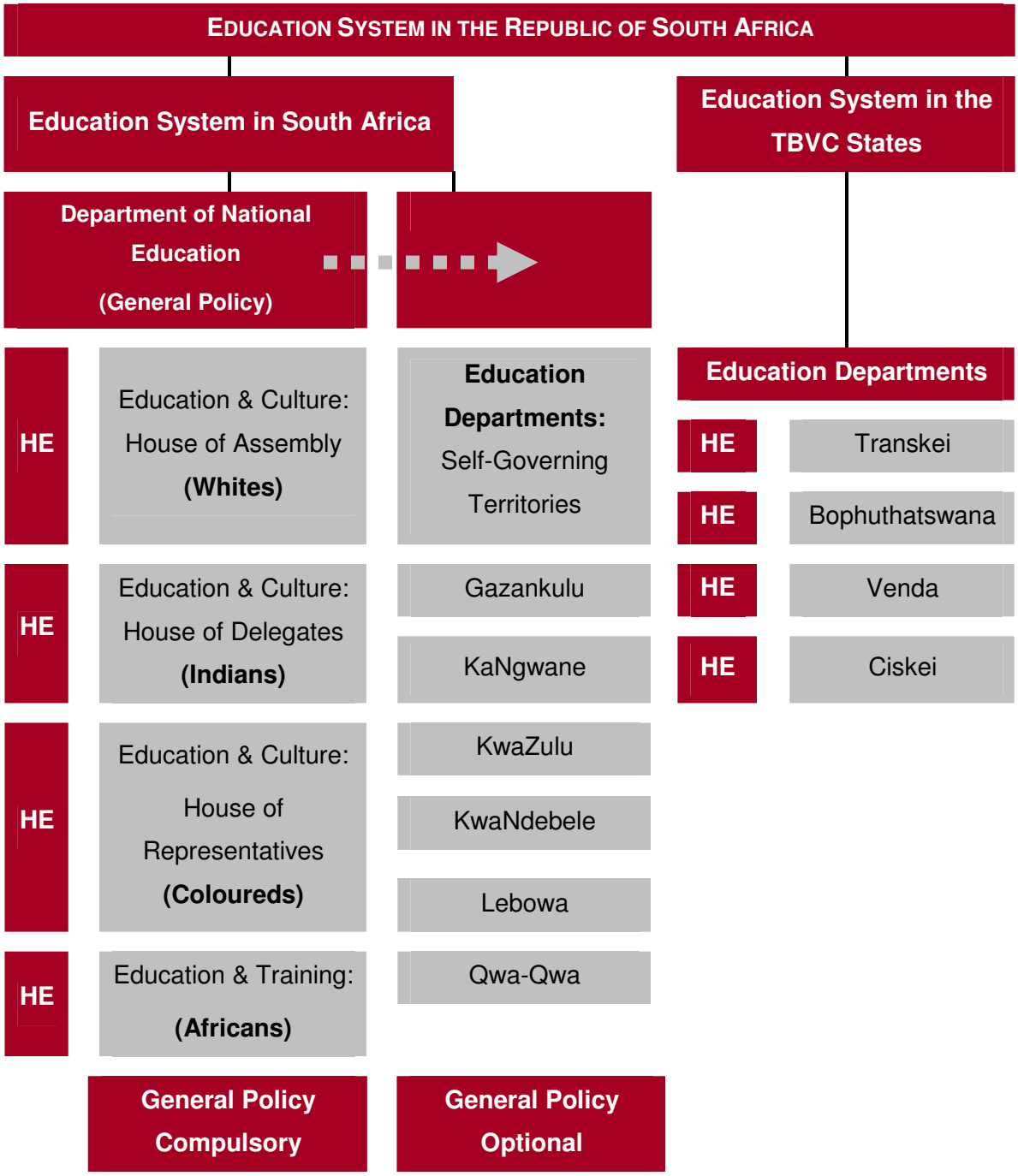

FIGURE 2.1: The public and higher education system in South Africa until 1993 (Source: Adapted from CHE, 2004a: 22)

The Select Committee of Education and Recreation (SCER) stipulates that the socio-political challenges facing higher education during the 1980s demonstrated a need to rethink the roles of universities in the transformation of society, particularly in advancing principles and values such as equality, diversity and representation (SCER, 2006: 4). Around 1991, three initiatives began to develop proposals for post-apartheid higher education policy. The first initiative was the National Education

Policy Investigation (NEPI), the second was a civil society initiative with origins in the 'peoples education' movements (the Union of Democratic University Staff (UDUSA) policy forum) and the third initiative was the Centre for Education Policy Development linked to the African National Congress (ANC) (CHE, 2004a: 24; NQF, 2008: 2). The mid-1970s witnessed a demand for change in education, spearheaded by the non-governmental education sector. By the mid-1980s, the entire education system had been discredited and rejected. Non-governmental education sector resistance resulted in the formation of the NEPI, which set about developing proposals for the restructuring of the formal educational system. The NEPI reports and framework, published in 1992, were premised upon the principles of non-racism, non-sexism, democracy and redress. According to Hay (2001: 2), NEPI's policy proposals influenced nearly all levels and aspects of post-apartheid higher education (Mapesela & Hay, 2005: 113).

In the early days of post-apartheid, there were many challenges facing higher education institutions - primary amongst these was the need to achieve greater equality, efficiency and effectiveness within institutions and across the system. Asmal reacted to these challenges by pronouncing that the restructuring of the higher education system would ensure the removal of the Verwoerd legacy that had created separate and unequal institutions (SA, 2003: 4-5). Others principally agreed with these challenges and that the focal point of post-apartheid higher education should be on the cleansing of the apartheid anathema (Tisani, 2004: 178; Study SA, 2007: 1-4).

The notion of transformation in higher education can be described as the process of establishing a framework for change, fundamental to which is the formation of a higher education system that is planned, governed and funded as a single coordinated entity. The first democratic government of South Africa established a National Commission on Higher Education (NCHE), which charted a programme for transformation. The NCHE was established by presidential proclamation at the end of 1994 (NCHE, 1996). The NCHE report rested on three envisaged 'pillars' for a transformed higher education system (NCHE, 1996). First, in order to satisfy the need of equity, redress and development, a policy of increased participation was required. This should be achieved, in the NCHE's view, through change from an elite higher education system to that of a mass higher education system (a process of

massification). In addition - in part to combat the potentially adverse effects of rising enrolments on academic standards, but more importantly to deal with differences in quality across institutions and to steer overall quality improvements in the system - the NCHE advocated a policy of quality assurance and quality promotion through various forms of capacity-building with a NQF. Secondly, the NCHE believed that a policy of greater responsiveness was needed to ensure that higher education engaged with the challenges of its social context. The NCHE third policy pillar of increased cooperation and partnerships led to the recommendation of a model of 'cooperative governance', whose elements included the state in a supervisory role (as opposed to control or interference) (CHE, 2004a: 25). The work of NEPI and the transformation it advocated were sustained by the NCHE, which set a framework for the higher education transformation (Mapesela & Hay, 2005: 113). By 1997, the key higher education policy and legislation were in place to enable the systematic programme for the transformation of higher education to unfold. During 1997, the NCHE also recommended the creation of a higher education forum, but opted for a single body - the CHE - with policy advisory and quality assurance functions.

At a national level, the government instigated a radical restructuring of higher education to make it more focussed, coherent and efficient. The Committee of Technikon Principals (CTP) was established in 1998. The CTP acted similarly to the South African Universities' Vice-Chancellors' Association (SAUVCA) and sought to represent, promote and develop the interests of technikons in South Africa (Du Pré, 2000: 5). According to Asmal (2001: 2), the crucial challenge that faced the new government, after the demise of apartheid, was to re-evaluate whether higher education could effectively succeed in stimulating, directing and utilising the creative and intellectual energies of a post-apartheid society. Though the transformation of these higher education institutions has had some effect on various levels (students, staff, faculties, management constituencies) within institutions, it is rash to suggest that these institutions are not able to adapt and succeed on their own in order to stimulate or direct, and utilise the creative and intellectual energies of a more diverse society. A more realistic approach, as suggested by Lazarus (2000: 21) seems more fitting. He states that the purpose of the new government is to restructure the higher education system in order to render it more equitable and efficient to generate the desired outputs in terms of student diversity and numbers.

The National Working Group (NWG) was appointed by the government in March 2001 to investigate and establish new institutional and organisational forums, including the feasibility of reducing the number of higher education institutions (NWG, 2001; CHE, 2004a: 43). Although it was not known at this point how the new paradigm of higher education was interpreted, the binary divide was dismantled and the number of institutions was reduced from 36 to 22 through a series of mergers and campus incorporations that involved most institutions. No campuses were closed so there remains as much higher education provision as there was before. Asmal, once again, reacted to the reduction of institutions by stating that it is clear to government that the status quo could not be maintained and that radical steps would be needed if the system were to play its pivotal role in responding to the many challenges that the country faces. He continued further by pronouncing that no institution would be left untouched (Mail & Guardian, 2005: 2). The first set of mergers and incorporations were effective in January 2004, and the second set in January 2005. The post-apartheid national landscape of South African higher education institutions, which was established through mergers and campus incorporations, is outlined in Annexure 1.

The new landscape comprises three types of institutions: eleven 'traditional' research-focussed universities, five universities of technology (UoTs) (formally known as technikons) and six new 'comprehensive' universities (CHE, 2004a: 49). UoTs are a new concept in South Africa (registered in October 2003) and not yet extensively defined or philosophically scrutinised. For the purpose of the study, it is appropriate to make use of the explanation that UoT programmes focus on the application of scientific principles in those cases where such knowledge is deemed to be essential to the successful application of the scientific principles concerned (Du Pré, 2004: 38). Comprehensive universities combine academic and vocational-oriented education and are aimed at enhancing students' access, expand research opportunities and market responsiveness (vocational training) (Blaine, 2007: 3). In addition to the three types of universities, two national institutes for higher education were established, one in Mpumalanga and the other one in the Northern Cape.

At the institutional level, universities needed to improve access to students of all races to help build a new democracy and to become more responsive to the transformed societal needs. This point was also addressed in parliament and it was

stated that the socio-political challenges facing higher education necessitated a self-affirmed recognition in many higher education institutions, as well as the achievement of equitable access to education as a crucial element in the embodiment of global social transformation (SCER, 2006: 4).

One way of widening access into higher education institutions is to allow prospective students who do not have the required entrance criteria to participate in introduction programmes specialised to the particular field of study. Higher Education South Africa (HESA) was formed on 9 May 2005 as the successor to the two statutory representative organisations for universities and UoTs - SAUVCA and CTP (HESA, 2008: 1). HESA is developing national benchmark tests to help universities select students who are most likely to succeed at academic study and to measure how well the new national school curriculum prepares learners for higher education. As with the Scholastic Aptitude Test (SAT) in the United States of America, the South African tests will measure academic literacy, quantitative literacy and skill in mathematics (Study SA, 2007: 1-4). Blaine (2006: 6) speculates that it will be a few more years before universities decide whether to use these tests for admission.

The DoE stipulates that the need to transform the higher education system in South Africa stemmed from two sets of factors. First, a historical legacy of inequity and inefficiency inhibits the system's ability to meet the moral, social and economic demands of the new South Africa. Secondly, a context of unprecedented national and global opportunities and challenges that required state intervention, especially in expanding access to higher education to all people in South Africa, regardless of race, gender, age, location or financial resources (Centre for Higher Education Transformation (CHET), 2007: 5). Higher education has seen major changes, which have left a permanent imprint on the system, its constituent institutions and their practices. Herbst (2007: 85) agrees when he states that institutions are facing many transformation challenges which have a profound impact in the areas of governance, management and leadership. In the decade since the adoption of the Higher Education White Paper 3 (DoE, 1997) and the Higher Education Act 101 (Republic of South Africa (RSA), 1997), changes have manifested on many fronts. Consequently, higher education institutions are required to develop curricula that are locally relevant but also geared towards an increasingly competitive, technological and knowledge-driven world. These institutions are required to produce graduates able to work on

South African problems and to train the growing numbers of graduates essential to economic growth and development.

Student numbers have nearly doubled in the 12 years of democracy, to 735 000 in 2006 (Study SA, 2007: 1-4). Major strides have been made in opening up access to groups disadvantaged under apartheid, especially Black and female students. The portion of Black students has grown to three-quarters of the student body and 55 percent of these students are female (Study SA, 2007: 1-4). South African universities are launching major restructuring initiatives financed by the R6 billion allocated from government, which will be used to refurbish buildings, construct new facilities, fund improvements to equipment and libraries, improve outputs, and produce more science, engineering and technology graduates (Gower & Pretorius, 2007: 1).

To summarise, national benchmark tests are not yet available for higher education institutions to select students who are most likely to succeed with their academic studies. Higher education institutions have to widen access opportunities for students, but not all applications will be successful. This study concentrates on prospective engineering students who were unsuccessful with their applications, but show potential of becoming successful engineering students within the academic paradigm of higher education legislation and structures.

2.3 HIGHER EDUCATION LEGISLATION AND STRUCTURES

Higher education academic programmes are defined as planned combinations of learning outcomes, each with a defined purpose or purposes. They must provide qualifying students with applied competence. In addition, they must open up access routes to additional education and training, and they must promote lifelong learning by providing both specific and critical cross-field outcomes (CHE, 2004a: 97-98). In order to develop curricula for engineering introduction programmes, it is essential to consider current legislation, and the various bodies and factors that have an external influence on the development phase. The factors, which have an external influence on this study, are highlighted next. SAQA determines the NQF levels of the development of curricula. The critical cross-field outcomes, criteria specified by

SAQA (SAQA, 2000: 18-19) are outlined in Annexure 2 and are still relevant in higher education qualifications.

2.3.1 The South African Qualifications Authority (SAQA)

SAQA is a statutory body of 29 board members whose main function is to observe the development and implementation of the NQF. The Minister of Education (MoE) develops national policy, legislation, national norms and standards - under advisement from the NCHE - for education planning and appoints SAQA board members, after consultation with the Minister of Labour (SAQA, 2008: 1). SAQA's policy and regulations (RSA, 1998) develop the discourse of articulation and flexibility in learning through a set of key concepts for those higher education qualifications to be registered on the NQF. Knowledge gained via academic programmes (that is, learning outcomes) should add value to the learner/student and, consequently, provide benefits to society and the economy by, amongst other things, the enrichment of the individual and the expansion of access routes to additional education and training for learners/students. This feature is embedded within the relevant goals and strategic objectives of the National Plan for Higher Education, 2001, as linked to the Higher Education White Paper 3 and outlined in Annexure 3.

A unique feature of SAQA, referred to in the NAP (CHE, 2001), is the articulation column, which provides for horizontal and diagonal articulation. The purpose behind this is to facilitate learner mobility as well as progression, and can be used to admit into the system those learners who do not meet the full entry requirements for their target programmes. SAQA highlights the importance of qualifications that might be achieved in whole or in part through Recognition of Prior Learning (RPL), thereby widening access to potential students whose qualifications for study might not be formal (CHE, 2004a: 97-98). SAQA's consultative panels consist of subject matter experts as well as qualifications experts, and their role is to evaluate qualifications and standards from the perspective of the sector for which the qualification or standards have been developed using SAQA's criteria (SAQA, 2008: 2).

Until year-end 2008, SAQA has adopted an eight-level framework, with NQF Levels 1 and 8 respectively being regarded as open ended. NQF Level 1 accommodates three Adult Basic Education and Training (ABET) certification levels, as well as the

General Education and Training Certificate (SAQA, 2008: 1). The various NQF levels were attained from the NAP in higher education released in 2001 and are illustrated in Annexure 4. These NQF levels are to be maintained in order to acquire diagonal articulation for those students who do not meet the entrance requirements for higher education qualifications (specifically, Level 4 to be entered into Level 5). Diagonal articulation generally means that a learner/student may be required to undertake additional enrichment learning in a specific target area prior to being admitted to a target programme. It has been proposed by the CHE that programmes which fall into the articulation column allow training providers to offer short, focused programmes that meet specific in-service or upgrading needs of adult participants (CHE, 2001).

The proposed articulation is still embedded within the SAQA goals and strategic objectives listed in Annexure 3 (SAQA, 2008: 1). In terms of an institutional example, the AD introduction programme is designed as a short-course programme, focussed on enhancing and developing the skills and academic performance of prospective engineering students (NQF Level 4) at the VUT.

2.3.2 The National Qualifications Framework (NQF)

The NQF traces its origins back to the labour movement of the early 1970s (NQF, 2008: 1-4). The Black Trade Union's demand for a living wage was repeatedly rejected by employers on the grounds that the workers were unskilled and, therefore, that their demands were unjustified. This, in turn, led to Black workers seeing training as a means of achieving their demands for better wages. On the assumption that skills development would lead to better wages, an integrated proposal was formulated, based on stage improvement in skills, linked to grading increments. The proposal stressed the need not only for basic education, without which workers would not be able to access the proposed system, but also for portability and national recognition of training so that workers would not be at the mercy of a single employer (NQF, 2008: 1-4). The education employer sector participated in the process of policy discussion, advocating a seamless framework for education and training, which provides quality learning that is responsive to the ever-changing influences of the external environment and that promotes the development of a nation which is committed to lifelong learning (NQF, 2008: 1-4).

The 1995 White Paper on Education and Training underscored the need for the development and implementation of the NQF. The NQF is a set of principles and guidelines where records of the learners/student's achievements are registered. It enables national recognition of acquired skills and knowledge, thereby ensuring an integrated system that encourages lifelong learning (SA, 2007: 1-3; SAQA, 2008: 2). These objectives of the NQF, as outlined in the SAQA Act No. 58 of 1995, are listed in Annexure 5. It attempts to move the measurement of achievement in education and training away from inputs towards outcomes. The introduction programme curricula are designed on NQF Level 4. The NCHE advocates a policy of quality assurance and quality promotion during various forms of capacity building through the NQF.

2.3.3 The Higher Education Quality Committee (HEQC)

The CHE is responsible for performing quality promotion and quality assurance functions through the HEQC. During 2001, the HEQC became primarily responsible for the Education Training Quality Assurance (ETQA) in higher education. The CHE and the HEQC remain accountable to the MoE (SA, 2007: 1-3). The interim HEQC commissioned a study during August 2000 in order to establish the different conceptions held by the Sector Education and Training Authorities (SETA) and other professional bodies about their Quality Assurance (QA) roles. This initial step by the interim HEQC represents the evolving process of exploring possible contractual relationships between the HEQC and other ETQA sectors. The promotion and enhancement of quality in higher education provision requires both breadth of vision and strategic focus in order to facilitate the achievement of diverse social purposes ascribed to higher education in the South African context (CHE, 2001: 2; HEQC, 2001: 9). These specific issues are listed in Annexure 6, Table A-6.1, and are in line with the goals and objectives of the National Plan 2001, as linked to the White Paper, as well as the generic outcomes criteria specified by SAQA.

During 2002, the HEQC published its Programme Audit Framework proposal. The proposal seeks to give effect to the statutory QA responsibility to audit the QA mechanisms of higher education providers, assigned to the HEQC by the Higher Education Act of 1997. The proposal outlines an audit system for universities, technikons and agricultural colleges, as well as for registered and accredited private

providers, the qualification of which falls under the jurisdiction of the HEQC (CHE, 2002: 1; HEQC, 2002a: 3; HEQC, 2002b: 7).

By 2003, the HEQC released a directory of ETQA and Professional Bodies. The directory highlights the various organisations with some-or-other-kind of higher education QA responsibility. It also indicates the challenges of establishing relationships for ensuring effective coordination and facilitation of higher education QA (CHE, 2003: 1-3). Audits are the responsibility of the HEQC in terms of being recognised by SAQA as the ETQA for the higher education band (CHE, 2003: 1-3). The HEQC advocates an international standard practice of institutional self-evaluation, followed by external validation by peers and specialists in higher education. Criteria for HEQC audit judgements from the proposed Programme Audit Framework Document, released in 2002, are listed in Annexure 6, Table A-6.2. The need for higher education institutions to produce quality education seems to be globally echoed (Maila, 2005: 1457). Quality, as well as transformation within the higher education environment, is a phenomenon controlled by regular change. The changes to the HEQF, as related to the study, follow.

2.3.4 The new Higher Education Qualification Framework (HEQF)

The revised NQF policy, in the form of the HEQF, aims at making the NQF more efficient and more responsive to the needs of the country. In particular, to assist citizens who were historically excluded from the national education, training and skills development systems, so that they have the opportunity to reach their potential. According to Pandor (DoE, 2007: 3), separate and parallel qualification structures for universities and UoTs have hindered the articulation of programmes and the transfer of students between programmes and higher education institutions. She also acknowledges the role of the CHE and others who contributed towards the development of this policy. She further states that this new qualification framework has been designed to meet the demanding challenges facing the higher education system in the twenty-first century. Pandor believes that this policy will guide higher education institutions in the development of programmes and qualifications that provide graduates with the intellectual capabilities and skills that will empower them and that, in turn, will enrich society, as well as enhance economic and social development (DoE, 2007: 3).

The HEQF, as promulgated by the South African Parliament in August 2007, incorporates an integrated approach to the qualification design. Qualification specifications require a movement from generic to specific outcomes and the most generic standards are found in the level descriptors. The generic outcomes are listed in Annexure 7. The most specific standards are found in the programmes that lead to qualifications. One or more recognised qualification types is linked to each NQF level (DoE, 2007: 7).

Credit Accumulation and Transfer (CAT) is the process whereby students' achievements are recognised and contribute towards further learning. This is regardless of whether or not the student achieved a full qualification. Credits obtained for a partially completed qualification at one institution may be recognised by another as meeting part of the requirements for the same qualification. Otherwise, credits for an incomplete qualification may be recognised as meeting part of the requirements for a different qualification, immaterial of whether it is at the same institution or at another institution. Accumulated credits (subject to limits) for a complete qualification may be recognised as meeting part of the requirements of another qualification. Until the CAT system is completely developed, a maximum of 50 percent credits of a complete qualification may be transferred to another qualification, provided that no more than 50 percent of the credits required for the other qualification are credits that have been used for a completed qualification (DoE, 2007: 9).

The HEQF is intended to facilitate articulation between further higher education qualifications, as well as within higher education qualifications. The opportunity to widen the entrance possibilities for students who do not entirely qualify for the higher education qualification applied for can be accommodated through this intention. However, the possession of a qualification does not guarantee a student's progression and admission to a programme of study. The minimum requirements for admission to a higher education institution from 1 January 2009 is the National Senior Certificate, the specifications of which where approved by the MoE.

From an institutional perspective, the VUT requires the National Senior Certificate as a minimum entrance requirement and, additionally, for the engineering diploma

programmes, a minimum of a 4-point rating for the subjects mathematics, physical science and English.

With these specified requirements in mind, it becomes possible to set the entrance requirements needed for a diagonal articulation programme (in the form of an introduction programme), which offers enrichment learning just below the entrance requirements needed for mainstream engineering diploma programmes. A comparison of the minimum entrance requirements for admission into the VUT engineering studies and those for the introduction programme are illustrated in Annexure 8.

Higher education is central to the social, culture and economic development of modern societies. In South Africa, higher education institutions are accountable to the government, through the DoE, and have to register their qualifications on the HEQF through SAQA. Furthermore, their programme offerings have to be accredited by the HEQC. In addition, the engineering programmes offered at higher education institutions have to be endorsed by an autonomy known as the ECSA.

As from 2009, the HEQF will be part of the 10-Level qualification framework spanning Levels 5-10; Levels 1-4 remain as currently defined (see Annexure 4).

Level descriptors are referred to in the HEQF policy document but have not been promulgated. Owing to the fact that level descriptors have not been promulgated, the ECSA uses a contextualised form of draft level descriptors published previously for the HEQF (ECSA, 2006a).

The HEQF levels will be applied in higher education institutions as from 1 January 2009 and are illustrated in Annexure 9. The qualification types, together with their entry requirements and indicated progression possibilities, give structure to the HEQF framework in terms of the qualification types.

Figure 2.2 depicts this structure with the main pathway and progression paths also indicated.

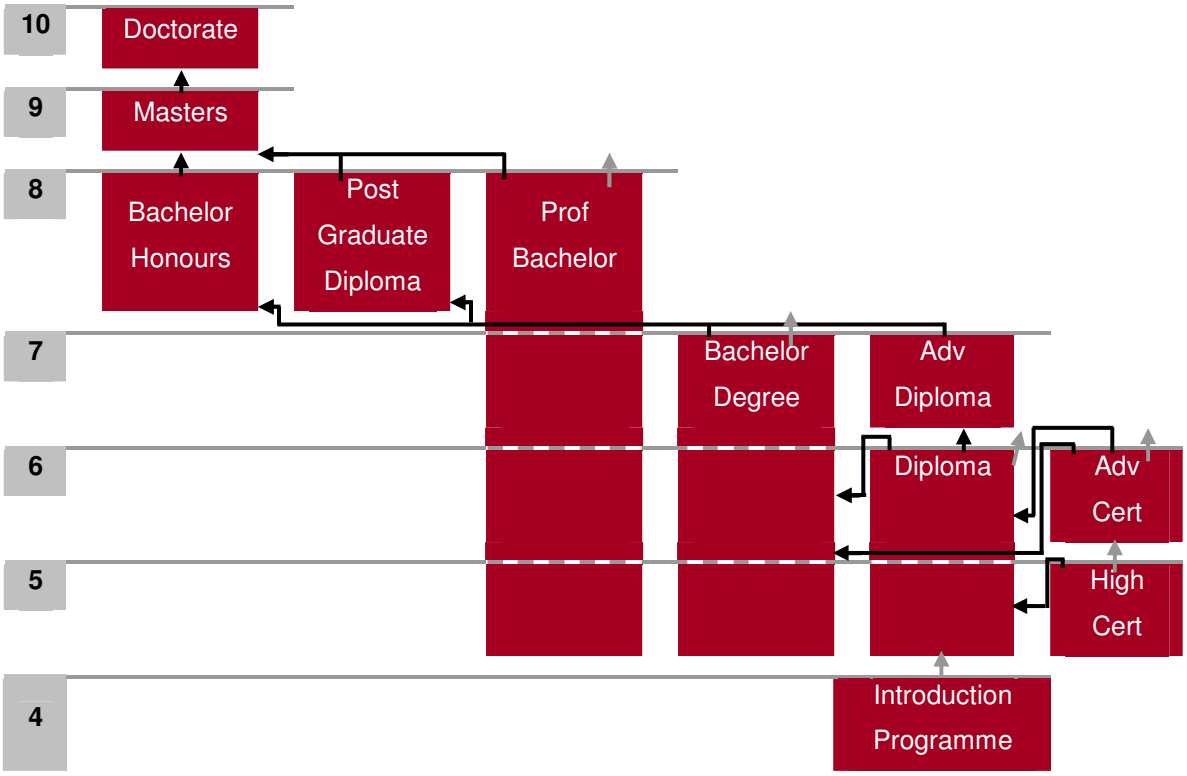

FIGURE 2.2: Structure of the HEQF framework with the inclusion of an articulation programme (Source: Adapted from ECSA, 2007: 3)

The introduction programme, similar to the one operating at the VUT, which offers enrichment learning for prospective engineering students who fall just below the entrance requirements needed for the mainstream engineering diploma programme, is included for clarification purposes. Developments in higher education, which influence the development of a curriculum framework for introduction programmes, follow next.

2.4 DEVELOPMENTS IN HIGHER EDUCATION

Winberg (2005: 196) suggests that higher education should aim not simply to transmit fixed blocks of information to students, but to develop independent creative and responsible critical thinkers. Higher education can be associated with the attainment of knowledge, knowledge that can emerge in different forms and have different values, to enable recipients to use the intellectual and emotional resources gained to embark on the solving of local and global problems essential to economic growth and development.

Van Wyk and Higgs (2004: 199) agree that higher education is concerned with developing competencies in the value corpus of knowledge and in imparting an evaluation of the different forms of knowledge that are available.

Scott (1989: 7) acknowledges that knowledge is at the heart of higher education. It is important to him that knowledge be interpreted in the widest possible sense: it should not only embrace 'what' the content and methods of particular subjects are, but also 'why' they provoke the intellectual and cultural questions and 'how' the practical application to the solution relates to personal, social and economic problems. Du Pré (2004: 12), on the other hand, postulates that criteria such as relevance of knowledge and applicability of skills are increasingly becoming important determinants of employability.

Just as the National Senior Certificate became the passport for participation in higher education, a higher education qualification, which provides transferable skills and ensures competency, is becoming the key requirement for economic security in the age of knowledge. The introduction programme offers enrichment learning for prospective engineering students. It starts preparing these students for the acquisition of knowledge and information needed within the higher education sector.

2.4.1 The role of universities in society

Juma (2005: 1-3) argues that addressing Africa's developmental challenges requires the creation of a new generation of universities that focus on solving community problems. Universities and other institutions in higher education are key players in domesticating knowledge and diffusing it into the economy. This can be acquired through forging close linkages with the private sector, which requires adjustments in the way universities function in Africa. The continent needs a new generation of universities that can serve as engines of both community development and social renewal (Juma, 2005: 1-3).

Harvey (2004: 3-4), on the other hand, suggests that the possible roles for universities are as follows:

- Universities and other higher education institutions need to play their intellectual role in research.

- Universities have to increase their networking with other institutions of higher education and participate in global debates through spearheading intellectual debates with those involved in education and development.
- Universities should take on the role of facilitating advocacy for national policy debates at all levels of the society as well as at institutional level, including with education parliamentarians such as the Forum for African Parliamentarians for Education in Africa.
- Universities should celebrate important international events such as the Education Decade for Sustainable Development.
- Universities should facilitate resource mobilisation on behalf of the education sector (Harvey, 2004: 3-4).

Consideration of the role of universities in social change and transformation raises questions: Who gets higher education? (The access question); What do they get? (The curriculum question); and Where does it lead them? (The labour market question) (Brennan & Lebeau, 2002: 4).

If educational credentials are the key legitimate route to adult roles and social status in the knowledge/achievement/democratic society, then the question of who has access to universities is a central one, relating to an understanding of these societies.

It is known from a variety of studies that different academic subjects and different forms of curriculum methodologies produce different kinds of individuals (Brennan & Lebeau, 2002: 5; Pascarella & Terenzini, 1995; Becher, 1989). The placement question is central to the long-term impact of higher education on graduates who may have an effect on the future direction of the society. Sharma and Ghista (2008: 1) refer to universities as laboratories for the development of a progressive society. This is seen through an institutions ideal in all fields of study and by the development of education and research.

They further elaborate by stating that a university needs to have a handle on the problems confronting society and a clear understanding of its own role in cultivating the ideals for its progress (Sharma & Ghista, 2008: 1).

According to Du Pré (2004: 14), universities have defined academic quality within higher education in terms of inputs such as student and academic staff quality, resources, and facilities, rather than outputs such as student performance. He further states that rethinking of the core academic functions of a university requires a shift in perspective from resources to results. Habermas's (1997: 1-3) interpretations of what the role of a university should be are defined more specifically and acceptably as follows:

- Universities must not only transmit technically exploitable knowledge, but also produce it. Therefore, they must meet industry's demand for qualified individuals, and simultaneously be concerned with the expanded reproduction of education itself.
- The university has the responsibility of ensuring that its graduates are equipped, no matter how indirectly, with the minimum of the qualifications in the area of extra-functional abilities. Here, the extra-functional abilities refer to lifelong learning, work-based learning and professional skills, relevant to the pursuit of a professional career.
- The task of the university is to transmit, develop and interpret the cultural tradition of the society.
- The university has always fulfilled a task that is not easy to define (Habermas, 1997: 1-3).

The foremost contribution a university can make to a free society is by preserving its independence as an institution committed to the free exchange of ideas. Universities need to be involved in critical analysis, experimentation, the exploration of a wide range of ideas and values, the study of the consequences of social action or scientific progress and the evaluation of these consequences in terms of values that are themselves subject to careful scrutiny (Chomsky, 2003: 278).

Du Pré (2004: 14) speculates that the ethos of a UoT should also be defined along these lines.

One way of resolving the apparent contradictions is to acknowledge that universities play multiple roles, both reproductive and transformative.

2.4.2 The role of universities of technology in society

In the perception of the 'old guard', technikons had fallen victim to academic drift. The persistence of the strong mindset and practices associated with an older version of 'educating for the needs of industry' (old guard) placed constraints on the achievement on university equivalence. The introduction of theory and research modules into even undergraduate programmes forced technikons in the direction of generic university courses, and 'softened' the hard techno-science context of the original technikon programmes (Winberg, 2005: 194). Technikons felt comfortable with the discourses of development and modernisation that were (and still are) dominant in the higher education policy.

The propulsion of technikons, ready-or-not, into a new era forced the institutions to rethink their educational and research missions and, for most, this meant rediscovering technological education (Cape Peninsula University of Technology (CPUT), 2004; Durban Institute of Technology (DIT), 2004). Du Pré (2004: 13) speculates that unless UoTs draw upon a greater diversity of individuals as students, South Africa cannot hope to generate the intellectual vitality needed to respond to a changing world. Winberg (2005: 196), on the other hand, postulates that UoTs are beginning to see themselves as offering a broad and critical education: one that enables students to engage with the consequences of science and its applications, and to question scientific ways of knowledge, especially in the context of environmental sustainability and human health.

Integrated approaches to teaching, learning and research, that combine the disciplines of science, engineering and technology with other disciplines, will need to be critically examined and promoted in seeking to educate students to emerge with a diversity of views and visions, and to develop an equitable, socially just and ecologically sustainable economy (Winberg, 2005; 196).

These functions and characteristics are also embedded in the functions and characteristics of a UoT, provided by the CTP and are listed in Annexure 10, Tables A-10.1, A-10.2 and A-10.3. The CTP, at its final general meeting in November 2005, had agreed on the establishment of a 'technology network' along the lines of the Australian Technology Network (ATN) to carry on the work of the CTP within the new UoT sector (South African Technology Network (SATN), 2008: 1-4). The CTP has

been replaced by the SATN, which provides for a network to ensure the continuation of the process of operation, collaboration, support and joint activities, such as curriculum development, applied research, quality assurance and cooperative education.

UoTs, alongside the traditional and comprehensive universities, constitute a dynamic and excellent higher education system in South Africa. The difference in focus and ethos between UoTs and traditional universities not only brings a much wider variety and diversity into the higher education system, but also contributes meaningfully to greater technology transfer and international competitiveness (Du Pré, 2004: 13). The Higher Education White Paper 3 (DoE, 1997) and the 2001 CHE Report came out strongly in favour of a university system, but suggested differentiation. Within the system, there can be a unitary system of universities, but differentiation in focus (Du Pré, 2004: 19).

In vocational programmes, students must have some mastery of the fundamental concepts and theories of the cognate disciplines upon which their knowledge field draws, while directing theoretical understanding to its application in practical contexts. Both vertical expansion of complexity and horizontal expansion of skills are possible. Winberg's (2005) postulation seems to offer the most accurate description of the changes occurring within the VUT.

2.4.3 The Vaal University of Technology (VUT)

The VUTs origin can be traced back to 1966 when the Vaal Triangle College for Advanced Technical Education opened its doors in Vanderbijlpark, South Africa (Brits, 2006: 2). The need for such an institution was prompted by the rapid industrial growth in the Vaal region. The College was inaugurated in 1967 and comprised of three departments: chemistry and physics, electrical engineering, and mechanical engineering. During 1972, the recognition of independence, in accordance with the Advanced Technical Education Act, was an important event for the College. The department of art, food and clothing technology was established in 1978. It was in the same year that student enrolment reached the 3 000 mark. Qualifications obtained from the College were investigated and the findings of the Goode Committee of Inquiry were published, recommending that a fifth year of study be introduced to accommodate the training of technologists (Brits, 2006: 2).

In 1979, all colleges of advanced technical education were renamed technikons in accordance with the Advanced Technical Amendment Act, and the six-year hierarchy of qualifications was approved by the DoE (Brits, 2006: 2-3). The Vaal College of Advanced Technical Education became the Vaal Triangle Technikon. The first satellite campus was established during 1987, offering part-time classes at Secunda (Mpumalanga). In that year, the Vanderbijlpark campus student numbers reached 6 000. The second satellite campus opened its doors during 1994 in Klerksdorp (North West). During the same year, the Secunda campus commenced with full-time courses in mechanical engineering, electrical engineering and marketing. Technikons received permission to offer degree courses, and the first enrolments took place during 1994 (Brits, 2006: 2-3).

Two additional satellite campuses were established during 1995 at Upington (Northern Cape) and at Kempton Park (East Rand). It was during this year that the first Bachelor degree (B Tech) was awarded (Brits, 2006: 2-3).

In 1996, the Vaal Triangle Technikon adopted a Transformation Charter compiled in consultation with all stakeholders. The academic structure underwent further changes. The first Masters degree (M Tech) was awarded. Tokyo Sexwale was elected the first chancellor of the Technikon. It was in 1999 that the new language policy, with English as the official language, came into operation. The first Doctorate degrees (D Tech) were awarded in 1999. During 2002, the first ever Honorary Doctorate was awarded to Archbishop Emeritus Desmond Tutu. In 2004, the Technikon became a UoT and the first institutional journal, the Academic Journal of Vaal University of Technology, was published to serve as a vehicle for young or new academics and researchers to publish their work. During this year, student enrolment reached the 17 000 mark (Brits, 2006: 3-4).

During 2006, the university celebrated its fortieth anniversary. New academic structures were introduced to provide for the final transformation of the VUT from its former technikon structure to a UoT structure (Brits, 2006: 4-5).

These structures came in the form of programme curriculum revision, ‘schools’ within the faculties were restructured into departments and managerial changes occurred.

2.4.4 Academic skills and competencies

There has been a shortage of pedagogical expertise in the development of technikon curricula. Winberg (2005: 192) agrees that technikon programmes, in their earlier manifestations, resemble school curricula (some UoT programmes still do). The context is dense, packed with many subjects, with virtually no time allocated to individual study, research or project work. The White Paper on Education and Training covers the need for quality education and training. It particularly refers to quality, which is linked to the capacity and commitment of the academic staff, the appropriateness of the curriculum and the way standards are set and assessed.

Professionals cannot perform their roles without specialist knowledge. There is agreement that academics in higher education need to be equipped with skills and competencies, not only to improve the quality of higher education, but also to assist them in dealing with change. (DoE, 1997; DoE, 2000; Mapesela & Hay, 2005: 115; Study SA, 2007: 1-4). Integrated approaches to teaching, learning and basic research that combine the disciplines of science, engineering and technology with other disciplines need to feature within introduction programmes for prospective engineering students. These features are incorporated by the HEQF and are to be applied within the higher education sector, which includes the introduction programme. The diversity within educational programmes is elaborated on in Chapter 3.

Competence-based education forms one of the integrated teaching and learning approaches, as students have to know from the introduction level that, for example, engineering comprises the need for specific skills. Competence-based education is founded on the predication that a profession, such as engineering, is substantially dedicated to prescribed skills, proficiencies, techniques and strategies. The lack of these competencies has been cited both locally and internationally (Saunders, 2000: 37; Whitty & Willmott, 1991: 309).

Eraut (1998: 128) postulates that the term competence can be used with no less diversity as the terms knowledge, skills and ability. His analysis of how competence should be defined starts with the question: what does it mean when an individual is described as competent in an everyday situation? He concludes that the public understand competency in relation to a profession, such as engineering, and would

describe it as the ability of an individual to perform the tasks and roles required to the expected standard. Saunders (2000: 37) elaborates on the logic of Eraut and concludes that knowledge, skills and behavioural attributes are required for performing tasks to an acceptable standard. Eraut (1998: 128) finally claims that one advantage of defining competence is the flexible way it can be applied to a profession at any stage of the career.

Nevertheless, trainee engineers need to perform the same type of tasks as expert engineers. Therefore, these definitions can be interpreted as different levels of competencies for different stages within a profession or academic programme. The trainee engineer works with the acceptable standards set and the expert engineer works with the acceptable standards set (although not set on the same level of competency).

From an institutional perspective, interviews with the VUT's first-year lecturers revealed the main problem areas evident with first-year students. These included a lack of mathematical hands-on skills (using a calculator), a lack of basic mathematical and scientific knowledge, a lack of ability to integrate mathematical and scientific skills, and a lack of reading, writing and verbal English proficiency (McFarlane *et al*., 2002: 3). The concern of not producing graduates with relevant skills has been cited by Gnanam (2000: 147); De La Harpe, Radloff and Wyber (2000: 232); Sutherland and Waetzel (2005: 2), as well as Sutherland and Waetzel (2006: 342).

Government, industries, as well as the higher education institutions themselves, opt to place increasing value on the development of 'generic' skills, in addition to facilitating learning towards attaining knowledge and skills. The VUT is currently restructuring their engineering programmes to offer a generic first year for their diploma students from January 2009.

Disciplinary knowledge is of a transient nature, whereas generic skills, such as communication, teamwork, leadership, analytical and critical thinking, should be the property of graduates, irrespective of their field of study, and should form an integral part of the undergraduate curriculum (Bath, Smith, Stein & Swann, 2004: 315).

Gravett and Geyser (2004: 46) have listed their views on generic outcomes as:

- communicating effectively using visual, mathematical and/or language skills;
- identifying and solving problems by using creative and critical thinking;
- organising and managing themselves and their activities responsibly and effectively;
- working effectively with others in a team, group, organisation and the community;
- collecting, analysing, organising and critically evaluating information;
- using science and technology effectively and critically; and
- understanding that the world is a set of related systems (Gravett & Geyser, 2004: 46).

These generic outcomes are similar and parallel to the critical and developmental outcomes identified and underwritten by SAQA and the NQF (see Annexure 2). Gnanam (2000: 151) speculates that the shift in focus towards generic competencies or attributes makes education relevant to any career, as well as to the reality of life in a modern society and that any curricular activity should accommodate this if validity is to be ensured. The curriculum framework for the introduction programme is used as a vehicle to develop and enhance the critical and developmental outcomes prescribed by SAQA and the HEQF within prospective engineering students. Moreover, it allows for diverse methodologies in teaching and learning.

2.4.5 Teaching and learning in higher education

'Traditional education' can be seen as a process where information is passed from the notes of the lecturer to the notes of the student, without passing through the mind of either one (Dicks, De Jager & Sutherland, 2006: 2). Teaching can be constructed as complex processes and abilities that bring about higher-order learning (Clark & Neave, 1992: 1905). However, Van Niekerk (2004: 188) states that society, and academics in particular, should realise that they have become used to seeing teaching in one particular way only. They want to teach the way they have been taught. Academics find it difficult to abandon the mode of 'chalk and talk'. He further claims that this mode of teaching is one of the biggest problems that curriculum designers have to deal with and that this problem is further compounded by the metaphor that associates teaching with 'the transmission or transfer of knowledge'

(Van Niekerk, 2004: 188). The student is usually assumed unable to engage in contesting subject matter or comparative critical inquiry and, for this reason, is always protected from the controversial (Van Niekerk, 2004: 188). This protective pedagogy insists that the best way to teach is to provide the novice student with established knowledge and to avoid disputes that may create confusion for them (Zavarzade & Morton, 1991: 1). Academics, as knowledge workers, should only provide the abstract concept needed within the subject matter to justify existing social relations (Zavarzade & Morton, 1994: 2). Gravett (2004: 22-30), in contrast to Van Niekerk (2004: 188), indicates how research into student learning supports the establishment of inquiry and interpretation. The challenge for academics in higher education is, consequently, to identify the way of attending to the knowledge domain (curricula) and to develop teaching and learning activities that embed effective ways of lecturing into different situations, which are then explored with students (Gravett, 2004: 22-30). Waghid (2004) also suggests that students should abandon the expectation that prescribed text and course readings are the master text.

Academics should accept as a condition of exploration and discovery, the occasional state of being lost, confused and unsettled. This is supported by Biesta (2004: 4) who states that sometimes we should let go of our epistemological and metaphysical certainties. Readings (1999: 26) supports these statements when he puts forward the question: can knowledge only be reproduced from the ‘warehouse’ (library or text) or should knowledge be produced during the teaching process? It is Waghid’s (2004: 6) proposal that teaches academics not to feel threatened by occasions in which they sometimes need to admit that they do not know or understand everything. Tisani (2004: 176, 180) agrees when she claims that academics also have to empower students and groom them to be knowledge producers. This can be achieved by explicating the tools and methods of knowledge production. The aim is to expose students to real-life situations to consolidate their learning (Tisani, 2004: 176, 180). The introduction programme accommodates teaching methodologies other than the ‘chalk and talk’ methodology that students are used to and exploits the methodologies mentioned by Gravett (2004), Waghid (2004), Biesta (2004) and even Tisani (2004). The introduction programme assignments are all developed around real life situations to enhance learning and the curriculum falls within the requirements of SAQA, HEQC, HEQF and ECSA.

2.5 THE ENGINEERING COUNCIL OF SOUTH AFRICA (ECSA)

In order to ensure that engineering practice is in the public interest, engineering is a regulated profession. ECSA is responsible for the regulation of the engineering profession in South Africa. Regulation involves setting standards for qualifications, practice and ethics; conducting assessment against the standards, awarding of professional titles to individuals assessed competent; promoting best practice; investigating complaints; and improving sanctions in the case of misconduct (ECSA, 2006b: 1-2). The ECSA accreditation criteria is harmonised with SAQA as well as the HEQC and this is depicted in Figure 2.3.

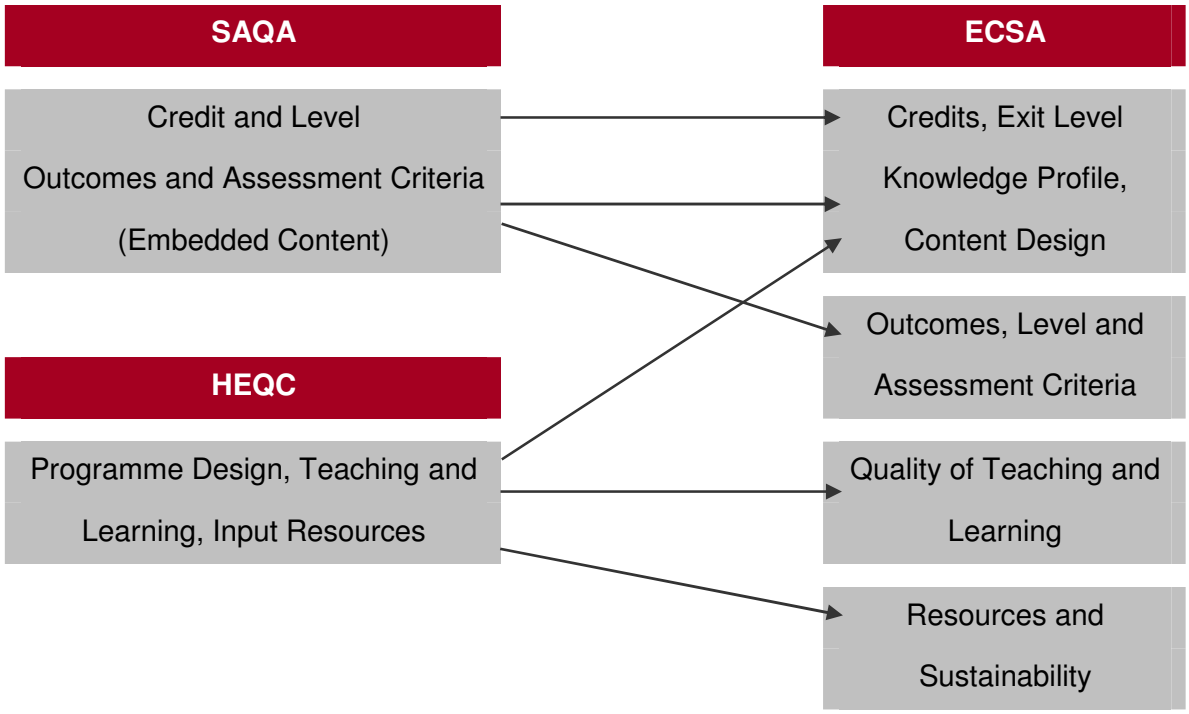

FIGURE 2.3: Harmonising accreditation criteria (Source: Hanrahan, 2007: 4)

The Engineering Profession Act No 46 of 2000 provides a number of measures to ensure safe, environmentally sound and effective engineering practice. The primary mechanism is the registration of individuals for professional categories: Professional Engineer (PrEng), Professional Engineering Technologist (PrEng Technologist), Professional Engineering Technician (PrEng Technician) and Professional Certificate Engineer (PrCert Eng) (ECSA, 2006b: 1-2). These categories provide a range of competencies to meet the varied demands of engineering work. Registration in a category signifies that the individual has been assessed competent against the

standards for the particular category and is subject to the provision of the Act. ECSA has specific engineering qualifications identified for completion before professional registration can occur. Figure 2.4 depicts the target engineering qualifications and professional designations, which are in line with the HEQF. The compatibility of the BEng has been long established and the new proposals for technology qualifications are felt to be broadly comparable (ECSA, 2007: 9).

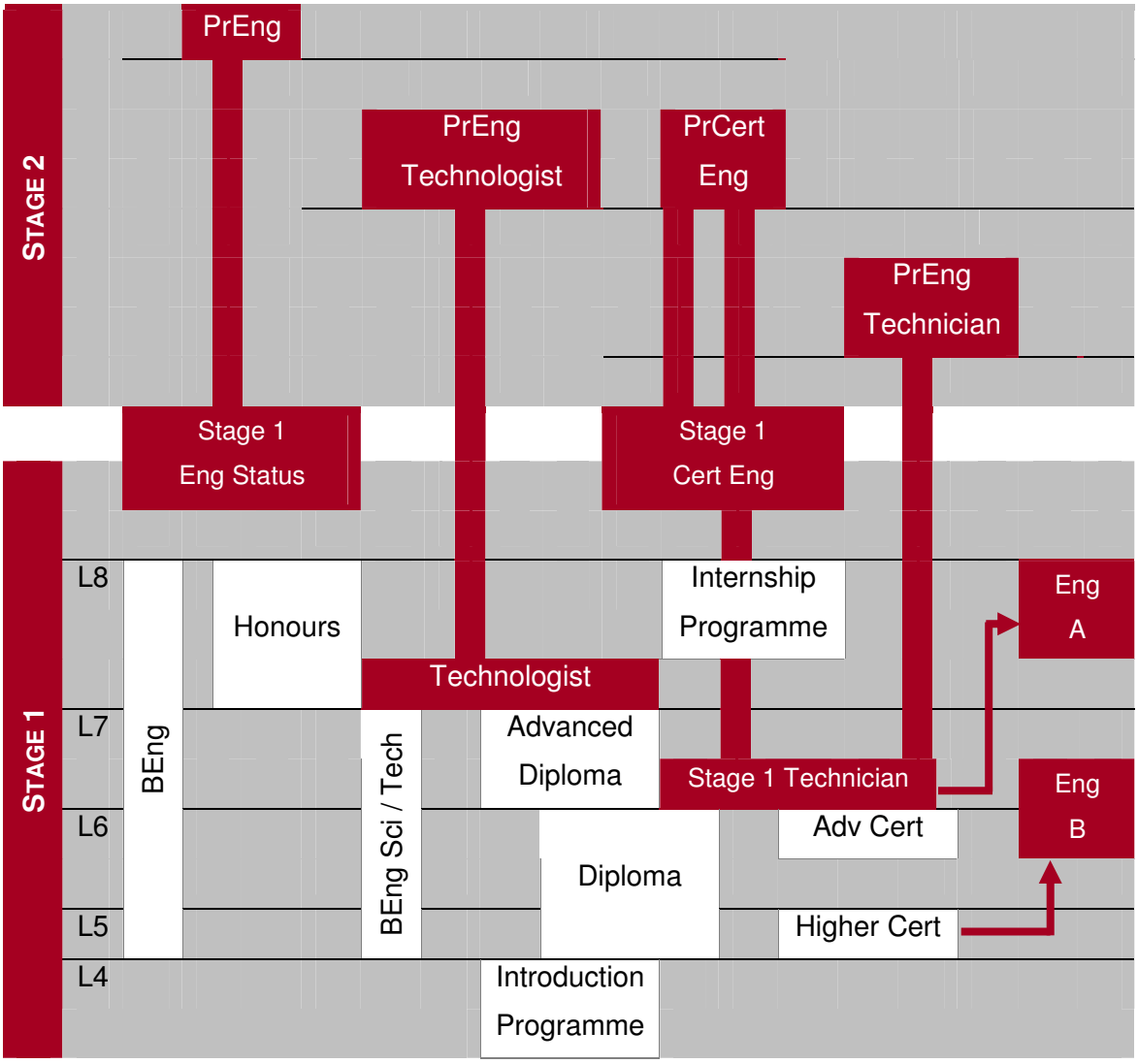

FIGURE 2.4: Target engineering qualifications and professional designations (Source: Adapted from Beute, 2007: 8)

In terms of an institutional example, all academics within the Faculty of Engineering and Technology at the VUT have to register with ECSA. To start delivering a programme of a particular type, the provider must obtain accreditation from the HEQC. ECSA evaluates engineering programmes offered at these providers

(Hanrahan, 2007: 5). The higher education institutions offering engineering programmes are accredited by ECSA every four years in order to receive accreditation for the qualifications on offer.

ECSA audits campuses to ensure that safety regulations are complied with and to assess curricula as well as assessment criteria for every engineering discipline offered at the specific institution.

To summarise, the functions ECSA maintain within the higher education sector are as follows:

- Setting and auditing of academic standards for purposes of registration through a process of accreditation of engineering programmes. ECSA has a well-defined process, which is not only recognised by organisations such as the CHE but also internationally through various accords.
- The accreditation visits are undertaken by a large committee of trained peers. This committee needs to be maintained through constant expansion and training.
- The registration process includes the setting and auditing of professional development standards through the provision of guidelines which set out ECSAs post-qualification requirements for registration in the different categories of registration, evaluations of applications, monitoring continuing professional development and renewal of registration.
- Prescription of a Code of Conduct, Code of Practice and the enforcing of such conduct through an Investigating Committee and Disciplinary Tribunal.
- Advising the Council for the Built Environment (CBE) and the Minister of Public Works on matters relating to the engineering profession and cognate matters requires the expertise of individuals in the engineering profession itself (ECSA, 2008: 1-2).

ECSA was notified (4 March 2008) by the CBE regarding the proposed amendments to the statutory regulatory framework of the Built Environment Professions, which requires that a single juristic body be established, entitled the South African Council for the Built Environment (SACBE) (ECSA, 2008: 1-2). ECSA is currently under threat of its legislative mandate as a result of the proposed amendments of the

existing legislative framework. Should the proposed amendments be accepted, SACBE exercises authority over the professional boards, resulting in ECSA being unable to operate as an independent entity. However, it is possible that the bill might be stopped, or referred back for further consultation.

2.6 CONCLUSION

This chapter provided a contextual overview of the higher education landscape in South Africa. The notion of transformation in higher education was described as the process of establishing a higher education system that is planned, governed and funded as a single, coordinated entity.

This chapter also highlighted that the merging of institutions in South Africa should make it easier for the government to manage the higher education system as a single, coordinated entity. Nevertheless, there are still problems relating to the governing of the higher education sector; however, these problems are beyond the scope of this study.

A contextual and conceptual overview of the legislative changes and the changing structures within higher education during the post-apartheid era were outlined. What seems discouraging is that national benchmark tests used for selecting those students who are most likely to succeed with their academic study are not yet available for higher education institutions. In the meantime, higher education institutions have to widen access opportunities for students, but not all applicants are suitable regarding the individual institution's entrance requirements. Therefore, this study concentrated on those students who were unsuccessful with their applications, but who show potential in becoming successful higher education students within the field of engineering.

The different skills and competencies that exist for different stages within an academic programmes were discussed and compared to trainee engineers and expert engineers who work according to set acceptable standards (although not set on the same level of competency). In this respect, the chapter also provided a contextual overview of ECSA's role within the higher education sector.

The next chapter deals with the factors within the Further Education and Training (FET) band that influenced the initiation of the introduction programme. It conceptualises the paradigm shift from teaching to learning and seeks to define curriculum development. It also explains how curriculum development was implemented to construct a curriculum framework for an introduction programme. The philosophical and theoretical foundation, approaches, models, phases and levels introduced during the process are discussed.

CHAPTER 3

PERSPECTIVES ON CURRICULUM DEVELOPMENT

3.1 INTRODUCTION

Traditional boundaries between university science and science in the industry, as well as between basic and applied research are disappearing (Gibbons, 1999: 11). As a result, science and society are invading each other's domain. The expansion of higher education has been accompanied by a culture of accountability that has impacted on both teaching and research. There is no longer a clear demarcation mark between university science and science in the industry, or between careers in the academic world and in the industry. There is now greater movement across institutional boundaries, a blurring of professional identities and a greater diversity of career patterns. Science was seen as the 'father' of all new knowledge and its discoveries were to be communicated to the society. Society did what it could to absorb the message and transformed the results of science into new products and processes, primarily by industry (Gibbons, 1999: 11).

This mode of knowledge production was successful for as long as its autonomy was uncontested. The knowledge production mode changed when the relationship with society changed, as science was drawn into a larger and more diverse range of problem areas.

This chapter seeks to provide a number of perspectives on the concept curriculum development and to explain how it is implemented. The philosophical and theoretical foundation, approaches, various models and phases introduced during the process are discussed. The chapter also conceptualises the 'paradigm shift' from teaching to learning. It outlines some of the factors within the FET band that led to the implementation of an introduction programme for prospective engineering students at the VUT. The process is explored against the backdrop of the higher education legislation and educational structures in South Africa, as outlined in the previous chapter.

3.2 CURRICULUM DESIGN AND DEVELOPMENT

The term curriculum has been associated with academic study and training in higher education since its appearance in vernacular English in the sixteenth century (Huggett, Smith & Conrad, 2001: 1). At several points in history, the term not only defined an identifiable course or plan of study in a university context, but also referred to the corollary body of scholars engaged in that coursework. As such, curricula refer to both an individual and collective learning experience. The national demographic of education has shifted and the curriculum in higher education has responded to and reflected changing political, socio-economic and cultural dynamics (see Chapter 2). Growing recognition of professional fields and the attendant expansion of professional education have also fostered curriculum adaptation and evolution. As these developments have changed expectations for higher education, they have also transformed perspectives on the meanings and development of curricula (Huggett *et al.*, 2001: 1).

3.2.1 Curriculum theory and development

The concept of a 'curriculum' stems from the Latin verb *currere*, which means 'race course', referring to the course of deeds/actions and experiences through which students grow and mature. Curriculum means two things: first, the range of courses from which students choose what subject matter to study; secondly, a specific learning programme (Egan, 1992). In the latter case, the curriculum collectively describes the teaching, learning and assessment materials available for a given course of study.

To Bobbit (1918) the curriculum is a social engineering arena. With his cultural presumptions and social definitions, he formulated two notable curricula features. First, scientific experts would best be qualified to and justified in designing curricula, based upon their expert knowledge of what qualities are desirable in adult members of society and what experiences would generate set qualities. Secondly, curriculum is defined as the deed-experiences students 'ought to have' to become the adults they 'ought to become' (Bobbit, 1918).

Contemporary views of curriculum reject Bobbit's proposed features, but retain the basis of curriculum as the course of experience that forms individuals into persons. A

starting point in understanding curriculum is the definition offered by John Kerr and taken up by Kelly in his work on the subject. Kerr defines curriculum as all the learning which is planned and guided by the institution, whether it is carried on in groups or individually, inside or outside the institution (Kelly, 1999: 10).

Curriculum is observed by Blenkin (Blenkin & Kelly, 1994: 23) as being a body of knowledge-content and/or subjects. Education, in this sense, is the process by which knowledge-content is transmitted or delivered to students by the most effective methods that can be devised. Where individuals still equate curriculum with a syllabus, they are likely to limit their planning to a consideration of the content or the body of knowledge that they wish to transmit.

The work of Ralph Tyler, in particular, has made a lasting impression on curriculum theory and practice. His view is that the real purpose of education is not to have the lecturer perform certain activities, but to bring about significant changes in the student's pattern of behaviour (Tyler, 1949: 44). Tyler's work was refined and elaborated on (Taba, 1962; Wheeler, 1967; Kemp, 1977; Nicholls & Nicholls, 1978) into what came to be called the 'instructional systems' approach to course design (Toohey, 1999: 52).

With the instructional systems approach, learning objectives need to be clearly defined in advance and specified in behavioural terms so that it is possible to determine accurately whether they are being met. This approach to curriculum design has been particularly attractive to governments because it holds the promise of accountability. If educational objectives are tightly specified and assessment is designed to determine whether they have been met, then the degree of effectiveness of the educational institution can be clearly demonstrated.

Posner's (2004: 749) stance on curriculum is formulated in terms of standardised test scores (teaching to the test) and he speculates that the skills and mental processes necessary to tackle unsolved mathematical problems are qualitatively different from those required to solve more routine problems. He adds that, on the other hand, this may be that the intellectual requirements are essentially the same but applied over a much longer period.

Stephouse (1975: 4-5) produced one of the best-known explorations of curriculum theory and practice. He defined curriculum tentatively as an attempt to communicate the essential principles and features of an educational proposal in such a form that it is open to critical scrutiny and capable of effective translation into practice. Conversely, a later defined version of curriculum posits it as a programme of activities designed so that students attain, as far as possible, certain educational and other schooling ends or objectives (Grundy, 1987: 11). Such programmes inevitably exist prior to and outside the learning experience, where students are told what they should learn and how they should do so. Much of the curriculum found in today's education system is based on the lecturer's past experience in education (Glasgow, 1997). A shift in theoretical understanding needs to accompany the shifts in instruction resources (Walmsley, 1997: 510). Curriculum theory itself is a challenging intellectual puzzle, a field full of contradictions and challenges, uncertainties and directions, but with an outcome that does matter.

Curriculum development is described by Van Rooy (1996: 107) and Oliva (1998: 23) as a rational activity and a comprehensive term that incorporates curriculum planning, design, implementation and evaluation. Humphreys, Post and Ellis (1981) define curriculum development as an integrated study in which students broadly explore knowledge in various subjects related to certain aspects of their environment. Schoemaker (1989: 5) formulates curriculum development as education that is organised in such a way that it cuts across subject-matter lines, bringing together various aspects of the curriculum into meaningful association to focus upon broad areas of study. Schoemaker's definition of curriculum development views learning and teaching in a holistic way and reflects the real world, which is interactive, much the same way as the approach undertaken by the introduction-programme curriculum developer. Posner (1992: 4) does not define curriculum. He believes that the common approach to the definition of this central concept is that definitions are not philosophically or politically neutral. A clear conceptual distinction between the ends and the means of education leads to consequences, which have political and ethical implications (Posner, 1992: 4). The term curriculum cannot be viewed as having one meaning, as there are five concurrent curricula to consider: the official, the operational, the hidden, the null and the extra curriculum.

Table 3.1 presents an overview of the five concurrent curricula.

TABLE 3.1: Overview of the five concurrent curricula

CURRICULA		DESCRIPTION
Official		The curriculum described in formal documents. It is simply that which is written as part of a formal instruction and may refer to a curriculum document, assessments, films and supportive teaching materials that are overtly chosen to support the intentional instructional agenda of an institution.
Operational		The curriculum embodied in actual teaching practices and assessments.
	Received	The concepts and content that students actually take out of the lecture room, which are truly learned and remembered.
	Internal	Processes, content and knowledge that combine with the experiences and realities of the student to create new knowledge. Educators should be aware of this curriculum but they have little control over it since it is unique to each student.
Hidden		Institutional norms and values not openly acknowledged by lecturers. It refers to the learning students derive from the nature and organisational design of the institution, as well as from the lecturers' behaviour and attitudes (Longstreet & Shane, 1993: 46).
Null		The subject matter not taught. This gives students the impression that these elements are not important in their educational experiences or society. Eisner (1994: 97) states that what an institution decide not to teach may be just as important as what they do teach. He further states that ignorance is not a neutral void; it has important effects on the kind of options one is able to consider, the alternatives that one can examine and the perspectives from which one can view a situation or problem.
Extra		The planned experiences outside the formal curriculum.
	Social	The massive, ongoing, informal curriculum of family, peer groups, neighbourhoods, church organisations, occupations, mass media and other socialising forces that 'educate' everyone throughout life (Cortes, 1981: 24).
	Phantom	The messages prevalent in and through exposure to any type of media. These components and messages play a major part in the enculturation of students into the predominant meta-culture, or in acculturating students into narrower or generational subcultures.
	Concomitant	What is taught or emphasised at home. Those experiences that are part of a family's experiences or, alternatively, related experiences sanctioned by the family.
	Rhetorical	Elements comprised from ideas offered by policy makers, educational officials, administrators, politicians or published works, offering updates in pedagogical knowledge.
	Electronic	The lessons learned through searching the Internet for information, or through using electronic forms of communication.

(Sources: Adapted from Posner, 1992: 12 and Wilson, 2005: 1-7)

The dominant framework is best represented in the work of Ralph Tyler, which has come to be called the Tyler Rationale for Curriculum Planning. Since curriculum reflects the models of instruction delivery chosen and used, some might argue that curriculum could be categorised according to the common psychological classifications of the four families of learning theories (social, information processing, personalisation and behavioural) (Wilson, 2005: 3).

However, the use of curriculum development models can assist in conceptualising a process through applying certain principles and procedures. Curriculum development models offered by authors like Mostert (1985), De Boer (1990), Oliva (1998), Carl (1997), Killen and Spady (1999), Lawson (2002: 22) (in Jackson & Shaw, 2002: 3), Geyser (2004) and Jacobs, Vakalisa and Gawe (2004) confirmed the fact that curricula are grounded in particular philosophies.

Curriculum planning is an activity in which the planner objectively and scientifically develops the means necessary to produce the desired learning outcomes (Posner, 1992: 14). Educational experiences are justified by the objectives that they serve. Means-end rationality leads to the assumption that decisions on such issues as instructional method and content are technical ones.

Technical decisions are concerned with technique, the how-to aspects of getting the job done. Curriculum planning is based on a technical production framework (production-oriented framework) if the proponents consider educational decisions to be made objectively, primarily by experts with specialised knowledge, and if they view education as a process whose major purpose is to produce learning, a process for which the logic of decision making should be based on means-end reasoning (Posner, 1992: 15). Conversely, linear technical production models require the determination of ends before deciding on the means.

Decisions are considered technical if they appear to be value-free, appropriate for the expert with specialised knowledge to make in an objective manner (Posner, 1992: 15). According to this view, curriculum decisions are best reserved for those individuals who have technical expertise about the methods and content optimally suited for particular objectives. Technical experts are responsible for making certain that their own values do not cloud their objectivity; that is, they try to keep their work

value-free. Decisions about purpose are conceived as technical decisions based on specialised knowledge that experts develop, even through studies of students and contemporary society or by virtue of their subject matter expertise (Posner, 1992: 15).

These points are represented as a technical production system outlined in Table 3.2.

TABLE 3.2: Technical production systems

GENERAL FEATURES	MEANING OF FEATURES	APPLICATION TO CURRICULUM AND INSTRUCTION
Production-orientated	Focus is on products	Learning outcomes are emphasised
Means-end reasoning	Means are justified on the basis of ends to be achieved	Instruction is justified according to desired learning outcomes
Technical basis	Determination is made by experts	Curriculum and instructional experts develop curricula
Linearity	Ends are determined before means	Planning begins with the ultimate educational purposes or aims, using them as a basis for determining educational goals, learning objectives, and instruction - in that order
Objectivity	Decisions can and should be made on a scientific basis, without the influence of personal values and biases	Instructional methods and objectives are selected on the basis of effectiveness and efficiency

(Source: Posner, 1992: 16)

Curriculum design and curriculum development are procedures that are closely linked to the description of developmental learning outcomes, assessments and quality assurance. Common philosophical orientations of curriculum parallel those beliefs adopted by different philosophical orientations (idealism, realism,

essentialism, experimentalism, existentialism, constructivism and re-constructivism) (Wilson, 2005: 2). The themes to curriculum development that are prevalent in the introduction programme's classroom practice and the different approaches within these themes are discussed next. These are the constructivism and production of knowledge approaches.

3.2.2 Constructivism

Constructivism has its roots in philosophy, psychology, sociology and education. Constructivism may be considered an epistemology, which argues that humans construct meaning from current knowledge and structures. Ongoing structuring (organising) processes are the conceptual heart of constructivism. Amongst the earlier recorded proponents of some form of constructivism are Lao Tzu (sixth century BC), Buddha (560-477 BC) and Heraclitus (540-475 BC). In western cultures, constructivism often establishes intellectual descent to Giambattista Vico (1668-1744), Immanuel Kant (1724-1804), Arthur Schopenhauer (1788-1860) and Hans Vaihinger (1852-1933) (Mahoney, 2004: 382).

Constructivism continued to grow throughout the twentieth century and it is now the focus of numerous books and international journals. Drawing on the dynamic view of learning described by Johan Herbart (1776-1842), Piaget developed a model of cognitive development in which balance is central. Piaget sees 'play' as an important and necessary part of the student's cognitive development (Piaget, 1950; 1967) and has provided scientific evidence for his views. Formulation of the theory of constructivism is generally attributed to Piaget, who articulated mechanisms by which knowledge is internalised by students.

It is important to note that constructivism itself does not suggest one particular form of pedagogy; it merely describes how learning should happen, regardless of whether students are using their experiences to understand a lecture. Constructivism as a description of human cognition is often associated with pedagogic approaches that promote learning by doing.

Social constructivism emphasises the importance of culture and context in understanding what occurs in society, and the constructing of knowledge based on this understanding (Derry, 1999; McMahon, 1997). This perspective is closely

associated with many contemporary theories, more notably the developmental theories of Vygotsky (1978; 1987) and Bruner (1966; 1971; 1977; 1979; 1983; 1990; 1996), as well as Bandura's (1973; 1977; 1986; 1997; 1999) social cognitive theory. Social constructivism is based on specific assumptions about reality, knowledge and learning (Doolittle, 2000: 90-95; Jackson, Karp, Patrick & Thrower, 2006: 1-9).

To understand and apply models of instruction that are rooted in the perspectives of social constructivism, it is important to know the premises that underlie them. Social constructivists believe that reality is constructed through human activity. Members of a society collectively invent the properties of the world (Kukla, 2000). The social constructivist reality cannot be discovered: it does not exist prior to its social invention (Jackson *et al*., 2006: 1-9). To social constructivists, knowledge is also a human product and is socially as well as culturally constructed (Ernest, 1999: 25-27; Gredler, 1997; Prawat & Floden, 1994: 37-48). Individuals create meaning through their interaction with each other and with the environment within which they live (Jackson *et al*., 2006: 1-9). Social constructivists view learning as a social process. It does not take place only within an individual, nor is it a passive development of behaviours that are shaped by external forces (McMahon, 1997). Meaningful learning occurs when individuals are engaged in social activities (Jackson *et al*., 2006: 1-9).

Social interaction always occurs within a socio-cultural context, resulting in knowledge that is bound to a specific time and place. It is the position of Bakhtin (1981; 1984: 10; 1986; 1993) that truth is not to be found inside the head of an individual person; rather, it is created between people collectively searching for the truth, in the process of their dialogic interaction. Truth, in this case, is neither the objective reality of the cognitive constructivists nor the experiential reality of the radical constructivist. Rather, it is a socially constructed and agreed-upon truth, resulting from co-participation in cultural practices (Doolittle, 2000: 90-95).

The introduction programme dealt with in this study applies a social constructivism approach. The theoretical and practical contexts, reality learning of the real world and construction of a personal and coherent reality, embed the four epistemological tenets and applied forms of social constructivism. In this way, the amount of learning

is increased and the focus is on forming conceptual frameworks into which new information is integrated and knowledge is produced.

3.2.3 The production of knowledge

It is difficult to define the concept of knowledge. Academics from various disciplines continue to debate the definition of knowledge from a variety of paradigms and epistemological stances. According to Nonaka and Takeuchi (1995), in McLean and Blackie (2004), it is evident that there are two clear strands in the debate surrounding the definition of knowledge. The first is the traditional or positivist view of knowledge as factor of truth, based in a single discipline, usually science. Plato was an important exponent of developing a theory of knowledge. From a rationalist perspective, he saw knowledge as 'truth' attainable only through reason and pure objectivity, independent of the subject pursuing it. He claimed that knowledge is 'justified true belief' achieved through rational reasoning grounded in theories, laws and concepts (McLean & Blackie, 2004). Alternatively, from an empiricist perspective, Aristotle contested Plato's views, stressing the importance of observation and sensory perception.

This longstanding debate provided the foundations of the 'philosophical inquiry of knowledge'. The second view of knowledge derives more from interpretive sociology and its theory of knowledge. It is non-hierarchical, trans-disciplinary, less defined and prescribed. Sociologists argue that knowledge can be produced by and shared amongst a greater number of individuals in a far wider range of situations. Rather than having an intellectual or theoretical focus, it emerges from day-to-day activities, or problems encountered in everyday life (McLean & Blackie, 2004). One clear trend that emerges from the dichotomy of scientific and sociological theories of knowledge is the move from a view of knowledge as absolute, permanent and objective, to a focus on its subjective and dynamic or evolutionary nature.

Therefore, knowledge can be identified as a shared set of beliefs that performs the function of social cohesion. Through the identification of unambiguous knowledge production, modes of knowledge can be produced.

There are opportunities for curriculum development through the changing of knowledge production modes. Gibbon's (1998: 59) theories about knowledge

production became influential at the end of the twentieth century. His knowledge production theories refer to the two stands of knowledge as Mode 1 and Mode 2 knowledge. Mode1 has its historic roots in the nineteenth century evolution of universities. It operates through tightly drawn academic disciplines and has a strong empirical approach (Gibbons, 1999: 13). Gibbon's Mode 2 is an integrated theory of knowledge production. This theory was argued as knowledge-production constrains started emerging from the mid twentieth century. The knowledge-production Mode 1 is based on the investigation-initiated and discipline-based theory. The knowledge-production Mode 2 is based on the context-driven, problem-focussed and inter-disciplinary theory (Gibbons, Limoges, Nowotny, Schwartzman, Scott & Trow, 1994).

Another major influence on curriculum development was identified as the shift in emphasis from teaching to learning.

3.3 THE SHIFT IN EMPHASIS FROM TEACHING TO LEARNING

The instruction paradigm, which was (and in many higher education institutions still is) the dominant traditional way of delivering lectures primarily comprises delivering instruction. A paradigm shift is taking place in higher education. According to Barr and Tagg (1995: 13; 2007: 1-2), the paradigm that has governed universities is one that defined a university as an institution that exists to provide instruction. Subtly, but profoundly, a shift to a new paradigm is occurring, where a university becomes an institution that exists to produce learning (Barr & Tagg, 1995: 13; 2007: 1-2).

Paradigm shifts occur when difficulties or anomalies begin to appear in the functioning of the existing paradigm, which cannot be adequately handled, and where there exists an alternative paradigm, which occurs for the original paradigm and which offers real hope for solving the major difficulties facing the current paradigm. Digest (1997: 1-6) suggests that the learning paradigm involves more than incremental changes in an institution's organisational procedure or priorities. According to O'Banion (1996: 22), the purpose of the learning paradigm is to place learning first in every policy, programme and practice in higher education by overhauling the traditional architecture of education. A comparison between the instruction paradigm and the learning paradigm is provided in Table 3.3.

TABLE 3.3: Comparison between the instruction and the learning paradigm

THE INSTRUCTION PARADIGM	THE LEARNING PARADIGM
Instructor-led dependent, micro-managed	Student-led, self-directed
Didactic prescriptive	Active discovery learning
Extrinsically motivated	Intrinsically motivated
Knowledge transfer	Learning to learn
Educative as an end	Education as a process
Synchronous	Asynchronous
Classroom bound	'Borderless'
Theoretical	Learning real world integration
Certification by time or task	Competency-based assessment

(Sources: Adapted from Barr and Tagg, 1995: 15-17; Centre for Development of Teaching and Learning (CDTL), 2007: 2)

Irrespective of the definition of the learning paradigm, increasing movements to consider student outcomes, to improve student assessment and to refocus institutional missions onto student learning are gaining prominence. These shifts lead to the investigation of the different learning domains.

3.3.1 Learning domains

Constructs such as Bloom's taxonomy, Kirkpatrick's model, Maslow's hierarchy of needs, McGregor's XY theory, the SWOT analysis model and Berne's transactional analysis theory are highly relevant to the understanding and development of individuals. It is not necessary to validate any of these constructs, as they have been successfully applied for many years in education (Chapman, 2006: 1-2).

Bloom's taxonomy and a recent adaptation to Maslow's Hierarchy of Needs are highlighted as constructs here given that they signify the teaching, learning and skill training featured in the VUT's introduction programme.

3.3.1.1 Bloom's taxonomy

Benjamin Bloom's taxonomy on learning domains (Bloom, 1965) (a set of classification principles or educational objectives) consists of cognitive, affective and

psychomotor domains, and was designed in and for an academic context. Bloom's aim was to develop a system of categories of learning behaviours to assist in the design and assessment of educational programmes (Atherton, 2005: 1-5).

Bloom's taxonomy model comprises three overlapping domains. The cognitive domain is associated with the intellectual capability (knowledge or think) part of learning. The affective domain is associated with the feelings, emotions and behaviour (attitude or feeling) part of learning. The psychomotor domain is associated with the manual and physical skills (skills or doing) part of learning. Each category has to be mastered before progressing to the next category can occur. Each domain represents a level of learning and these levels increase in difficulty (Bloom, 1965).

The cognitive domain of Bloom's taxonomy in Annexure 11 is included because it is still common currency. However, Anderson and Krathwohl (2001) have made some minor, but significant modifications to the model (Atherton, 2005: 1-5). The psychomotor domain was ostensibly established to address skill development relating to task and physical movement, though it also concerns modern day learning, business and social skills. Whatever the learning situation, it is likely that this domain is significant.

Dave's psychomotor domain is probably the most commonly referenced and used (Atherton, 2005: 1-5). It is adequate and appropriate for most adult skill training. Simpson's or Harrow's models may be more useful if expression of feeling and emotion is required as the main emphasis of the skill training programme (Atherton, 2005: 1-5).

The introduction programme applies the cognitive model of Anderson and Krathwohl, the affective domain of Bloom (in parallel with the Direct Access Development (DAD) model), and Dave's psychomotor domain for learning.

The DAD model is a recent adaptation of Maslow's hierarchy of needs.

3.3.1.2 Adaptation of Maslow's hierarchy of needs

Constructs from the past do not necessarily fit the needs of the present (Dicks *et al*., 2006: 1). However, it is important to compare and even incorporate older methodologies with newer constructs. Only a limited number of educators make use of methods that involve the processes through which the brain functions in order to process the data it receives (Dicks *et al*., 2006: 1).

Successful teaching has little to do with confusing or alarming students; rather, it has more to do with compassion and humility. Competent educators aim to help students feel that a subject can be mastered and encourage students to attempt activities by themselves (Ramsden, 2002). According to Dicks *et al.* (2006: 1), real learning involves the method of information transfer into the brain whereby learning is only possible if this information is understood. Information which is understood, to the point that it can be used or applied, will result in true learning. Many educators do not understand that problems regarding memory or thinking are not from a lack of storage space, but rather from the way in which information is positioned in the brain (Dicks *et al*., 2006: 1).

MacLean points out that the human brain actually consists of three brain fractions which form part of a big neural cluster, controlling the brain as a whole (Dicks *et al*., 2006: 3). The three fractions are known as the reptilian brain (brain stem), the early-mammalian brain (limbic) and the neo-mammalian brain (neo-cortex) (Howard, 1994).

The DAD model (hierarchy of emotions) of learning compares the role that the amygdale plays in the different levels of brain evolution to Maslow's hierarchy of needs. The full development of the model, with its adaptations from Maslow, is outlined in Table 3.4.

A hierarchical approach is still applicable, and one emotional level must be attained sufficiently before the next higher emotional level can be activated. The DAD hierarchy of emotions is believed to result in critically reflective students, by developing them to become independent thinkers who want to learn.

TABLE 3.4: DAD hierarchy of emotions adapted from Maslow's hierarchy of needs.

To become what one is suited for			**Need for:** – Self-respect – Achievement – Reputation – Status	**Desire for:** – Love – Friendship – Group acceptance	**Need for:** – Security – Order – Freedom from fear	**Need for:** – Food – Water – Air – Shelter	**Maslow's Hierarchy of Needs**
Self-Actualisation			Social Needs	Belongingness	Survival Needs	Physiological Needs	
1:1	**2:1**	**3:1**	**4:1**	**5:1**	**6:1**	**7:1**	
Breakthrough: Inspiration - not ruled by emotions			Break-even point: From this point onward self-motivation increase		Little freedom of choice	Breakdown: Emotional desperation	**Perception Ratio**
THE AMYGDALE LINKS THE EMOTIONAL ASPECT OF EXPERIENCES TO MEMORY							
Love to	Choose to	Desire to	Want to	Need to	Ought to	Have to	**Verbal**
Cerebral Cortex	Corpus Callosum	Hypo-Campus	Basil Forebrain	Hypothalamus	Spinal Cord	Primitive Neuron	**Brain Evolution**
Neo-Mammalian Brain	**Early-Mammalian Brain**			**Reptilian Brain**			
This fraction of the brain controls most of the following functions: - cognitive thinking - memory (remember) - movement and control - sound mastering If students take ownership and have a love of learning, there will be less for the lecturer to do about the self-development of students.	The amygdale forms part of this brain fraction. It links the emotional aspect of experiences to memory. This brain fraction develops between the ages of 15 months and 54 months. This fraction is seen as the relationship brain and is involved with processing of emotions. It is used during cognitive functions and forms the gateway between the neo-cortex and the reptilian brain. When the reptilian brain is gated off, the early-mammalian brain deals with dreaming. In order for this dream to become reality, it must be visualised, defined and re-defined.			This fraction is the instinctive brain and is in charge of no emotions. This brain fraction develops between conception and the age of 15 months. This part forms the area of the brain between the thalamus and spinal cord. This is the oldest and the most primitive part of the brain. It is hard-wired with dendrites, unemotional and connected with territory and physical survival.			**Triune Brain**
Super-Ego	**Ego**			**ID**			
The super-ego is the moral side of the psyche and reflects social ideas.	The ego is the conscious mediator between the id and the super-ego. It helps one to respond to the world in social and acceptable manner.			The id is the basic time and energy source which is directed at avoiding pain and obtaining pleasure.			**Freudian Theory of Personality**

(Source: Dicks *et al.*, 2006: 6)

Bloom's affective domain includes the manner in which individuals deal with things emotionally, including feelings, values, appreciation, enthusiasm, motivation and attitudes. These emotions form part of an individual's learning experience and the DAD model links the emotional aspects of experience to memory, via the amygdale in the brain. These learning experiences have to be embedded into a curriculum through which the introduction programme students can grow and mature.

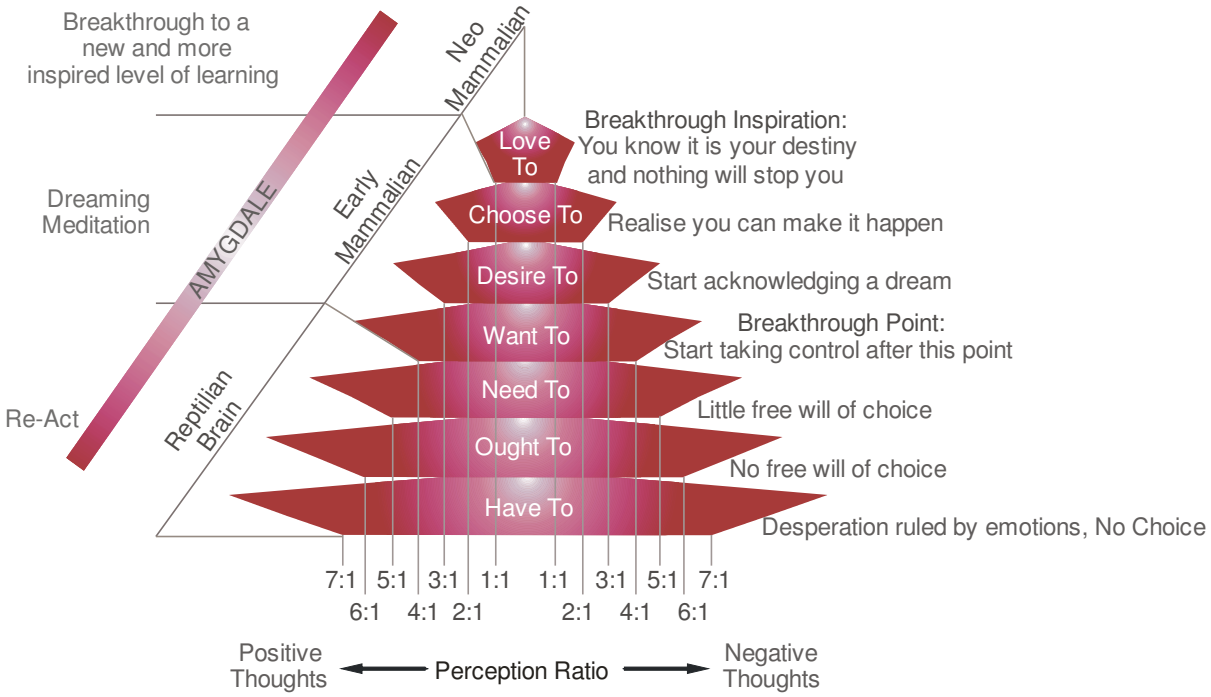

FIGURE 3.1: A compact representation of the DAD model or hierarchy of emotions (Source: Dicks *et al*., 2006: 7)

Students have the option to repress or express themselves. Their perception levels (seven levels of consciousness), relating to the seven levels of brain evolution and verbal expression, determine if they can adequately express themselves (Demartini, 2002: 142). The compact representation of the DAD hierarchy of emotions in Figure 3.1 represents the possible scale of emotional states and verbal expression. The bottom of the scale represents a low-frequency state, involving imbalance, where desperation is the primary motivating force (Demartini, 2002: 142). The reptilian brain fraction, the oldest and the most primitive fraction of the brain, is unemotional, concerned with territory and physical survival only. Should this fraction of the brain be activated, the amygdale enhances the emotion of desperation, where the student

has little or no free will and where no learning can take place. The amygdale links the emotional aspect of experiences to memory. It is the part of the brain that is responsible for attitude and beliefs (Bennett-Coleman, 2001). The amygdale forms part of the early-mammalian brain fraction (Dicks *et al*., 2006: 6). This brain fraction processes emotions and is activated during cognitive functions. When the reptilian brain fraction is gated off, the early-mammalian brain fraction deals with dreaming. For this dream to become reality, it must be visualised, defined and re-defined (want-to, desire-to, choose-to emotional states). The student starts taking control, acknowledging the need for academic achievement, and realises that such achievement can materialise.

The top of the scale represents a high-frequency state, involving balance, where inspiration is the primary motivating force (Demartini, 2002: 142). The students are aware of their destinies and nothing stops them from reaching their goals. The more balanced one's perceptions becomes, the higher the emotional levels rise. The perception ratio compares negative to positive external influences or events. For example, the 7:1 ratio indicates that these events have seven times more negative influences than positive influences. De-motivation occurs and one should attempt to move away from them. If the perception ratio changes to 4:1, one 'wants-to', and control of emotions occurs.

Emotions or perceptions towards academia are apparently controlled by means of the same technique. Should students be able to move away from negative influences or events, concentrate on the positives within their study fields, a high perception ratio may be obtained. This may lead to a 'love' of academia, which may lead to deep learning instead of surface learning (Dicks *et al*., 2006: 5).

3.3.2 Deep learning versus surface learning

Teaching a subject can be done in three ways: present knowledge, represent knowledge and/or assist students in constructing knowledge (Nelson & Palumbo, 1982: 288). Knowledge presentation and representation are both building blocks for learning, but understanding comes through construction - the active engagement of students with the material (Fosnot, 1996; Jonassen, Mayes & McAleese, 1993; Wittrock, 1990; Dicks *et al*., 2006: 5). According to Fosnot (1996), knowledge construction takes place through students' inferences, elaboration on new

information and generation of relations among information. The introduction programme modules were developed with these considerations in mind. Students' learning approaches to the material are crucial factors in the understanding of how they construct knowledge.

Student learning approaches (the way in which students go about their academic tasks thereby affecting the nature of the learning outcome (Biggs, 1994: 319)) generally fall into two distinct categories - deep learning or surface learning. Deep learning approaches are characterised by intrinsic motivation, a focus on understanding the meaning of the learning material and an attempt to relate new ideas to previous knowledge and experience. In contrast, surface learning approaches are associated with extrinsic motivation, a focus on finishing tasks and the memorisation of direct facts (Posser & Trigwell, 1999: 16). A simplified comparison between the two learning approaches is provided in Table 3.5.

TABLE 3.5: A simplified comparison between deep learning and surface learning approaches

APPROACHES TO LEARNING	
DEEP	**SURFACE**
An intention to understand material for oneself	An intention simply to reproduce parts of the material content
Vigorous and critical interaction with knowledge content	Ideas and information passively accepted
Relating ideas to one's previous knowledge and experience	Concentrating only on what is required for assessment
Discovering and using organising principles to integrate ideas	Not reflecting on purpose or strategies
Relating evidence to conclusions	Memorising facts and procedures routinely
Examining the logic of arguments	Failing to distinguish guiding principles or patterns

(Source: Posser and Trigwell, 1999: 17)

The deep learning approach works concurrently with the DAD model through linking the emotional aspects of experience to memory and this is applied to the modular developmental processes of the introduction programme at the VUT. The model is, therefore, applicable to engineering subjects (including mathematics and science), which rely on the pedagogy of Problem-Based Learning (PBL).

3.3.3 Problem-Based Learning (PBL)

PBL is based on an alternative pedagogical model to the conventional didactic one and offers benefits to the quality of student learning (Greening, 1998: 1). The PBL approach to education suggests a strong role for factors such as authenticity, as well as student independence, and is principally associated with the encouragement of deep learning.

Many have reviewed PBL, and concepts on PBL have been cited in Schmidt (1983: 11-16), Coles (1985: 308-309), Albanese and Mitchell (1993: 52-81), Koschmann, Myers, Feltovich and Barrows (1994: 227-264), Robbs and Meredith (1994), Savery and Duffy (1995: 31-38), DesMarchais and Vu (1996: 274-283), Novae Research Group (1996), Greening, Kay, Kingston and Crawford (1997) and Greening (1998: 10-15). PBL is unconfined by discipline boundaries, encouraging an integrative approach to learning, which is based on requirements of the problem, as perceived by the students themselves.

In light of the shift from teaching to learning and the various curriculum theories, possible problem areas within the FET band might prevail. A discussion of these problem areas is required as it has direct curriculum implications regarding the EIP, at the VUT in particular.

3.4 THE FURTHER EDUCATION AND TRAINING (FET) BAND

This study concentrated on those students who, while unsuccessful with their application for access into the higher education system, show potential (given the right assistance) in becoming successful higher education students within the study field of engineering. The main aim of the introduction programme is to enrich and competently upgrade prospective students who have a NQF Level 4 qualification to an acceptable level for entrance into the diploma programmes (HEQF Level 5) at the

VUT. At this point, it is necessary to conceptualise the changes that have occurred within the secondary school curriculum.

3.4.1 The Revised National Curriculum Statement (RNCS)

The RNCS streamlines and strengthens Curriculum 2005 and continues to be committed to OBE. The revised curriculum builds on the vision and values of the South African Constitution and Curriculum 2005 (RNCS, 2005: 1-6). The RNCS aims for a clear and accessible design and use of language. The learning outcomes and assessment are two design features that clearly describe the goals and outcomes each student needs to achieve in order to proceed to each successive level of the system. Within each learning area, the RNCS sets out progressively more complex, deeper and broader knowledge, skills and attitudes for learners. This is known as conceptual progression, and the assessment standards in each learning area statement ensure this progression across levels. Progression is a key feature of the revised curriculum. Integration ensures that learners experience the learning areas as linked and related, by making links within and across learning areas. Integration supports and expands learners' opportunities to develop skills, attitudes and values while they acquire knowledge across the curriculum (RNCS, 2005: 1-6). The RNCS has three curriculum design features compared to the original eight of Curriculum 2005. The three features are: critical and developmental outcomes, learning outcomes and assessment standards. The critical and developmental outcomes are a list of outcomes inspired by the South African Constitution. They describe the kind of citizen it is hoped will emerge from the education and training system and underpin all teaching and learning processes. The integration of knowledge, skills and values occurs within and across learning areas and it is balanced with conceptual progression from level to level within a learning area (RNCS, 2005: 1-6).

Since 1994, the educational system in South Africa has undergone rapid changes. The secondary school system struggles to produce learners who are adequately prepared for higher education (Sutherland & Waetzel, 2006: 341). The school system underwent a series of changes in the curriculum before settling down and offering OBE. To keep up with these changes, teachers have had to undergo a variety of types of training sessions. Unfortunately, the learners became the guinea pigs during the experimental stages of these transformations (Sutherland & Waetzel, 2006: 341). The main entrance criterion into the field of engineering at VUT is not

only a National Senior Certificate (VUT, 2007). The competency level on the subjects mathematics and physical science play a major part in the successful completion of the first-year engineering programme. Groenewald (2005) states that by the end of the first year one out of every three students will drop out of university. Statistics to support this statement follow.

3.4.2 Statistics within the Further Education and Training (FET) and higher education sectors

Figure 3.2 indicates a steady increase in learners who take the subject of mathematics. However, the majority of learners still write this subject in the National Senior Certificate examination on standard grade. Similarly, there is a steady increase in learners who take physical science as a subject, but they are poorly represented and, in the National Senior Certificate examination, the majority of learners write this subject on standard grade (Note that this will not apply from 2009 onwards).

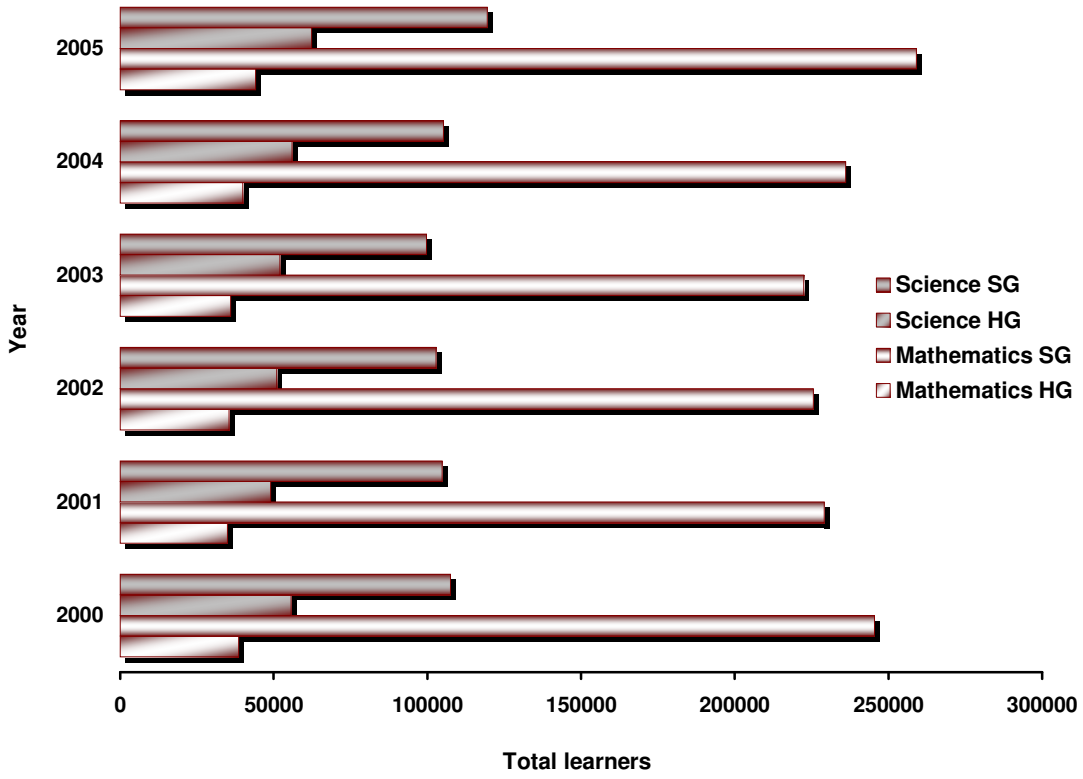

FIGURE 3.2: Senior Certificate examination results for the subjects of mathematics and physical science (Sources: Adapted from South African Environmental Observation Network (SAEON), 2004: 1; DoE, 2006: 26)

Both subjects (mathematics and physical science) experienced a decline from 2000 to 2003; thereafter, there was an increase in the number of learners writing the subjects at the National Senior Certificate examinations. The school leavers are academically under prepared, mainly because the majority of these learners are encouraged to study the subjects of mathematics and physical science on the standard grade level (Sutherland & Waetzel, 2006: 342). These statistics help to explain why so many students have difficulty in their first year of engineering at higher education institutions.

Taking into account that only learners with both the subjects of mathematics and physical science can apply for entrance towards an engineering qualification, the number of learners eligible for access into engineering programmes is very low (maximum 22 percent for 2005).

These statistics are depicted in Figure 3.3. The 22 percent represents the maximum applications that could have been received; however, not all of the learners are eligible for access due to the entrance criteria of higher education institutions. Therefore, the percentage of students eventually entering an engineering programme at higher education institutions is estimated to be lower than the 22 percent of the total enrolments.

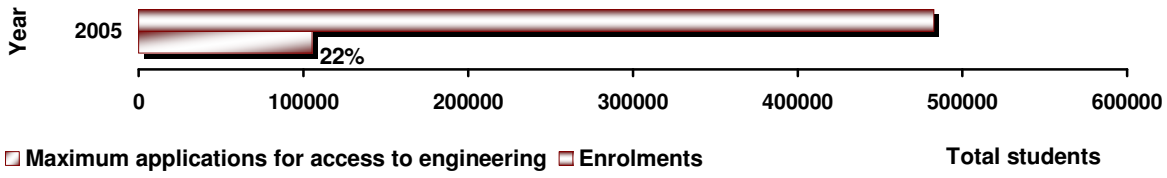

FIGURE 3.3: Maximum applications for access to an engineering programme versus total enrolments in higher education institutions
(Source: Adapted from DoE, 2006: 26, 32)

The graduation numbers (headcount) of 2001 do not show significant change compared to 2005 (Figures 3.4 and 3.5), which indicate a slight percentage increase in graduates.

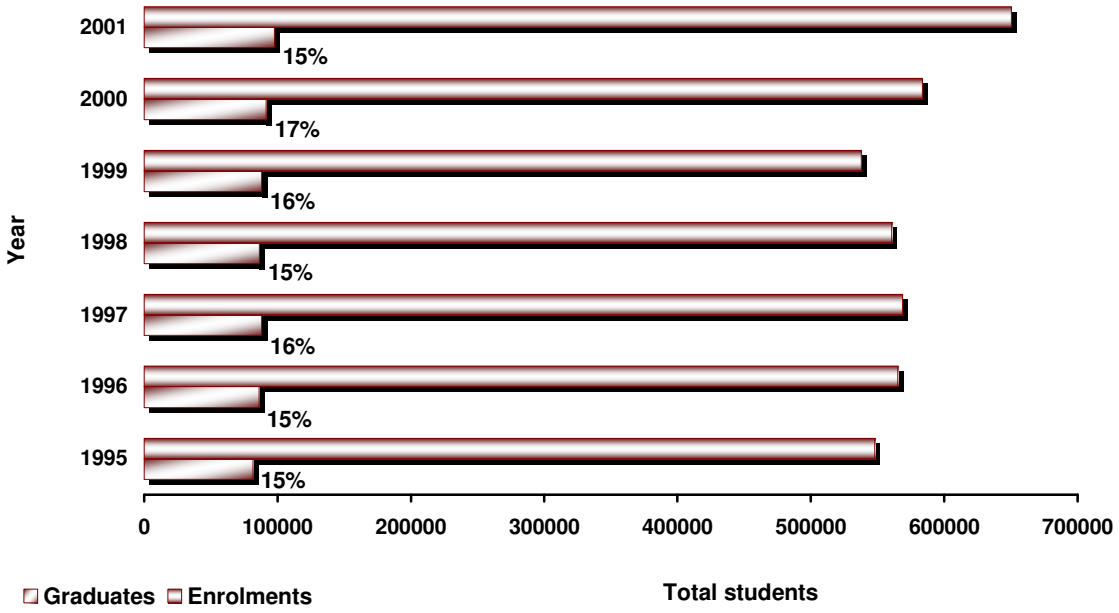

FIGURE 3.4: Headcount of students in public higher education institutions (a)
(Source: Adapted from National Advisory Council on Innovation (NACI), 2004: 6)

While universities do not lack students entering their institutions, they do lack students who successfully complete their programmes (Figures 3.4 and 3.5). The low throughput rates, as indicated in Figures 3.4 and 3.5 respectively, have forced South African higher education institutions to investigate the causes underlying students' failure to graduate within the prescribed time period.

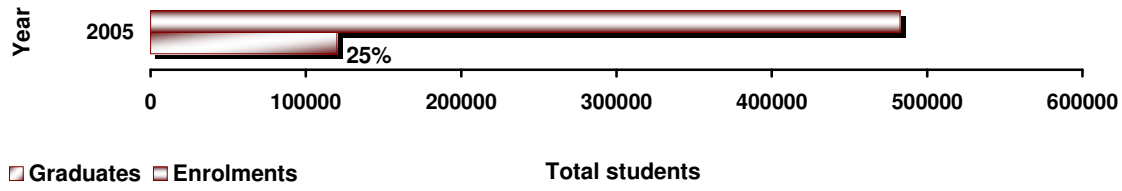

FIGURE 3.5: Headcount of students in public higher education institutions (b)
(Source: Adapted from DoE, 2006: 32, 34)

The enrolment figures clearly indicate that there are students who do not reach their final year of study and, therefore, cannot graduate. Upon further investigation, higher education institutions recognised that a major failure rate occurred within the first year of study (Groenewald, 2005; Sutherland & Waetzel, 2006: 343).

These statistics justify the need for an intervention programme. As such, most higher education institutions in South Africa and abroad have designed intervention programmes in the form of foundation, introduction, access or bridging programmes. These programmes have been implemented for different reasons and needs (Sutherland & Waetzel, 2006: 343). The slight increase in the throughput rate of higher education institutions may well partially be due to the introduction programmes introduced at universities. It is important to develop suitable curricula for introduction programmes. The curricula should serve domestic and international students attempting a qualification within the higher education study field of engineering.

3.5 INTERNATIONALISATION OF THE CURRICULUM

Within the field of engineering studies, the term ‘international curriculum’ is highly appropriate given that all prospective international engineering students have to complete the introduction programme before entering the engineering diploma programmes at the VUT. There are various definitions and adaptations available for the term ‘internationalisation of the curriculum’ and ‘international curriculum’.

Kameoka (1996) defines internationalised curricula as those with an international orientation in context, aimed at preparing domestic and/or foreign students for performing professionally and socially in an international and multicultural context. Knight’s (1999) adaptation of a working definition of the internationalisation of higher education states that it is the process of integrating an international/intercultural dimension into the teaching, research and service functions of the university.

The International Association of Universities (IAU) refers to internationalisation of higher education as an education system that promotes cultural diversity and fosters intercultural understanding, respect and tolerance among people (IAU, 1998). The IAU task force (IAU, 2002) clarifies that the internationalisation of higher education is a process that integrates an international or intercultural dimension or perspective into the major functions of the universities, namely teaching, research and service.

Leask (1999) defines internationalisation of curriculum as developing curricula which are culturally inclusive and which develop multicultural awareness and cross-cultural

communication skills while achieving the specific skills and knowledge objectives appropriate to the discipline areas. Bell's (2002) adaptation of the internationalisation of curriculum states that it involves integrating international and intercultural perspectives into subjects so that the students are able to appreciate and value cultural and intellectual diversity and function in a multicultural or global environment.

Given South Africa's higher education landscape and the VUT's role within this landscape, for the purpose of the study 'internationalisation of the curriculum' is referred to as integrating intercultural perspectives into the compulsory subjects of the engineering introduction programme, which aims at preparing domestic and foreign students to understand and value intellectual diversity and function in a multicultural environment.

A literature research was conducted to ascertain international science, engineering and technology introduction programmes on offer. The international perspectives on introduction programmes, similar to the VUT's introduction programme, are aimed at under prepared post-secondary (pre-collegiate) students from educationally and economically disadvantaged communities.

3.5.1 African and developing countries

Many secondary schools, mainly in rural and poor areas, still do not have the same resources and are not as well equipped as urban schools (University of Namibia (UNAM), 2008: 1-2; Kerbal, 2008: 1-18). Therefore, learners graduating from these schools do not attain the same level of understanding and educational achievement as those who attended well-resourced schools. To prepare students for their post-secondary and higher education studies, individual universities and UoTs within Africa and the developing countries have initiated a one-year foundation engineering programme. The foundation programmes on offer have a common interest: they are flexible and have a dynamic curriculum where subjects are specially packaged to enable students to pursue their career paths in engineering. The major subjects dealt with in the foundation year are mathematics, science and computer studies (UNAM, 2008: 1-2; Kerbal, 2008: 1-18; Universiti Teknologi Petronas (UTP), 2008: 1-12).

The foundation programmes prepare the student to continue with an engineering degree programme in higher education institutions (UTP, 2008: 1-12). The overall

goal of the foundation programmes is to increase the quantity and quality of qualified science, engineering and technology graduates for these countries growing economies. The foundation programmes enable these countries to have a larger pool of prospective students who are likely to graduate with a Bachelor of Science (BSc) or Engineering (BEng) (UNAM, 2008: 1-2; Kerbal, 2008: 1-18; UTP, 2008: 1-12).

3.5.2 Canada

The proportion of Canadian working-age adults with post-secondary credentials is the highest in the world (Canada, 2005: 14-15). Serious concern exists about the acquisition of basic literacy and numeric skills by secondary school students, the content and quality of education, student performance on standardised science and mathematics achievement tests, and the number of students who do not complete high school. A study regarding the Ontario colleges points to reduced numbers of secondary school leavers qualified in mathematics and sciences (Canada, 1995: 1-7; Chartrand, 2002: 1-2; Canada, 2003: 1-3). The learning continuum conveys the notion of learning as a continuing process and, in order to do so, individuals must have a solid base of foundation skills such as literacy and numeric skills (Canada, 1995: 1-7; Chartrand, 2002: 1-2; Canada, 2003: 1-3). Apparently, although no introduction programme has been established yet, the identified problems may well lead to the implementation of such an initiative.

3.5.3 China

The Chinese Open Resources for Education (CORE) is a non-profit organisation. The majority of China's local and international universities form part of CORE, which strives to include world education. China has many universities that focus on the development of the engineering student. The majority of these universities offer engineering and technology as their main study field. The key bases of these universities are to train talent, addressing vital problems concerning technologies and policies in reforming and modernising. They maintain a focus on basic science as an introduction pathway to engineering. The universities have paid special attention to the development of students in the applied sciences.

The introduction programmes are characterised by the integration of a rigorous scientific approach into engineering, seeking evidence and truth in science (CORE, 2007: 1-2).

3.5.4 Scotland

Since 1999, the Scottish Executive (Scottish Office) attempted to address social exclusion by increasing educational participation levels. Higher education in Scotland is committed to ensuring that everyone has an equal chance of obtaining a degree, based on personal ability and not on social background or income (Dockrell, Bradley & Keenan, 2006: 82-90).

The provision of learning opportunities alone does not create participants who want to engage in education (Bloomer & Hodkinson, 2000; Aldridge & Tuckett, 2003; Dockrell *et al*., 2006: 82-90). Individuals are deterred from applying to higher education institutions because they lack traditional entry qualifications. Against the background of policy and practice, the Community Access to Mainstream Learning (CAML) was established. The aim of CAML is to encourage non-traditional students to recognise and value learning for personal development and growth. Once they are engaged in the process of learning, it can lead to access into a higher education institution. The non-traditional students are encouraged to understand themselves, and to explore and research the range of learning possibilities available to them. The next step for them is to make an informed choice about the next stage in their learning career, knowing that - personal circumstances, opportunities and constraints permitting - they can proceed along to the highest end of the learning ladder (Coffield, 2002; Aldridge & Tuckett, 2003; Crossan, Field, Gallacher & Merrill, 2003; Dockrell *et al*., 2006: 92-90).

The CAML was developed as a learning programme designed to support excluded students by assisting them to progress with a preferred learning route to mainstream learning, whether it is community-based, college-based or university-based. The success of this programme cannot yet be scientifically proven; only during 2007 can research be attempted (Bloomer & Hodkinson, 2000; Coffield, 2002; Aldridge & Tuckett, 2003; Crossan *et al*., 2003; Dockrell *et al*., 2006: 82-90).

3.5.5 The United Kingdom (UK)

Introduction programmes are located within the intermediate level of the Framework for Higher Education Qualifications (FHEQ) for England, Wales and Northern Ireland (Quality Assurance Agency (QAA), 2004: 1-2). A challenge facing higher education in the UK is the 'widening participation' agenda. In Britain, the participation rate of young adults is currently above 33 percent, compared with 12 percent in the 1980s, and the present Labour government aspires to a target of 50 percent by the end of the decade (Hodgson & Spours, 2000: 295-322). With increased enrolments by mature and part-time students and those from ethnic minorities, the student body has become more diverse, especially in institutions serving inner-city communities. Higher education has also been opening up in the United States of America (USA) and Canada and in other countries with systems modelled on that of the British system (Digby, 2002: 86).

Generally, the move to mass higher education has been accompanied by a paradigm shift related to the drive to equip graduates for the changing world of work in the contemporary 'knowledge society' and 'global age' (Barnett, 1994; Scott, 1995; National Committee of Inquiry into Higher Education (NCIHE), 1997; Blackstone, 2001: 84-175; Digby, 2002: 85-90). The new paradigm, expressed in notions such as developing student capability, key skills and lifelong learning, places the learning process and student development, together with the delivery thereof, at the heart of curriculum design.

The common challenge is to develop introduction programmes that can cater for the more heterogeneous student population, while simultaneously being suited to different academic and professional domains (Stephenson & Weil, 1992; Whitston, 1998; Rawson, 2000: 22-38; Digby, 2002: 85-90).

3.5.6 The United States of America (USA)

In an attempt disseminate information to educators about the ever-increasing array of pre-collegiate introduction programmes available for educationally and economically disadvantaged students, the TRIO College Board conducted a National Survey of Outreach Programmes (Perna & Swail, 2001: 99-110). The term TRIO is not an acronym, but refers to the three programmes (Talent Search, Upward Bound

and Student Support Services) originally funded by the Congress under Title IV of the Higher Education Act of 1965.

The study concluded that pre-collegiate introduction programmes significantly help disadvantaged students achieve the same success level as their more privileged counterparts. However, the survey also reveals that the lack of internal rigorous evaluation limits the extent to which these programmes can serve more students effectively. These findings are supported by other attempts to assess the success of programmes in increasing the post-secondary opportunities of disadvantaged students (Hayward, Brandes, Kirst & Mazzeo, 1997; Nozaki & Shireman, 2001: 49-50; Perna, 2002: 64-83). Several major reports that surveyed the field of college access, enrichment programmes and evaluations are currently available. The consensus reached in these reports is that data on programme evaluation are, in general, unreliable and, consequently, provide little useful information about the impact of the programmes (Bailis, Hahn, Aaron, Nahas & Leavitt, 1995; Hayward *et al*., 1997; James, Jurich & Estes, 1997; 2001; Oesterreich, 2000; Gandara, 2001; Perna & Swail, 2001; James *et al*., 2001; Gullatt & Jan, 2005).

Conducted mostly on college campuses, Upward Bound comprises 772 programmes. In addition, it operates more than 100 mathematics/science programmes that develop the mathematics, science, study and problem-solving skills of its participants (Gullatt & Jan, 2005). Studies show that Upward Bound programme participants are four times more likely to earn an undergraduate degree than those with similar backgrounds who are not in the programme (Fields, 2001: 26-31). As a result, this programme has become an institution on many college campuses and has significantly impacted the direction of education policy (Council for Opportunity in Education (COE), 2003).

3.6 ACADEMIC DEVELOPMENT IN ENGINEERING

Higher education institutions have expended much effort in attempting to deal effectively with the problem of the under preparedness in their first-year entrants. In order to prepare students for the engineering labour market, higher education institutions need to have engineering AD programmes that focus on fostering

students with knowledge of mechanical practices and techniques, as well as on fostering students with higher level thinking, problem-solving skills and the skills required to cooperate with others (Doolittle & Camp, 1999: 25; Bullen & Knight, 2005: 219-223).

An initial review found that there was little research completed at higher educational institutions regarding AD programmes within the study field of engineering. The programmes on offer appear to have focused on the students' prior learning rather than on opening up opportunities for students to think individually. Hence, the curriculum development of these programmes was based on the subject matter rather than opportunities for students to learn according to their own approaches (Amos & Fisher, 1988: 17-23; Woollacott & Henning, 2004: 2-7; Bullen & Knight, 2005: 219-223; Chanchalor, Jirapattarasilp & Chaisri, 2005: 253).

In order to develop effective AD programmes within the study field of engineering, a more specific understanding of its nature is required. Various approaches have been adopted, but the simplest approach is to focus on 'academic literacy'. Academic literacy in its narrowest sense refers to the ability to read and write effectively within the university context (Amos, 1999: 177-182). However, Langer (1987) interprets academic literacy more as a way of thinking, where the actual practices of literacy, what they are and what they mean for a given society, depend on the context. Fisher (Amos & Fisher, 1988: 17-23) explored this even further, pointing out that effective access to a discipline and, hence, success in the related study field, means more than admission to the institution. It entails preservation and socialisation within the institution, as well as growing intellectual social competence, advancement and success (Amos & Fisher, 1988: 17-23).

One aspect of the socialisation process is the mastery of the 'ground rules' of a specific discipline. Ground rules refer not to a set of skills as such, but to the structures of values, attitudes and the ways of thinking and doing necessary for success within a particular discipline (Amos & Fisher, 1988: 17-23; Bullen & Knight, 2005: 219-223).

Another aspect that should be dealt with within engineering AD programmes is the lack of sophistication or deficiencies in a student's cognitive functioning (Woollacott

& Henning, 2004: 2-7). Kitchener (King & Kitchener, 2004: 5-18) identified three levels of cognitive functioning. The first level, known as cognitive functioning, includes general thinking and reasoning abilities. The second level, known as meta-cognitive functioning, deals with thinking about one's thoughts. The third level, known as epistemic cognition, deals with understanding how to approach problems. The first cognitive level deals with general thinking and reasoning abilities such as perception, calculations, problem solving, and the ability to conceptualise and function at an abstract level. The second meta-cognitive level deals with knowledge about the cognitive strategies and tasks, and knowledge about the ability to recognise the success or failure of any of these processes. The third epistemic cognition level deals with the monitoring and nature of the problem, as well as the truth-value of alternative solutions (King & Kitchener, 2004: 5-18).

One of the identified reasons for the under preparedness of engineering students is their lack of mathematical skills (Bullen & Knight, 2005: 219-223). Secondary schools no longer provide adequate skills in mathematics and the physical sciences (Sutherland & Pozzi, 1995; Hibbert & Mustoe, 2003).

Both national and international secondary schools no longer see universities as their prime stakeholders. Rather, they recognise that their focus should be more on preparing large cohorts of learners with the skills necessary to enter and play a contributing role in their local communities and society in general (Northwood, Northwood & Northwood, 2003: 157-164; Bullen & Knight, 2005: 219-223). It appears that secondary schools are failing universities by not better preparing students for their higher education studies.

Consequently, all engineering AD programmes pay attention to what can be called 'academic proficiency'. Academic proficiency deals with the ability to function effectively in the higher education environment. The higher education environment typically involves high staff/student ratios, a traditional lecturer format, high content loads, a fast pace and a limited number of tutorials per week (Alfred, Dison & Hgemeilar, 1999: 112-118; Woollacott & Henning, 2004: 2-7)

A literature review was conducted to ascertain the science, engineering and technology introduction programmes on offer in South Africa. Universities and UoTs

mentioned in this study have published some information regarding their introduction programmes on offer. Other higher education institutions may have had similar programmes on offer, but no publications could be found and they were therefore not included in the study.

3.7 INTRODUCTION PROGRAMMES IN ENGINEERING

During the investigation phase of this research, it became apparent that several South African higher education institutions offer engineering introduction programmes (including the VUT). As is the case with international introduction programmes, no scientific research material was available regarding the evaluation of these introduction programmes. This means that little useful information exists about the impact of such programmes. It was established that the majority of higher education institutions offer their engineering introduction programmes mainly as 'extended' programmes, where the first year of study is extended into a two year programme. This implies that some first-year engineering subjects, offered during the second year of the extended programme, are credit bearing.

3.7.1 The University of Cape Town (UCT)

The introduction programme for engineering offered at the UCT is called the Academic Support Programme for Engineering in Cape Town (ASPECT). A preliminary assessment of this programme proved that it is only successful for a small percentage of students entering the mainstream programme. The rate of graduation, in the minimum five-year period, still fluctuates between 15 percent and 25 percent (Pearce, 2000a).

Jawitz previously stated that there is little doubt that the programme has been successful in assisting students with significant disadvantages to increase their pass rate in their first year of study (Jawitz, 1992).

An intervention Engineering Foundation Programme (EFP) was introduced in 1999 for those students who struggled in ASPECT. Half courses were offered over a full academic year, meaning that the course material is dealt with at a slower pace. These courses were initially designed as introduction programmes. The duration of

the course is five years and is, therefore, an extended programme. The first two years of this extended programme are taught at half pace; while from the third year a normal pace is set (Pearce, 2000a).

Physics is the first problem-solving course that engineering students at the UCT encounter. Indications are that by focussing on just the mechanics and electro-magnetism students, they are given the chance to understand better the material that is presented, as well as learning the rudiments of problem solving (Pearce, 2000b). Mathematics is taught by ASPECT staff but the tests and examinations are the same as those given in the regular first-year course (Pearce, 2000c).

According to Fraser (2008), the EFP has been discontinued but ASPECT is still functioning successfully.

3.7.2 The University of KwaZulu-Natal (UKZN)

The introduction programme for engineering offered at the UKZN is called the GENCOR Science Foundation Programme (SFP). It was established that the SFP students were better prepared for first year in comparison to students entering the normal route as school leavers (Raubenheimer, 1998).

Feedback obtained from alumni SFP students indicated that students had more self-confidence. Once they formed part of the mainstream programmes, they were able to return to their SFP staff members for assistance. The students felt they were obligated to pass, as the SFP staff had invested so much time in them. Alumni SFP students acted as mentors and role models for the other students (Raubenheimer, 1998).

Statistics show that, while the total faculty obtained a 55 percent pass rate, 71 percent of SFP students graduated with a BSc degree, and 42 percent of these SFP graduates did so in minimal time (Raubenheimer, 1998).

According to Kioko (2008), the SFP is still functioning successfully as a stand-alone introduction programme.

3.7.3 The University of Pretoria (UP)

The introduction programme for engineering offered at the UP is called the AD Programme. After the first year of study, a greater number of students were promoted to the second year in comparison with the four-year degree programme. The averages of both the AD students and the four-year degree students did not differ, indicating that the support offered had no immediate effect. Feedback from lecturers suggested that the five-year students were more mature in their approach towards their studies. A growing demand for admission to the AD programme is a sign of success (Du Plessis, Pauw & Van Harmelen, 1996).

No update regarding the AD programme offered at the UP could be established by the researcher.

3.7.4 The University of Stellenbosch (US)

The introduction programme for engineering offered at the US is called the AD Programme (ADP). This programme is a four-week programme, offered at the beginning of a full academic year.

The university also offers a one-year specialised Foundation Programme (FP). Research findings concluded after comparing the two programmes that both were academically unsatisfactory. It was suggested that there was insufficient differentiation between the two programmes and it was recommended that they target smaller groups with fewer academic differences. Furthermore, it was recommended that the target groups be redefined and narrowed, without lowering academic standards (Troskie-de Bruin, 1999).

Both of these programmes have been replaced by an extended degree programme and a mentor programme (Young, 2008).

3.7.5 Cape Peninsula University of Technology (CPUT)

The introduction programme for engineering offered at the CPUT is called the AD Programme. CPUT established that, owing to the large number disadvantaged learners in the community, there was a need for an AD programme (Beute, 1996). No actual details or results of the programme have been published.

The Faculty Manager (engineering) of CPUT confirmed that the AD programme was discontinued during 2007 and replaced with the DoE funded foundation programme, which was offered as an extended programme from 2008 (Thomas, 2008).

3.7.6 Durban University of Technology (DUT)

The introduction programme for engineering offered at the DUT is called the Foundation Programme. During an interview with the programme manager (Singh, 2005), the problem of bottlenecks in second year was discussed. The students passed the foundation programme, together with the subjects that were credit bearing, successfully.

The bottleneck effect occurred during the second year of mainstream study. The students repeatedly failed subjects during this year of study, which negatively influenced the Institution's throughput rate. The University decided to phase out the foundation programme and currently refers prospective students to technical colleges for upgrading (Singh, 2005).

3.7.7 Tshwane University of Technology (TUT)

The introduction programme for engineering offered at the TUT is called the Technology Access Programme (TAP). This AD programme is a capacity-building programme for students who have the potential to complete an engineering qualification successfully. However, they may not have had access to adequate schooling and, as such, may not have developed the necessary concept building, knowledge acquisition and life skills necessary to enable them to enter into engineering studies (TUT, 2007).

During this programme students learn new skills and gain knowledge in the following areas: communication skills, practical skills development, computer skills, knowledge of engineering and technology and knowledge of mathematics and the sciences (TUT, 2007).

Even though the TAP has been offered as a successful stand-alone AD programme, the TUT has discontinued the programme and replaced it with the DoE funded Foundation programme, which was offered as an extended programme from 2008 (Potgieter, 2008).

To summarise, the South African higher education institutions which offer introduction programmes are not always successful.

A summary of the higher education institutions offering introduction programmes similar to the introduction programme at the VUT are listed in Table 3.6.

TABLE 3.6: Summary of the higher education institutions offering introduction programmes in South Africa (excluding the VUT).

UNIVERSITY	PROGRAMME NAME	PURPOSE	PROBLEMS EXPERIENCED	OUTCOMES
UCT	ASPECT	Intro to Eng	Offered as an extended programme	Successful
	EFP	Intro to ASPECT	Students attend half-paced courses for two years	Unsuccessful
UKZN	SFP	Intro to Eng	-	Successful
UP	AD	Intro to Eng	Support offered had no immediate effect	Students were more mature
US	ADP	Upgrading Programme	Targeted group selection	Unsuccessful Replaced by an extended programme
	FP	Introduction Programme	Targeted group selection	Unsuccessful Replaced by a mentor programme
CPUT	AD	Intro to Eng	-	Discontinued
DUT	Foundation	Intro to Eng	Bottlenecks during second year	Unsuccessful
TUT	TAP	Intro to Eng	Discontinued	Successful

There is not a high success rate at university level and although the students are rated as more mature when they attempt the mainstream programmes, it does not mean that they are academically better performers.

Even at UoTs there seems to be a low success rate, which justifies the rationale of this study: to develop a curriculum framework for an introduction to engineering programme, based on the formation of the introduction programme offered at the VUT.

3.8 FORMATION OF THE INTRODUCTION PROGRAMME AT VUT

Academic growth within the engineering field is partly steered by the industry, as engineering programmes at higher education institutions strive to include current developments within their academic offerings. Links with commerce and industry are vitally important to education at UoTs. It ensures that curricula stay contemporary (in line with the needs of industry) and allows students to gain relevant experience within suitable environments.

It can be argued that higher education has come to be seen by the South African government, the public and often academy itself as a consumer good, best steered by the market in a social ethos of meritocratic individualism [*sic*] (Jonathan, 1997; Jonathan, 2006: 17). Marais (1992: 9) agrees with the argument and states that science and technology are of the utmost importance in South Africa if we intend to make an effort at keeping pace with the more wealthy countries of the world. He continues by saying that it is only through such endeavours that the country's primary products can be upgraded and thereby gain added value in the world market. This statement is also supported by Barker (1999). However, it can also be argued that the higher education sector only has a social responsibility regarding the development of technological skills. Lamprecht (1992: 72) believes that there is more of a social responsibility rather than an economic responsibility in the development of technological skills.

The engineering programmes offered at the VUT are specialised to accommodate the various industry sectors, which the VUT as a tertiary institution 'feeds' (VUT, 2007). This implies that the VUT engineering curricula are based on the theory and practical skills needed for industry (vocational training) and are not entirely based on, nor built upon, any province's school curriculum (McFarlane *et al.*, 2004: 97). The implication of offering specialised curricula can lead to students having difficulties adapting within the higher education academic environment (Sutherland & Waetzel,

2006: 342). Schooling inequalities in standards of teaching in mathematics and the sciences, combined with disparities in personal aspiration which accompany structural inequality, ensure that a disproportionate number of socially-disadvantaged students are found in the faculties of arts, humanities and social sciences (Cooper & Subotsky, 2001; CHE, 2004a: 26).

The researcher has been involved over the years in developing and applying various techniques (revising the engineering curriculum, developing support programmes for students, executing the modularisation of the engineering curriculum, running lecturer educational programmes and increasing input from industry) that attempted to address the need for increased student throughput in engineering. Yet, it appeared that the problem with student throughput in engineering lay mainly in bridging the gap between the National Senior Certificate and the first year of study at the VUT. Interviews conducted with lecturers who offer first-year engineering subjects confirmed the researcher's presumption that students attempting engineering studies are often academically under prepared.

Possible factors influencing the under preparedness experienced by students include the wide diversity within school curricula, the quality of teaching and interpersonal life-skills orientation (McFarlane *et al*., 2004: 97). Secondary variables, such as the students' intra-personal skills and personal growth, and the curricula have an impact on the development and acquisition of certain life skills.

Under preparedness, for the higher education sector, has frequently been cited, both nationally and internationally (Grimes, 1997: 47-57; Amos & Fisher, 1998: 17-33; Lea & Street, 1998: 157-173; McFarlane, 1998; Sutherland *et al*., 2002: 20; Northedge, 2003b: 17-32; Weingartner, 2003; McFarlane *et al*., 2004: 97; Coughlin, 2006: 209-218).

The researcher identified a need for some form of introduction programme, aimed at enriching those prospective students who do not initially qualify for admission into the mainstream engineering diploma programmes. The Deputy MoE has also stressed that citizens need to benefit from these programmes. He has further stated that education must be prioritised as a core element of social transformation (Surty, 2007: 1-3).

Schooling inequalities have a negative impact on higher education academic performance, and the responsibility to overcome these inequalities has now been transferred to higher education. However, for higher education institutions to assist in this immense responsibility, the NQF levels have to be complied with. It is not possible to overcome these inequalities within the mainstream academic offerings, as the NQF levels differ from those of the National Senior Certificate. Troskie (1994: 94-95) states that universities should be responsible for introduction programmes, as most universities have, as a part in their mission statements, a responsibility towards the community and are thus partly responsible for educating students towards the entry requirements. The only problem Van Tonder (1996) foresees with this statement is the fact that there exists no formal financial structure at universities to accommodate this form of practice.

The VUT wants to continue operating as a business, to meet the demands made by industry and to increase the throughput rate of the university (VUT, 2007). Therefore, it is not ideal for prospective engineering students to be referred to other tertiary institutions if these students do not meet the admission requirements. The researcher has proved over the last five years that it is possible to maintain a self-sustainable engineering introduction programme if the students themselves recognise the need to improve their National Senior Certificate results in order to obtain the necessary admission requirements. The introduction programme, Introduction to Science, Engineering and Technology (Intro SET), is by no means compulsory and it will always be the students' choice of whether or not to register for the programme.

Felix (2002) states that an introductory programme strives to prepare students for survival in the mainstream by providing remedial support prior to admission to the engineering curriculum. Grayson (1992) and Van Tonder (1996) both argue that the main aim of introduction programmes for engineering at South African universities is to identify academically talented but under prepared students who wish to pursue a career in engineering, and to help them develop the skills and resources needed to obtain a tertiary qualification in this area. This argument suits the Intro SET programme as it is a specific curriculum programme, developed to enhance prospective engineering students academically, socially and proficiently, so that they are able to attempt their diploma studies at the VUT successfully. The MoE states

that a key focus over the next few years will be on well-designed introduction programmes and the provision of student support services on all campuses with the view to enhancing academic success (Pandor, 2007: 1).

3.8.1 Introduction to Engineering (2002 - 2003)

The introduction pilot programme was initially named Introduction to Engineering (Intro Eng) and commenced in January 2002. This programme was similar to the current Intro SET; however, quite a few changes have been implemented in order to upgrade the quality of the programme. The Intro Eng programme comprised two modules, with duration of seven weeks respectively. In the subject of mathematics, an additional textbook has been included (Croft & Davison, 2003). In the subject of science old workbooks, which are still used by learners in secondary schools, were replaced with two new textbooks (Tro, 2003; Hewitt, 2006).

The addition of an extra module was necessary to accommodate the science curriculum for the three major engineering fields offered at the VUT. Science Module 1 comprises physics; Module 2, chemistry; and Module 3, electrical. Students from the Applied and Computer Sciences complete Modules 1 and 2 for science, just as the engineering students, though they are not allowed to study within the field of engineering after completion of the programme, as the science subject offered to them in Module 3 is based on physiology.

A new subject ‘computer literacy’ was added. This became necessary as the ‘successes’ of this programme contributed to the addition of the Faculty of Applied and Computer Sciences student enrolment for the Intro Eng programme. The introduction programme was now fully integrated towards science, engineering and technology, hence the name change to Intro SET.

3.8.2 Introduction to Science, Engineering and Technology - Programme Outline (2004 - 2006)

The aim of the Intro SET programme is to aid prospective engineering students who need to improve their National Senior Certificate results in order to obtain the necessary admission requirements. The VUT tends to attract students who are mainly from previously disadvantaged schools. The entrance requirements for the programme allow entry to those students who do not meet the entrance

requirements for the engineering mainstream diploma programmes. Students who do not qualify for the mainstream engineering programmes are requested to apply for the Intro SET programme if they prefer to study engineering at the VUT. The programme outline for the Intro SET programme is described in Table 3.7.

TABLE 3.7: Intro SET Programme outline for 2004 - 2006

NEW APPLICATIONS AND ENROLMENTS		
SUBJECTS (STANDARD GRADE)	**MINIMUM REQUIREMENTS**	**COMMENTS**
Mathematics	D-symbol SG (Grade 12)	Prospective bio-medical technology diploma students require the additional subject of biology to gain entrance into Intro SET
Physical Science	D-symbol SG (Grade 12)	
English	D-symbol SG (Grade 12)	
Biology	D-symbol SG (Grade 12)	

HEAD OF DEPARTMENT'S REFERRAL: ENROL FOR INTRO SET			
MODULE 1 - NQF2: DURATION 5 WEEKS			
Mathematics	**Science**	**Language Literacy**	**Computer Literacy**
60% pass	60% pass	60% pass	60% pass
Evaluation: Unit assessments - Unit(s) re-assessment			
Fail Module: Repeat Module 1 subject(s)		**Pass** Module: Enrol for Module 2	
MODULE 2 - NQF3: DURATION 5 WEEKS			
Mathematics	**Science**	**Language Literacy**	**Computer Literacy**
60% pass	60% pass	60% pass	60% pass
Evaluation: Unit assessments - Unit(s) re-assessment			
Fail Module: Repeat Module 2 subject(s)		**Pass** Module: Enrol for Module 3	
MODULE 3 - NQF4: DURATION 5 WEEKS			
Mathematics	**Science**	**Language Literacy**	**Computer Literacy**
60% pass	60% pass	60% pass	60% pass
Evaluation: Unit assessments - Unit(s) re-assessment			
Fail Module: Repeat Module 3 subject(s)		**Pass** Module: Enrol for mainstream National Diploma: Engineering	

The programme is offered as a stand-alone course, with duration of one semester.

Students can register annually for the Intro SET programme, during January and July. Registration for the Intro SET programme commences on a ‘first pay first in’ basis. This procedure is followed because the programme only has a capacity of 90 new registered students per semester. There is a huge demand for this programme and it increases every semester. This registration method was found to be the best strategy for self-sustainability and the fairest method to be applied for registration. Students have to pass three modules, which include the subjects of mathematics, science, language literacy and computer literacy. Students are also required to pass every subject before they can progress to the next module.

The pass rate of each subject is a minimum of 60 percent. If a student fails one subject within a module, it can be repeated as soon as that module is on offer the following semester. The student is not able to progress to the next module unless all the subjects of the current module have been completed successfully. Owing to the fact that integration is applied across the subjects, all subjects are pre-requisites for the following module on offer.

Continuous assessment is applied throughout the three modules. Each subject (per module) is divided into two units. After completion of each unit an assessment is completed. Should students fail to obtain the minimum of 60 percent for the first assessment, they have the opportunity to be re-assessed. After completion of the module (four weeks), a re-assessment of one or both of the units is completed.

Assessment criteria by which judgements are made should be specified and the following principles of good assessment should be applied: they should be valid, reliable, transparent, fair, practical and realistic (Geyser, 2004: 96-97). Malan (2000: 26, 31) states that the eventual purpose of assessment is to validate learning outcomes - be it for diagnostic, formative or summative purposes. Summative assessment would include continuous (formative) assessments.

It is highly recommended that all curriculum design activities should be evaluated and student assessment, in particular, should:

- be based on an understanding of how students learn;
- accommodate individual differences in students;

- allow for students to deliver proper feedback on their learning experiences;
- provide students with the opportunity to reflect on their learning and practice experiences; and
- form an integral component of OBE facilitation, curriculum and module design (Van Tonder, Wilkinson & Van Schoor, 2005: 1-2).

All the prescribed assignments are assessed continuously and form part of the final mark obtained for the subject. Assignments are included in the subject study guides, received by the student the day classes commenced. Textbooks, study guides and practical components are supplied to the students the first day classes commence. These study materials are included in the price of the programme. Students are responsible for their own stationery, notebooks (for note taking and homework), calculators (the same one they used during secondary school) and dictionaries. None of the subjects offered are credit-bearing; however, students who complete this programme successfully are allowed to re-apply for the diploma programmes.

Students from the Faculty of Applied and Computer Sciences are also enrolled for this programme. The majority of students coming from this faculty want to study the National Diploma: Bio-Medical Technology. To do so, they need the extra subject biology to meet the entrance requirements. Practical experiments and assignments of the above-mentioned subjects are integrated and related to each other. This enhances the students' cognitive processing abilities and facilitates their understanding of why certain concepts need to be studied theoretically.

Many agree that introduction programmes similar to the Intro SET have to provide the necessary scaffolding to construct sustainable strategies for the successful expansion of the South African school system (Solon, 1957; Dennison, 1962; Pounder, 1999: 156; Reinecke, 2000: 42; Humphreys & Conlon, 2003: 68-73; Park, 2003: 5-8; Pandor, 2007: 1-2). Programme developers should be accountable for the lasting effect concerning programme improvements and offer successful returns over time (Meyer & Pearsons, 1994; Harvey, 1998: 237-255; Verkleij, 2000: 85-92; HEQC, 2001; HEQC, 2002a: 5; HEQC, 2002b: 9; HEQC, 2003; Pretorius, 2003: 129-136).

Du Plessis *et al*. (1996) state that a growing demand for admission to introduction programmes is a sign of success. However, success of the Intro SET programme was measured by the success rate of the Intro students enrolled for the engineering diploma programmes.

3.9 THE PROGRAMME: INTRODUCTION TO SCIENCE, ENGINEERING AND TECHNOLOGY

With regard to the established reference of the internationalisation of the curriculum earlier in this chapter and the contextual programme specifics available from the overview of introduction programmes similar to the Intro SET programme in this chapter, the researcher's description regarding the Intro SET programme that forms the unit of analysis for this study is defined as:

> *The independent short-course format introduction programme, Intro SET, strives to enable identified academically talented, but under prepared post-secondary domestic and foreign students from educationally and economically disadvantaged communities to value intellectual diversities, function in a multicultural environment, and develop the skills and resources required to obtain a tertiary qualification necessary to pursue a career in engineering.*

3.10 CONCLUSION

This chapter offered an overview of the contextual and conceptual views on curriculum development against the backdrop of current legislation for higher education in South Africa. From this overview the following important points are concurred:

- Curriculum design and curriculum development are issues that are increasingly linked to the sound description of developmental learning outcomes, assessments and quality assurance procedures. These developmental outcomes, assessments and quality assurance procedures should ultimately be supported by scientific literature and policy concerns, as has been indicated in this chapter. The chapter also links the EIP curriculum to generic learning

outcomes specifically set at the NQF Level 4, suggesting the application of continuous assessments in line with OBE criteria and pertinent quality assurances to fit the HEQC audit criteria for higher education institutions.

- Learning constructs signify the teaching, learning and skill training features resulting in critically reflective students who ‘want to’ learn. The application of Bloom’s taxonomy, in parallel with the DAD model, as highlighted by this chapter, might increasingly enhance a deep approach to learning and link the emotional aspects of experience to memory. This approach is highly applicable to the introduction programme subjects (mathematics, science, computer literacy and language literacy), which rely on the pedagogy of PBL. PBL is unconfined by discipline boundaries, encourages an integrative approach to learning and is based on requirements of the problem, as perceived by the students themselves;
- Data from the FET band confirm the causes underlying student failure to graduate within the engineering study field, which justifies the need for an intervention programme at higher education institutions. Schooling inequalities have a negative impact on academic performance in higher education and the responsibility to overcome these inequalities has been transferred to higher education institutions. The DoE statistics indicate that less than 22 percent of secondary school graduates are eligible to apply for a higher education qualification in engineering studies, which has significant implications for access into these programmes.
- The poor success rate of current programmes seems to justify the development of a curriculum framework for an introduction to science, engineering and technology programme at applicable higher education institutions. The chapter indicates that higher education institutions that offer introduction programmes as independent sustainable programmes are in need of a sound curriculum framework. Higher education institutions that choose to offer the DoE Foundation Programmes (extended diploma or degree programmes) follow the framework set out by the DoE. These institutions receive funding from the DoE and it seems that self-sustainability is not yet required.

The following chapter outlines the methodology used for the empirical part of the study and provides a comprehensive discussion on how these methods were employed.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 INTRODUCTION

A research design is a blueprint on how one intends conducting research (Zemke & Kramlinger, 1982; Yegidis & Weinbach, 1996; Mouton, 2001: 56) and it is tailored to address a specific research question. This chapter describes the research design and methodology that was used for the empirical section of the study. The intention is to provide a justification for the selection of the used research approaches, methods and techniques applied.

4.2 RESEARCH APPROACH

Quantitative research, within the context of a longitudinal case-study design, was used to determine whether there was a statistical difference between the performance of EIP students and direct students. The quantitative research approach, or positivist approach, emphasises observable facts and excludes subjective speculation. The positivist approach is based on a philosophical approach known as logical positivism. As a result, the study was primarily aimed at that which can be observed and measured objectively - that which exists independently of the feelings and opinions of individuals. The term 'objective' implies that individuals other than the researcher would agree on what was being observed, such as the score that the observation registered on the measuring instrument (Welman *et al.*, 2005: 6).

The measuring instrument applied here was the academic examination results obtained from the VUT's Integrated Tertiary System (ITS) between the second semester of 2002 and the first semester of 2007. In order to establish the reasons why students drop out of the diploma programme, a quantitative research approach, with qualitative elements, was used.

The VUT's ITS system was utilised to track down those students who dropped out of the diploma programme between the second semester of 2002 and the first semester of 2007. The measuring instrument applied was a structured questionnaire survey using Likert-ranking scales, as well as open-ended questions to generate qualitative data.

4.3 RESEARCH DESIGN

Given the background to the problem and the aims of the study, an increase in the pass rate of Intro students over a five-year period, together with the identification of the reasons for dropping out of the diploma programme, might serve as important indicators of the Intro SET programme's success. Furthermore, this is likely to provide a basis for the formulation of a sound EIP framework.

The study addressed the research problem, which was articulated by the question: What comprises a curriculum framework aimed at prospective engineering students at the VUT?

Before the case study design, which was used as the design type for this study, is described, some background is required to enhance understanding of the role that the Intro SET programme plays in obtaining a three-year diploma qualification at the VUT.

The UoTs differ from universities, as students do not necessarily enrol annually at UoTs. The Faculty of Engineering and Technology at the VUT, enrols students every semester. Therefore, first-year students can enrol annually in January and in July.

Students registered for the Intro SET programme may re-apply for the diploma programme after successful completion of the Intro SET. The participants in the five-year study used to obtain the required data were Intro students who registered for the diploma programmes at the VUT between the second semester of 2002 and the first semester of 2007.

Figure 4.1 illustrates how students can enrol for the diploma, and how they need to proceed before obtaining a diploma qualification in engineering studies.

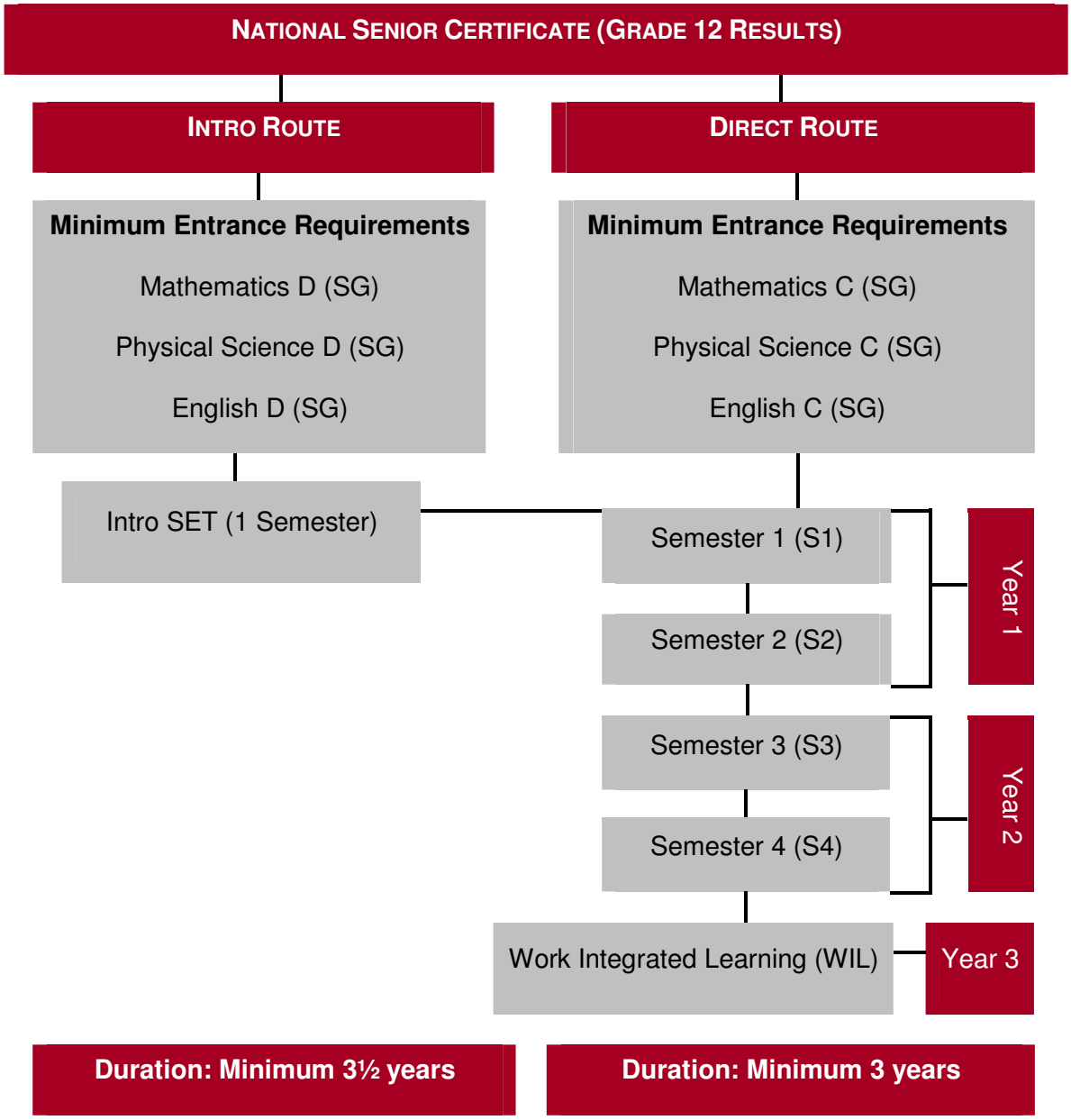

FIGURE 4.1: Engineering diploma: entrance-to-exit level

The researcher's specific role as a lecturer was interpreted as being that of an initiator, a participant, an implementer and a 'successful' manager of the Intro SET programme at the VUT.

The selection of research paradigms and methodologies was based upon a triangulation approach, which provided the best of both the quantitative and qualitative results obtained. Triangulation occurred when the quantitative results was compared to the qualitative responses and then compared to the literature.

The researcher participated throughout the research project and strived to ensure that the goals of the study were reached using impartial and honest methods.

The conceptual framework for the study has been established and is illustrated in Figure 4.2.

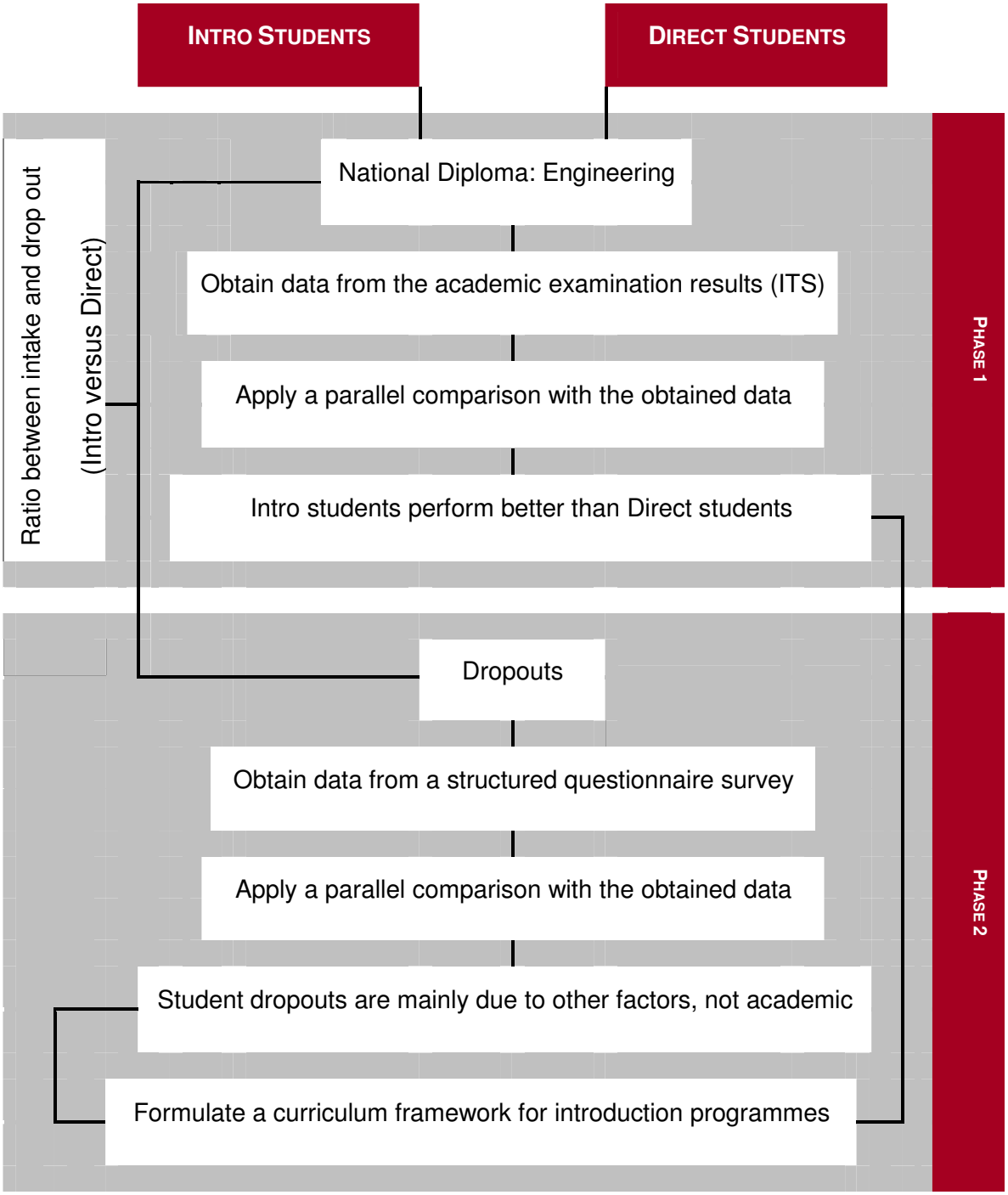

FIGURE 4.2: Conceptual framework of the study

4.3.1 Arguments regarding quantitative and/or qualitative approaches

A social science methodology is rooted in issues that are the substance of the philosophy of science, particularly assumptions about the nature of the social world (ontology) and the nature of warranted social knowledge (epistemology) (Greene, 2006: 93-98). While some social science researchers (Ayer, 1959; Popper, 1959; Lincoln, 1985; 1989: 237-239; 1992: 375-391; 1995; Lincoln & Guba, 1985; 1986: 73-84; 1988: 89-115; 1989: 231-240; 1990: 53-59; Schwandt, 1989: 11-16; Schrag, 1992: 5-8; Miles & Huberman, 1994; Maxwell & Delaney, 2004) perceive qualitative and quantitative approaches as incompatible, others (Miller & Creswell, 2005; Creswell, 2001; Patton, 1990; Reichardt & Cook, 1979: 590-597; Campbell & Stanley, 1963) believe that a skilled researcher can successfully combine both approaches (Siegle, 1996: 3).

Quantitative purists articulate assumptions that are consistent with what is commonly called a positivist philosophy (Johnson & Onwuegbuzie, 2004: 14). Specifically, quantitative purists believe that social observations should be treated as entities in much the same way that physical scientists treat physical phenomena. In addition, they argue that the observer is separate from the entities and subject to observation. Quantitative purists maintain that social science inquiry should be objective. Time-and-context free generalisations (Nagel, 1986) are desirable and possible, and real causes of social scientific outcomes can be determined reliably and validly.

Qualitative purists, also known as constructivists and interpretivists, reject what is known as positivism (Johnson & Onwuegbuzie, 2004: 14). They argue for the superiority of constructivism, idealism, relativism, humanism and, sometimes, post-modernism (Guba & Lincoln, 1989; Lincoln & Guba, 2000: 163-189; Schwandt, 2000: 189-213; Smith, 1983: 6-13; 1984: 379-391). These purists argue that multiple-constructed realities abound, that time-and-context free generalisations are neither desirable nor possible and that research is value-bound. They further argue that it is impossible to differentiate causes and effects fully, that logic flows from specific to general and that the knower and the known cannot be separated because the subjective knower is the only source of reality (Guba, 1990: 17-27). Qualitative purists are characterised as having a dislike of a detached and passive style of writing, preferring instead detailed, rich and thick (empathic) description, written directly and somewhat informally (Johnson & Onwuegbuzie, 2004: 14).

The argument usually becomes muddled because one party argues from the underlying philosophical nature of each paradigm and the other focuses on the apparent compatibility of the research methods, enjoying the rewards of both numbers and words. Since the positivist and the interpretivist paradigms rest on different assumptions about the nature of the world, they require different instruments and procedures to find the type of data desired. This does not mean, however, that the positivist never uses interviews nor that the interpretivist never uses surveys.

During the mid-1980s, scholars began expressing concern that researchers were indiscriminately mixing quantitative and qualitative approaches and forms of data without acknowledging or articulating defensible reasons for doing so (Greene & Caracelli, 1989; Rossman & Wilson, 1985: 627-634). As a result, different reasons for mixing both forms of data in a single study were identified. Greene and Caracelli, (1989), for example, identified a number of reasons for combining data-collection approaches. These reasons were beyond the traditional notion of triangulation. Mixed-data approach researchers have since expanded the reasons for conducting mixed-data approach investigations (Punch, 1998; Mertens, 2003: 135-164; Newman, Ridenour, Newman & DeMarco, 2003: 167-188).

Mixed-data approach investigations may be used to understand a research problem better by converging numeric trends from quantitative data and specific details from qualitative data. These types of investigations can be used to identify variables/constructs that may be measured subsequently using existing instruments or by developing new ones. In addition, mixed-data approach investigations may be used to obtain statistical, quantitative data and results from a sample of a population and use them to identify individuals who may expand on the results through qualitative data and results. Mixed-data approach investigations may also be used to convey the needs of individuals or groups of individuals who are marginalised or under represented (Punch, 1998; Mertens, 2003: 135-164)

The crucial aspect of justifying a mixed-data approach research design is that both single data approaches (quantitative and qualitative) have strengths and weaknesses. The combination of data approaches, on the other hand, focuses on each data approach's relevant strengths. The researcher should aim to achieve a

situation where the blending of the quantitative and qualitative data approaches of research produces a final product that can highlight the significant contributions of both (Nau, 1995: 1). Specifically, where qualitative data can support and explicate the meaning of quantitative research (Jayaratne, 1993: 117).

The stance taken by realists (Cicourel, 1964; Crotty, 1998) is that the mixed-data approach is an excellent starting point for empirical research. Data approach pluralism has been cited in several works (Sayer, 2000; Danermark, 2002; Carter & New, 2003). It refers to a pluralism of method that enables the researcher to use different techniques to get across dissimilar facets of the same phenomenon. For example, while Skeggs (1997) focuses more on ethnographic and interview data, Goldstein (2003) concentrates more on quantitative data, but they also recognise the value of the other type of data. This sort of pluralism was an acceptance of the data approach choices of researchers, as it recognised that classification was a multi-facetted phenomenon, with personal and private aspects as well as publicly recorded aspects.

In educational research, combined epistemological and methodological approaches lead to research that is more effective. Educational research that is based on the empirical-positivist theory draws on neutral, objective and statistical language and includes the use of questionnaire-driven surveys (Kelchtermans, Schratz & Van Den Berghe, 1994: 249; Kelchtermans, 1998: 230; Waghid, 2000: 26).

Epistemological and paradigmatic ecumenicalism were within reach in the paradigm of mixed-data approaches within the empirical study.

Different approaches allow us to know and understand different things about the world; nonetheless, individuals tend to adhere to the methodology that is most in keeping with their socialised worldview (Creswell & Miller, 2000: 124-130; Glesne & Peshkin, 1992: 9). Keeves (1997: 386) agrees, summarising that both quantitative and qualitative data seek to contribute to the ‘body of knowledge’ that allows the use of generalisations to benefit educational and social practices. Both phases of the study statistically analysed the quantitative data. The qualitative data obtained from the questionnaire was only used to enrich the text descriptions with detail and

highlight the participants' views and personal experiences regarding the areas investigated.

4.3.2 Phase 1 of the empirical study

During Phase 1 of the empirical study, the comparison group post-test only design was pursued, utilising the quantitative data collection method. In a static group comparison design, one group was the experimental group (Intro students), who were exposed to the independent variable x. The other group, the comparison group (direct students), were not exposed to variable x. The independent variable x for the empirical study was the Intro SET programme. Reliable, accurate and valid measurements were necessary.

The design is depicted in Figure 4.3.

THE COMPARISON GROUP POST-TEST ONLY DESIGN		
Experimental Group (Intro students)	x	0_1
Comparison Group (Direct students)		0_1

FIGURE 4.3: The comparison group post-test only design
(Source: Adapted from De Vos *et al.*, 2005: 139)

The broken line between the two groups illustrated in Figure 4.3 serves to emphasise the fact that the groups were not obtained by random selection.

4.3.3 Phase 2 of the empirical study

The questionnaire survey was constructed by utilising the dendrogram (Schutte, 1992) depicted in Figure 4.4. It defines the conceptual framework for Phase 2 of the empirical study from which the questions were constructed.

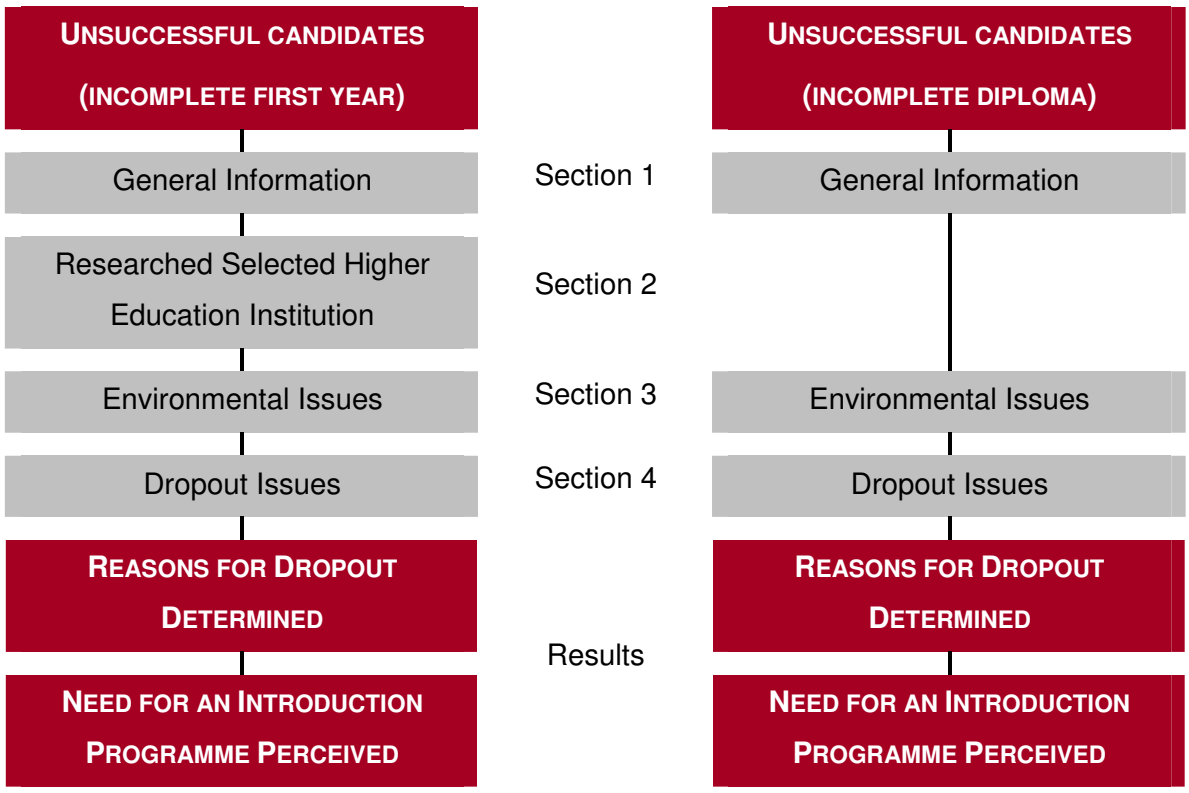

FIGURE 4.4: The conceptual framework for Phase 2 of the empirical study

Questionnaire surveys are inherently based upon an in-depth qualitative enquiry of the empirical study (Blaikie, 2000; De Vaus, 1991; Harvey, 1991; Layder, 1993; Marsh, 1979; 1982; 1988). Formally managed questionnaire surveys are set up after a period of examining the relevant literature (Marsh, 1982; Bulmer & Warwick, 1993; Marsh, 1979; 1988). The dendrogram method was applied after the bounded scope of the theory was defined by a comprehensive literature study. This acted as a guide for compiling the relevant questions (closed-ended and open-ended) within the scope of the case analysed, namely the EIP at the VUT.

Survey data can include categorical and qualitative data (Menard, 1995; Mikkelsen, 1995), which have separate nominal categories and interact with case studies, providing a rounded view on a limited number of cases. The question formats that were included in the content domain varied according to the type of information required (Schnetler, 1988: 45). A funnel approach, as suggested by Oppenheim (1992: 110), Huysamen (1994: 133) and Babbie (1992: 154), was used. According to this approach, a broad question is asked first before progressively narrowing down the scope of questions until it concludes in a specific point.

Likert-scale response closed-ended questions were used to gather data on attitudes and perceptions, as scaled responses yield ordinal data and were preferable to other forms of questions, such as open-ended questions, multiple-choice questions and dichotomous questions (Struwig & Stead, 2001: 95). The four-point scale that was used varied from ‘strongly agree’ to ‘strongly disagree’ (see Annexure 12). The closed question approach was advantageous because substantial information about the student dropout-group existed. In this regard, Monette, Sullivan and De Jong (2002: 163) state that, in general, closed-ended questions should be used when all the possible theoretically relevant responses to a question can be determined in advance and the number of possible responses is limited. The degree, frequency and comprehensiveness of the phenomenon can be associated quite meaningfully by means of closed-ended questions.

Owing to the large sample used, closed-ended questions were valuable and the result of the evaluation became available quickly. Other advantages of closed-ended questions are that respondents understand the meaning of the questions better, and questions can be answered within the same framework. In addition, with closed-ended questions responses can be compared better with one another, answers are easier to code and statistically analyse, response choices can clarify question meaning for respondents, there are fewer irrelevant and confusing answers to questions and replication is easier (Neuman, 2003: 278).

The most important disadvantages of closed-ended questions are that they can suggest ideas that the respondent would not otherwise have and respondents may become frustrated because their desired answer is not a choice. Furthermore, with closed-ended questions, misinterpretation of a question may go unnoticed, and such questions may force respondents to give simplistic responses to complex issues (Neuman & Kreuger, 2003: 273). In order to avoid these reactions and to keep the data-gathering process advantageous, open-ended questions were also included in the questionnaire. Open-ended questions gave respondents the opportunity of writing any answer in the open space.

According to Neuman (2003: 279), open-ended questions may be best if the researcher wants to learn how the respondents think, to discover what is actually important to them or to get an answer to a question with many possible answers.

Information obtained in this manner can later be divided into several sections. The open-ended questions have advantages when a variable is relatively unexplored, such as, in the case of this study, students' reasons for dropping out of the diploma programme.

Neuman and Kreuger (2003: 273) agree that open-ended questions permit adequate answers to complex issues and allow respondents to answer in detail and to qualify and clarify responses. They also make space for unanticipated findings to be discovered, and permit creativity, self-expression and richness of detail.

The open-ended questions enabled the researcher to explore the variable better and obtain an idea of the spectrum of possible responses. The respondents should be stimulated to think the questions through and the responses should be written, as completely as possible, on the questionnaire. Open-ended questions lengthen the time of completion and respondents may be tempted to leave notes incomplete, which decreases the real value of the data obtained from the questionnaire (De Vos, Strydom, Fouchè & Delport, 2005: 174).

4.3.4 The case-study design

A research design where subjects are assessed at several different times in their lives is interpreted as a longitudinal study (Simon, 2008: 1). In a case study, research is directed at understanding the uniqueness and idiosyncrasy of a particular case in all its complexity (Welman *et al*., 2005: 25). McNamara (2008: 1) agrees that case studies are particularly useful in depicting a holistic portrayal of a researcher's experiences and results regarding a programme. Wheeler (2001: 8), in summarising the views of Simon (2008) and Welman *et al*. (2005), refers to a case study as an intensive study approach using multiple methods to examine specific individuals, organisations or contexts for a defined purpose within a defined unit of analysis. He further states that the study can be exploratory, explanatory or descriptive in its orientation.

According to Yin (2002), case studies can include quantitative evidence, rely on multiple sources of evidence and benefit from the prior development of theoretical propositions. Starke (1995) states that one of the areas in which case studies have been gaining popularity is education and, in particular, education evaluation.

A case study may also be categorised by the epistemology of the researcher and the research framework, which may be embedded in the different philosophical traditions of research.

To summarise, the orientation of the case-study design for the research was to accommodate the positivist (empirical-analysis paradigm) and post-positivist (interpretive paradigm) research traditions. Case studies have been criticised as not being representative of similar cases and, therefore, the results of the research cannot be generalised (Hancock, 1998: 7).

The researcher does not agree with this statement regarding the purpose of case-study design, which, rather than using large samples and following a rigid protocol to examine a limited number of variables, involves an in-depth, longitudinal examination of a single instance or a case.

Therefore, it is particularistic and contextual.

4.4 DATA COLLECTION

The first phase of the study determined whether the Intro students performed academically better than, or at least as well as, the direct students. The case-study design can be compared to the post-test only design, except that it provided for more measurements of the dependant variable. The variable should be clearly defined. In order to obtain data for the first phase, the comparison group post-test only design was pursued.

The first tributary data to be obtained in Phase 1 was the academic performance of both the Intro students and the direct students on the ‘complicated subjects’ in the first semester of the diploma programmes. Complicated subjects within the study were regarded as subjects with a very low throughput rate of less than 50 percent. Students tend to be unsuccessful in passing these subjects at their first attempt. The two subjects identified were Mathematics 1 and Electrical Engineering 1. As from 2009, both of these subjects will be compulsory in the first-year engineering studies. The ratio between those students who passed after their first attempt and those who took several attempts before passing established if a higher percentage of Intro

students passed these subjects with fewer attempts when compared to the direct students. The analysis also indicated if these subjects were statistically dependant on the Intro SET programme.

The second tributary data to be obtained was the total number of dropout students for the same period (between the second semester of 2002 and the first semester of 2007). The ratio between the intake students and the dropout students established whether an equal percentage of Intro students dropped out of the diploma programme when compared to the direct students. Thereafter, the overall academic performance of the Intro students was compared to the overall academic performance of the direct students. The overall academic performance for the study was interpreted as the first attempt pass rate of the individual subjects enrolled for by Intro students and direct students respectively.

The final comparison was between the number of Intro student graduates and the number of direct student graduates over the five-year period. The ratio between the intake students and the graduate students established if a greater percentage of Intro students qualified from the diploma programme when compared to the direct students, which subscribed to the main rationale of this study.

The second phase of the study determined why the diploma students dropped out of the programme. Phase 2 of the study did not only make use of quantitative data. Qualitative data were used to support the quantitative data collected, which were then compared, via triangulation, to trends identified in the literature study. It was then possible to conduct a detailed analysis and initiate new ideas through addressing revelations or contradictions. During analysis, quantitative data helped by screening the generality of the specific observations, whereas qualitative data assisted the quantitative side of the study by aiding with conceptual development and instrumentation.

The second phase of the study sought to obtain data, using a self-administered questionnaire survey, from students who had dropped out of the diploma programme between the second semester of 2002 and the first semester of 2007. The purpose here was to determine the reasons, other than students' academic performance, for the dropout. The students who dropped out during their first year completed an

additional section of the questionnaire. The aim was to determine why dropout occurred after the first year and whether they were dropout Intro students or dropout direct students. It was then possible to compare and statistically validate whether the Intro students performed better academically than the direct students during their first year of study. Target groups for data collection purposes needed to be established and this is discussed next.

4.4.1 Target Groups

During Phase 1 of the study, selection criteria for both the Intro group and the direct group were identical. Both groups' selection criterion was the enrolment into the diploma programme between Semester 2 of 2002 and Semester 1 of 2007. The only variance between the two groups was the fact that the Intro group was exposed to the Intro SET programme (2002 - 2006) before enrolment into the diploma programmes at the VUT.

The static group comparison post-test only design improves on the exploratory one-group and multi-group post-test only designs, by introducing a direct group, which does not receive the independent variable but is subject to the same post-test as the Intro group (De Vos *et al*., 2005: 139). Sampling is purposive and not random (Sithole, 1991; Thyer, 1993; 2001).

The target-group selection criterion for Phase 2 of the study was for students (Intro students and direct students) to have dropped out of the diploma programme between Semester 2 of 2002 and Semester 1 of 2007. The total population was obtained from the VUT's ITS; thereafter, a random selection approach was applied for sampling purposes.

4.4.2 Sampling

The total number of Intro students enrolled for the diploma programme between Semester 2 of 2002 and Semester 1 of 2007 was 201 and the total number of direct students - no repeaters were taken into consideration - for the same period was 6 386, which represented the first tributary population for Phase 1 of the study. The total number of Intro students who dropped out of the diploma programme between Semester 2 of 2002 and Semester 1 of 2007 was 108 and the total number of direct students who dropped out during the same period was 3 707, which represent the

second tributary population for Phase 1 of the study. As this part of the study made use of data obtained from the ITS system, a 100 percent confidence level was obtained.

Sampling for Phase 2 comprised the total dropout population and was random to ensure a chance of drawing a representative sample of the population identified for the study. Random sampling involves drawing a sample of a population in such a way that all possible samples of a fixed size *n* have the same probability of being selected (De Vos *et al*., 2005: 196-197). However, the total dropout population group was divided into Intro students and direct students, which classified the method used as strategic sampling.

Stratified random sampling is suitable for heterogeneous populations because the inclusion of a small sub-group percentage wise can be ensured (Van Der Walt, 1984: 78). Stratification involves the universe being divided into a number of strata, which are mutually exclusive. The members of each stratum are homogeneous with regard to some characteristic such as gender, home language or age, or, as in the case of this study, dropouts from the diploma programmes (De Vos *et al*., 2005: 200; Glicken, 2003: 180; Mitchell & Jolley, 2001: 497; Singleton, Straits, Straits & McAllister, 1988: 145). This type of sampling is mainly used to ensure that the different groups of a population acquire sufficient representation in the sample (Chadwick, Bahr & Albrecht 1984: 59; Nachmias & Nachmias, 1981: 434). The desired number of individuals was then selected proportionally within each of the different strata. This implies drawing each sample according to the number of individuals in the stratum.

Therefore, Phase 2 of the study required larger samples (316) from the larger strata (3 707), and smaller samples (24) from the smaller strata (108). Selection within both strata still occurred randomly. Hoinville, Jowell and associates (1978: 62) refer to this sampling method as proportional stratification.

4.4.3 Data Analysis

Results from the formal academic assessments were obtained from the VUT's ITS, which was used to obtain objective numerical data for Phase 1 of the study. A comparison between subjects passed (above 50 percent) and subjects failed (below

50 percent) determined if the experimental group, who were exposed to the Intro SET programme, passed their subjects more frequently than the comparison group who entered the diploma programme directly after completion of the National Senior Certificate.

The graduation results, also obtained from the ITS, were used to compare the graduation ratio between the two groups. This complemented the statistics obtained from the academic results. It was necessary to investigate the individual subject passes, as not all the students from the Intro or direct groups had completed their studies yet.

The final comparison in Phase 1 of the study was to determine if the Intro group dropout ratio equalled that of the direct group. Only students who enrolled for the diploma programme for the first time (no repeaters) were taken into consideration in order to obtain a true comparison between the two groups.

Results from the administered questionnaire survey were used to obtain data for Phase 2 of the empirical study, which sought to establish why students dropped out of the diploma programmes. First-year dropout students answered additional questions in order to establish if they had attempted any form of investigation regarding information available about higher education institutions prior to enrolling for the diploma programmes. The questionnaire not only determined why the students dropped out, but also if an introduction programme would have made a difference in their choice to drop out of the diploma programmes. Comparisons between the trends that emerged from the literature review, the quantitative and the qualitative data provided for some form of triangulation.

4.4.4 Triangulation

According to Tashakkori and Teddlie (1998: 18), triangulation techniques evolved from the pioneers Campbell and Fiske (1959: 81-105), who used more than one quantitative method to measure a psychological trait, a technique that they called the multi-trait-multi-method matrix. Padgett (1998: 32) describes triangulation in qualitative research as the convergence of multiple perspectives, which can provide greater confidence that what is being targeted is being accurately captured.

However, there are no guidelines on the practical application of the principle of triangulation. Denzin (1978) originally defined the term triangulation and provided a description of four different types of triangulation methods.

The study comprised multiple quantitative data collection and analysis, supported by qualitative data. Priority was given to quantitative data, while qualitative data was primarily used to strengthen the argument and to support the obtained quantitative data. Data collection was connected, and integration occurred at the data interpretation stage as well as in the discussion.

The typical methodological triangulation method denotes the use of multiple methods to study a single topic, combining quantitative and qualitative methods in a single study (Padgett, 1998: 97). This is one of four types of triangulation methods, as described by Denzin and applied throughout this study.

The triangulation of the data aimed to provide scientific support for claims that the Intro SET programme was successfully implemented and that it can serve as a basis for formulating a curriculum framework for introduction programmes at higher education institutions.

4.4.5 Consent and confidentiality

The subjects who qualified to be participants were assured of confidentiality throughout the study. All subjects were protected from identification, since names and student numbers were omitted from the published results of the study. All participants answering the questionnaire were informed that their contribution was on a voluntary basis and that their responses would be treated with the strictest of confidence.

The questionnaire required the student's student number, strictly in order to divide the participant responses into the different strata (Intro or direct dropout students). The exercise confirmed the findings of Dixon (1989: 39), who noted that when respondents experienced a sense of anonymity, they are more willing to provide reliable information in a questionnaire survey. No student refused to complete the questionnaire.

The survey questionnaire was the measuring instrument used during Phase 2 of the study, and it was tested for validity and reliability. The next section discusses the methodologies applied to ensure the validity and reliability of the questionnaire.

4.4.6 Validity and reliability

According to Babbie (2004: 143), validity refers to the extent to which an empirical measure accurately reflects the concept it is intended to measure. In other words, the validity of the measurement of a procedure is the degree to which the measurement process measures the variable it claims to measure (Gravetter & Forzano, 2003: 87).

Here two aspects were considered: that the instrument actually measures the concept in question, and that the concept is measured accurately. It was important to measure the concept in question, as accuracy cannot be obtained if another concept is measured instead.

The measuring instrument should do what it is intended to do and the instrument may have several purposes, which vary in number, kind and scope (De Vos *et al*., 2005: 160). The most common classification scheme attempting to categorise the validity underlying measurement is content, face, criterion and construct validity. According to Monette *et al*. (2002: 115), it has to do with whether the measuring device covers the full range of meanings or forms that would be included in a variable being measured. A valid measuring device provides an adequate sample of all content or elements of the phenomenon being measured. To determine content validity, two questions were asked: Does the measuring instrument really measure the reasons, other than the academic performance of students, for student dropout from the diploma programmes? Does the instrument provide an adequate sample of items that represent the reasons, other than the academic performance of students, for student dropout from the diploma programmes?

Gravetter and Forzano (2003: 87) suggest that face validity is the simplest and least scientific definition of validity. It concerns the superficial appearance or face value of a measurement procedure. The relevant question in this regard was as follows: Does the measurement technique look as if it measures the reasons, other than the

academic performance of students, for students dropping out of the diploma programmes?

Criterion validity moves away from subjective assessment of face validity and provides evidence of validity that is more objective. This involves multiple measurements and is established by comparing scores on an instrument with an external criterion that is known to, or believed to, measure the concept being studied (De Vos *et al*., 2005: 161).

Construct validity is perhaps the most difficult validation to achieve because it involved determining the degree to which the instrument successfully measures the theoretical construct. As a construct cannot be seen, felt or heard, and cannot be measured directly and its existence must therefore be inferred from the evidence at hand. For example, Mouton and Marais (1990: 66) ask if isolation and powerlessness really are dimensions of alienation and therefore valid measurements of the construct alienation.

Construct validation is a lengthy, involved procedure, which uses data from a variety of sources. The relevant question in this regard was: How well does the questionnaire measure the reasons, other than the academic performance of students, for students dropping out from the diploma programmes?

In all cases, it was essential for the constructed questionnaire in its semi-final format to be thoroughly pilot-tested before utilising it in the main investigation. This ensured that any errors could be rectified immediately at little cost.

No matter how effective the sampling or analysis of the results, ambiguous questions contribute to non-comparable responses, leading questions contribute to biased responses, and vague questions contribute to vague answers (Ginsberg, 2001; Glicken, 2003; Henning, Van Rensburg & Smit, 2004; De Vos *et al*., 2005: 172). In this regard, Babbie (2004: 256) recommends that it is better to invite individuals to complete the questionnaire, rather than only to read it looking for errors. All too often, a question seems to make sense on a first reading, but it proves to be impossible to answer.

Only after the necessary modifications have been made following the pilot test should the questionnaire be presented to the full sample (De Vos *et al*., 2005: 172). Pilot testing a survey instrument consists of trying it out on a small number of individuals that have similar characteristics to those of the target group of respondents. However, the pilot test should not include anyone from the actual target group (De Vos *et al*., 2005: 70). Therefore, informal testing was the first step taken in refining the questionnaire.

The preliminary questionnaire was subjected to the scrutiny of a panel of colleagues and specialists who are familiar with the nature and scope of the study. To address face and content validity, five individuals, specialising in the field of engineering education, received questionnaires. Rubin and Babbie (2001: 194) state that content validity is established based on judgements.

The researcher and other experts made judgements about whether the measured criteria covered the universe of facets that made up the concept. Monette *et al*. (2002: 115) refer to this aspect as 'just opinion' and emphasise that although it is still subjective, it implies that there are more individuals to serve as a check on bias or misinterpretation and therefore jury opinion is superior to using individual tests of content validity.

The reliability of a measurement procedure is the consistency of the measurement. This refers to a measuring instrument's ability to yield consistent numerical results each time it is applied; results that do not fluctuate unless there are variations in the variable being measured (Creswell, 1998; Gravetter & Forzano, 2003: 91; Monette *et al*., 2002: 117). In other words, if the same variable was to be measured under the same conditions, a reliable measurement procedure produces almost identical measurements. High reliability does not guarantee valid results, but there can be no valid results without reliability (Bostwick & Kyte, 1981: 120-121).

As suggested by Denscombe (2001a: 93; 2001b: 170), the dropout students were briefed in the classroom regarding the purpose of the questionnaire and instructed on how to answer the questions. During the analysis of the pilot-test group responses (10 dropout students who did not participate in the sample group), it became clear that more space was needed to be provided for the open-ended

questions to be answered. This problem was rectified before administering the questionnaire to the sample group.

In summary, the measuring instrument used for Phase 2 of the study was in the form of a self-administered questionnaire survey to determine the reasons, other than academic performance, for student dropout from the diploma programmes. There was more than one external independent criterion against which to compare the score on the administered questionnaire. The external criterion used was deemed valid and reliable, as financial, health and/or environmental issues could be valid reasons for dropping out of the diploma programmes. The questionnaire tested reliably when responses of the sample group were compared to the pilot-test group responses.

4.5 CONCLUSION

This chapter provided an overview of the paradigmatic approaches applied in the study. Different arguments regarding quantitative and/or qualitative approaches towards data collection have been discussed. It was hereby established that both quantitative and qualitative data collection approaches seek to contribute to the body of knowledge that allows the use of generalisations to benefit educational and social practices. The case study, rather than using large samples and following a rigid protocol to examine a limited number of variables, involved an in-depth, longitudinal examination of the single case studied at the VUT.

During the design and methodological stages, it was established, by means of a theoretical framework, that the first phase of the study determined if the Intro students performed better academically than the direct students. In order to obtain data for the first phase, the comparison group post-test only design was pursued. The selection criteria for both the Intro group and the direct group were identical. Both groups' selection criterion was the enrolment into the diploma programme between Semester 2 of 2002 and Semester 1 of 2007. The only variance between the two groups was the fact that the Intro group was exposed to the Intro SET programme (2002 - 2006) before enrolment into the diploma programmes at the VUT. Results from the formal academic assessments were obtained from the VUT's ITS, which was used to obtain objective numerical data.

It was also established that the second phase of the study determined the reasons (other than academic performances) why the diploma students dropped out of the programmes. The questionnaire survey was constructed by utilising a dendrogram that defined the conceptual framework for Phase 2 of the empirical study from which the questions were constructed. Likert-scale response questions were utilised to gather data on attitudes and perceptions, while open-ended questions were utilised to learn how the respondents think and to discover what was actually important to them.

A triangulation approach was used to improve the validity in the study, as it enhanced the rigour of both the quantitative and qualitative data. The study comprised multiple quantitative data collection and analysis, supported by qualitative data. Priority was given to quantitative data, while qualitative data was primarily used to strengthen the argument and to support the obtained quantitative data. Data collection was connected, and integration occurred at the data interpretation stage as well as in the discussion.

The analysis of the data generated through the application of the research methods, which follows in Chapter 5 and Chapter 6, sheds light on the situation analysis to determine the need for the introduction programme at the VUT. It also motivated the subsequent development of a curriculum framework for introduction programmes at higher education institutions, in line with the aim of the study.

The next chapter deals with the results from Phase 1 of the study, obtained from the VUT's ITS, the statistical analysis of the data and a summative discussion of the findings.

CHAPTER 5

PHASE 1: STUDENT PERFORMANCE RESULTS

5.1 INTRODUCTION

The objectives of the empirical study were determined (see Chapter 1) and Phase 1 of the study was guided by the sub questions, which were set to answer the main research question: *What comprises a curriculum framework aimed at prospective engineering students at the VUT?*

The goals of Phase 1 of the empirical part of the study were to determine whether:

- Intro students passed their academic subjects more frequently than the direct students;
- Intro student dropout percentage ratio equalled that of the direct student dropout percentage ratio; and
- Intro students graduated at a better percentage ratio than the direct students.

The data was obtained from the VUT's ITS between the second semester of 2002 and the first semester of 2007, resulting in a time frame of five years. The generated data were statistically analysed and descriptions of the findings are provided next.

5.2 ACADEMIC PERFORMANCE RESULTS

The study concentrated on those students who were unsuccessful with their applications for access into the higher education system, but who demonstrated potential in becoming successful higher education students within the study field of engineering. The focus of the EIP was on the acquisition of life, numeric, computer and language skills, together with the academic resources required to enrich and competently upgrade prospective engineering students with a NQF Level 4 qualification to an acceptable level for entrance into the VUT's engineering diploma programmes (HEQF Level 5). Intro students were rejected diploma students, who normally would have been referred to other institutions within the FET band to obtain a qualification. These students had poor Grade 12 results but had the potential to

complete the Intro SET programme successfully and, thereafter, re-apply for the diploma programmes. If the Intro students performed better than direct students within their academic diploma programmes, the focus of the study has been completed, and a sound curriculum framework for an EIP programme can be formulated to conclude the rationale of the study.

The first tributary data obtained in Phase 1 was the academic performance of both the Intro students and direct students on the identified complicated subjects of Mathematics 1 and Electrical Engineering 1. The ratio between those students who passed after their first attempt and those who took several attempts before passing established if a higher percentage of Intro students passed these subjects with fewer attempts compared to the direct students.

5.2.1 The subject: Mathematics I

The aim was to determine if the Intro students performed better academically than the direct students in the subject of Mathematics I. The results serve as an indication of whether the Intro SET subject of mathematics supported the subject of Mathematics I in the mainstream diploma programmes. The number of attempts for Intro students and direct students before passing the subject Mathematics I are listed in Table 5.1.

TABLE 5.1: Number of attempts for Intro students and direct students before passing the subject Mathematics I

NUMBER OF ATTEMPTS BEFORE PASSING MATHEMATICS I									
	Type	1	2	3	4	5	6	7	ROW TOTAL
COUNT	Direct	3009	765	173	31	8	4	1	3991
ROW %		75.39	19.17	4.33	0.78	0.20	0.10	0.03	100
COUNT	Intro	82	47	16	4	0	0	0	149
ROW %		55.03	31.54	10.74	2.68	0.00	0.00	0.00	99.99
COLUMN TOTAL		3091	812	189	35	8	4	1	4140

H_0 - Represents the number of attempts required to pass the subject of Mathematics I and was *independent* of whether the student was an Intro student or direct student.

H_A - Represents the number of attempts required to pass the subject of Mathematics I and was *dependent* on whether the student was an Intro student or direct student.

Pearson's χ^2 (chi-square) test $\chi^2 = 38.76263$ df = 6 p = .00000

Pearson's chi-square test proves that the number of attempts required for passing Mathematics I was *statistically independent* of whether the student was an Intro student or a direct student. Results are graphically depicted in Figure 5.1.

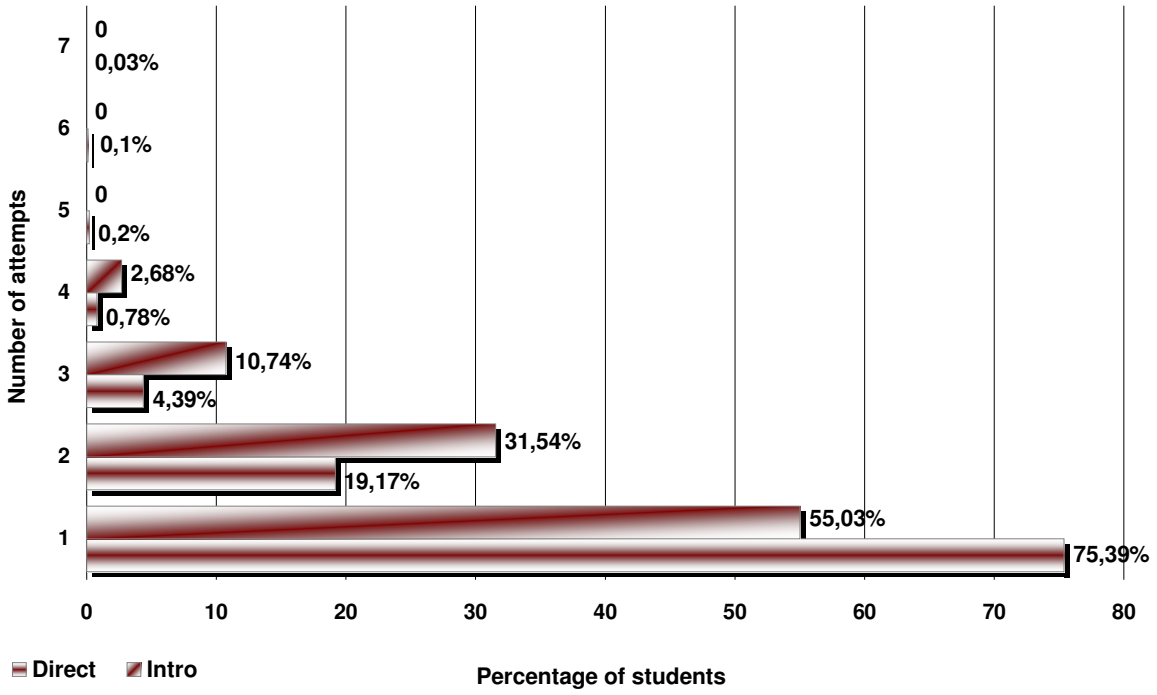

FIGURE 5.1: Number of attempts for Intro students and direct students before passing the subject Mathematics I

This result indicates that a higher percentage (20,35%) of direct students (75,39%) passed the subject of Mathematics I the first time around than of Intro students

(55,04%). After the second attempt, the majority of direct students (94,56%) and Intro students (86,57%) passed the subject of Mathematics I.

A $p \leq 0.05$ proves that there was a *statistical dependence*, and that the H_A is true. This is a *negative* result. It was assumed that the *direct* students performed academically *better* in the subject of Mathematics I than the Intro students. However, *Intro* students needed *fewer* attempts to pass the subject of Mathematics I than direct students needed.

This result indicates that the Intro SET subject of mathematics had *no effect* on the subject of Mathematics I in the mainstream diploma programmes. The implication of this result suggests that the Intro SET subject of mathematics has to be examined in order to determine if the curriculum needs to be revised. Alternatively, it is necessary to determine if the teaching and learning constructs were correctly applied.

5.2.2 The subject: Electrical Engineering I

The aim was to determine if the Intro students performed academically better in the subject of Electrical Engineering I than the direct students. The result serves as an indication of whether the Intro SET subject of science supported the subject of Electrical Engineering I in the mainstream diploma programmes. The number of attempts for Intro students and direct students before passing the subject Electrical Engineering I are listed in Table 5.2.

TABLE 5.2: Number of attempts of Intro students and direct students before passing the subject Electrical Engineering I

NUMBER OF ATTEMPTS BEFORE PASSING THE SUBJECT OF ELECTRICAL ENGINEERING I										
	TYPE	1	2	3	4	5	6	7	8	ROW TOTAL
COUNT	Direct	1969	1007	399	119	30	12	6	3	3545
ROW %		55.54	28.41	11.26	3.36	0.85	0.34	0.17	0.08	100
COUNT	Intro	52	39	12	3	0	0	0	0	106
ROW %		49.06	36.79	11.32	2.83	0.00	0.00	0.00	0.00	100
COLUMN TOTAL		2021	1046	411	122	30	12	6	3	3651

H_0 - Represents the number of attempts required to pass the subject of Electrical Engineering I and was *independent* of whether the student was an Intro student or a direct student.

H_A - Represents the number of attempts required to pass the subject of Electrical Engineering I and was *dependent* on whether the student was an Intro student or a direct student.

Pearson's χ^2 (chi-square) test $\chi^2 = 4.919609$ df = 7 p = .66977

Pearson's chi-square test proves that the number of attempts required for passing the subject of Electrical Engineering I was *statistically dependent* of whether the student was an Intro student or a direct student, and that the H_A is true. This is a *positive* result. Results are graphically depicted in Figure 5.2.

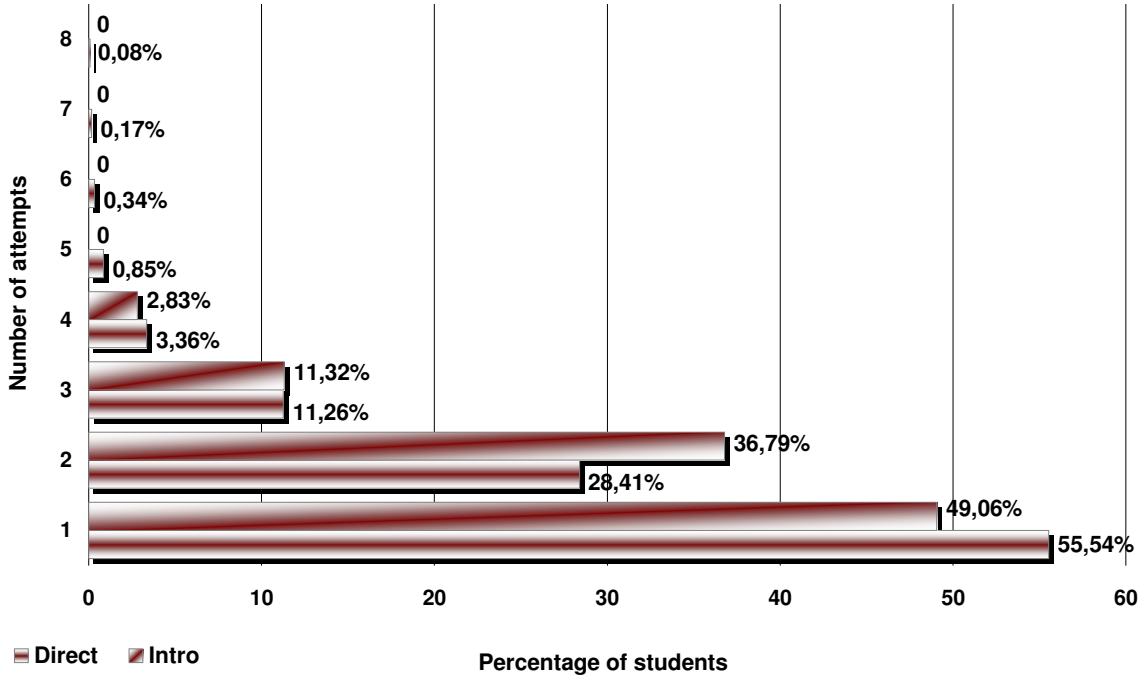

FIGURE 5.2: Number of attempts of Intro students and direct students before passing the subject Electrical Engineering I

This result indicates that the percentage of direct students passing the subject of Electrical Engineering I the first (55,54%) and second (28,41%) time differed from

the percentage of Intro students passing the subject of Electrical Engineering I the first (49,06%) and second (36,79%) time. Although some Intro students did not pass the subject Electrical Engineering I on their first attempt (6,48%), they performed academically better than direct students on their second attempt (8,38%).

A $p > 0.05$ proves that there was a *statistical dependence*, and that the H_A is true. This is a *positive* result. It was assumed that the *Intro* students performed academically *better* in the subject of Electrical Engineering I than the direct students. The *Intro* students also needed *fewer* attempts to pass the subject of Electrical Engineering I than the direct students needed. This result indicates that the Intro SET subject of science had a *positive effect* on the subject of Electrical Engineering I in the mainstream diploma programmes.

5.2.3 The overall academic performance

The aim here was to determine if the Intro students performed academically better or at least as well as direct students, over the five-year period, regarding the overall examinations completed. The result serves as an indication of whether the Intro SET subjects supported the subjects of the mainstream diploma programmes. The overall examinations completed by the Intro students and the direct students are listed in Table 5.3.

TABLE 5.3: Overall examinations completed by the Intro students and direct students

OVERALL EXAMINATIONS COMPLETED				
	TYPE	TOTAL NUMBER OF EXAMINATIONS WRITTEN	TOTAL NUMBER OF EXAMINATIONS PASSED	TOTAL NUMBER OF EXAMINATIONS FAILED
COUNT	Direct	139,552	102,073	37,479
ROW %		100	73	27
COUNT	Intro	3,940	2,752	1,188
ROW %		100	70	30
COLUMN TOTAL		143,942	104,825	38,667

H_0 - Represents the number of examinations passed and was *independent* of whether the student was an Intro student or a direct student.

H_A - Represents the number of examinations passed and was *dependent* on whether the student was an Intro student or a direct student.

Pearson's χ^2 (chi-square) test $\chi^2 = 0.692$ df = 1 p = .405354

Pearson's chi-square test proves that the number of examinations passed did *not depend* on whether the student was an Intro student or a direct student.

Results are graphically depicted in Figure 5.3.

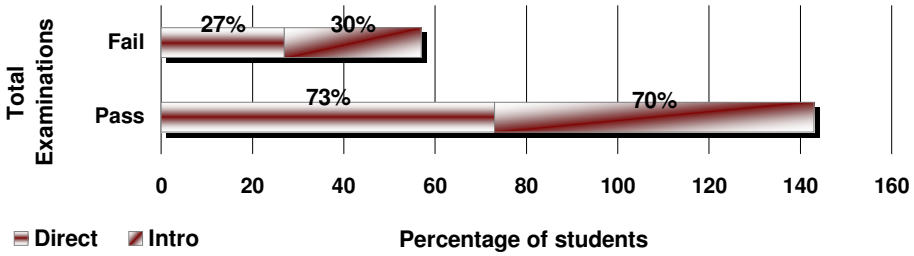

FIGURE 5.3: Overall examinations completed by the Intro students and direct students

This result indicates that there was *no statistical difference* between the percentage of examinations that the direct students passed (73%) versus the percentage of examinations that the Intro students passed (70%).

This result provides support for the argument that the Intro students performed *at least as well* as the direct students.

This is a *positive* result. It was assumed that the *Intro* students performed academically *as well as* direct students. This result indicates that the Intro SET subjects of mathematics, science, language literacy and computer literacy had a *positive effect* on the subjects in the mainstream diploma programmes.

5.3 DROPOUT RESULTS

The aim here was to determine if the Intro students' dropout rate was equal to that of the direct students. The dropout ratio between Intro students and direct students is given in Table 5.4.

TABLE 5.4: Dropout ratio between Intro students and direct students

DIPLOMA PROGRAMMES - DROPOUTS				
	TYPE	DROPPED OUT	CONTINUED	ROW TOTALS
COUNT	Direct	3707	2679	6386
ROW %		58.05	41.95	100
COUNT	Intro	108	93	201
ROW %		53.73	46.27	100
COLUMN TOTAL		3815	2772	6587

H_0 - Represents the number of dropout students and was *independent* of whether the student was an Intro student or direct student.

H_A - Represents the number of dropout students and was *dependent* on whether the student was an Intro student or direct student.

Pearson's χ^2 (chi-square) test $\chi^2 = 1.49$ df = 1 p = .222163

Pearson's chi-square test proves that the number of dropout students did *not depend* on whether the student was an Intro student or a direct student.

This result indicates that there was *no statistical difference* between the percentage of direct students (58,05%) dropping out of the diploma programmes and the percentage of Intro students (53,73%) dropping out of the diploma programmes. This result provides support for the argument that the *Intro* students performed at least *as well as* the direct students within the diploma programmes. This is a *positive* result.

Results are graphically depicted in Figure 5.4.

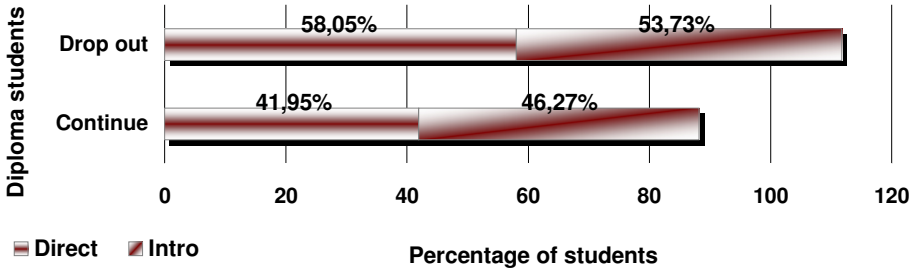

FIGURE 5.4: Dropout ratio between Intro students and direct students

It was assumed that the *Intro* students dropped out of the diploma programmes *as much* as the direct students did. This statistically supports the results that the Intro students performed as well as the direct students within the academic diploma programmes. However, there was a small, but *positive*, percentage difference (4,32%) in Intro students continuing with the diploma programmes. The reasons for dropping out of the diploma programmes are dealt with in Chapter 6.

5.4 GRADUATION RESULTS

The study aimed at assessing whether the EIP has been well conceptualised and properly implemented. Effective measures towards student support and effective student learning had to be maintained, especially among under-prepared students, and the findings of the graduation results aspired to provide additional insights into developing teaching and learning strategies, as well as curricula to address these challenges.

The aim here was to determine if the Intro students performed better academically than the direct students over the five-year period, in order to formulate a sound programme framework to be utilised by other higher education institutions, in addition to the VUT.

The graduation rates of the Intro students and direct students are listed in Table 5.5.

TABLE 5.5: Academic progress of Intro students and direct students

ACADEMIC PROGRESS 2002 - 2006				
	TYPE	GRADUATED	HAVE NOT GRADUATED	ROW TOTALS
COUNT	Direct	736	5650	6386
ROW %		11.53	88.47	100
COUNT	Intro	27	174	201
ROW %		13.43	86.57	100
COLUMN TOTAL		765	5824	6587

H_0 - Represents the number of graduates and was *independent* of whether the student was an Intro student or a direct student.

H_A - Represents the number of graduates and was *dependent* on whether the student was an Intro student or a direct student.

Pearson's χ^2 (chi-square) test $\chi^2 = 0.692$ df = 1 p = .405354

Pearson's chi-square test proves that the number of graduates did *not depend* on whether the student was an Intro student or a direct student. This result indicates that there was *no statistical difference* between the percentage of the direct students graduating in the academic diploma programmes and the percentage of the Intro students graduating in the academic diploma programmes. Results are graphically depicted in Figure 5.5.

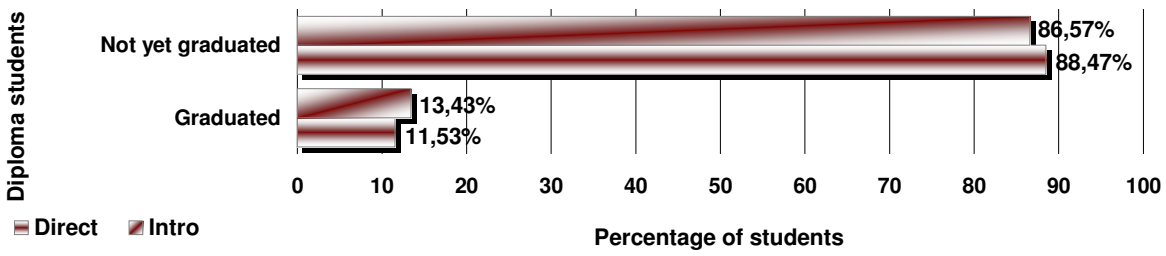

FIGURE 5.5: Graduation ratio between Intro students and direct students

This result provides support for the argument that the Intro students performed *at least as well* as the direct students. This is a *positive* result. It was assumed that the *Intro* students graduated from the diploma programmes *at the same rate* as the direct students. This statistically supports the results that the Intro students performed as well as the direct students within the academic diploma programmes.

However, there was a small, but *positive*, percentage difference (1,90%) in Intro students graduating from the diploma programmes. Therefore, it can be assumed that the EIP has been well conceptualised and properly implemented and that a sound programme framework can be formulated to conclude the rationale of the study.

5.5 CONCLUSION

This chapter presented the results of the quantitative data analysis. Data were generated from the VUT's ITS in order to complete the first phase of the study. Descriptive statistics were used in analysing the data.

The higher education sector has to widen access opportunities for students, but not all applicants are suitable in regards to the entrance requirements of higher education institutions. The analysis concentrated on those students who were unsuccessful with their applications to the VUT, but who showed potential in becoming successful higher education students within the study field of engineering.

With respect to this section of the study, the following results were obtained from the data:

- The results indicate that the *direct* students performed academically *better* in the subject of Mathematics I than the Intro students. It was assumed that the Intro SET subject of mathematics had *no effect* on the subject of Mathematics I in the mainstream diploma programmes. However, the *Intro* students needed *fewer* attempts to pass the subject of Mathematics I than the direct students needed.
- The results indicate that the *Intro* students performed academically *better* in the subject of Electrical Engineering I than the direct students. The *Intro* students also needed *fewer* attempts to pass the subject Electrical Engineering I than the

direct students needed. It was assumed that the Intro SET subject of science had a *positive effect* on the subject of Electrical Engineering I in the mainstream diploma programmes.

- The results indicate that the *Intro* students performed academically *as well as* the direct students. It was assumed that the Intro SET subjects of mathematics, science, language literacy and computer literacy had a *positive effect* on the subjects of the mainstream diploma programmes.
- The results indicate that the *Intro* students dropped out of the diploma programmes *as much* as the direct students did. This statistically supports the results that the Intro students performed as well as the direct students within the academic diploma programmes. However, there was a small, but *positive*, percentage difference in the Intro students continuing with the diploma programmes.
- The results indicate that the *Intro* students graduated from the diploma programmes *at the same rate* as the direct students. This statistically supports the results that the Intro students performed as well as the direct students within the academic diploma programmes. However, there was a small, but *positive*, percentage difference in the Intro students graduating from the diploma programmes. Therefore, the results indicated positively that the EIP had been well conceptualised and implemented and that an acceptable level of confidence was established. This provided a platform for looking into possibilities for a curriculum framework, which was the main aim of the study.

The next chapter deals with the quantitative and qualitative data generated from the questionnaire survey, in order to determine the reasons why students tend to drop out of the diploma programmes.

CHAPTER 6

PHASE 2: QUESTIONNAIRE RESULTS

6.1 INTRODUCTION

Phase 2 of the study was guided by the sub question why diploma students drop out of the programme. The aim of Phase 2 was therefore to determine whether diploma students dropped out of the programme due to reasons other than their academic performance.

This chapter presents the results obtained from the questionnaire survey completed by the students that dropped out of the diploma programmes. The frequency tables contain data divided into the Intro student and direct student strata (see Chapter 4, Section 4.4.2). The graphical representation depicts the data for the entire group of students that dropped out of the diploma programmes, as set out in the conceptual framework (see Chapter 4, Section 4.3). The analyses and descriptions of the findings, as well as summative discussions thereof, are provided.

6.2 BIOGRAPHICAL INFORMATION

This section of the questionnaire contained questions regarding the biographical information of the dropout diploma students. The information forms an integral part of the empirical study, as the information regarding the students' study levels at dropout, diploma programmes they were registered for, age categories and gender were determined. Information gathered from this section of the questionnaire was referred to as explanatory variables, as these variables contained information that was unique to each participant.

The researcher assumed that the majority of diploma programmes dropouts occurred within the first year of study. This assumption was made because of the feedback received from the interviews with other lecturers teaching engineering-related subjects on first-year level, who confirmed that first-year students tended to be under prepared (see Chapter 2, section 2.4.4). Table 6.1 lists the data generated

in order to establish at what study level of the diploma programmes the students dropped out. The category descriptors in Table 6.1 read as follows; S1 (Semester 1), S2 (Semester 2), S3 (Semester 3), S4 (Semester 4) and P2 (Practical 2 of WIL).

TABLE 6.1: Study level at dropout

FREQUENCY TABLE: STUDY LEVEL AT DROPOUT					
TYPE	CATEGORY	COUNT	CUMULATIVE COUNT	PERCENT	CUMULATIVE PERCENT
INTRO	S1	24	24	100.00	100.00
	Missing	0	24	0.00	100.00
DIRECT	S1	208	208	65.82	65.82
	S2	36	244	11.39	77.21
	S3	43	287	13.61	90.82
	S4	18	305	5.70	96.52
	P2	3	308	0.95	97.47
	Diploma	8	316	2.53	100.00
	Missing	0	316	0.00	100.00

These results are graphically depicted in Figure 6.1.

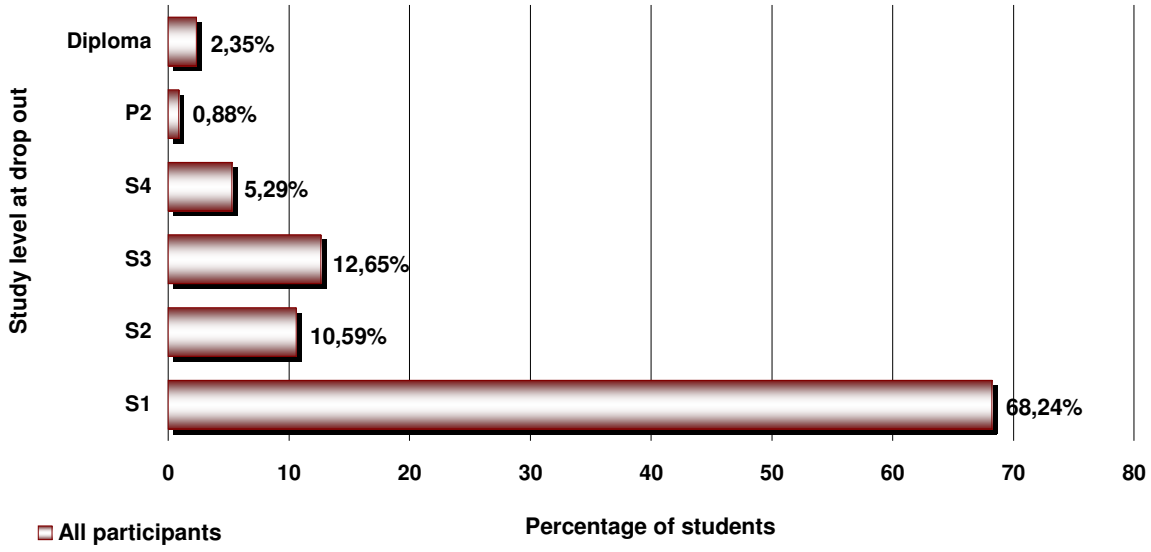

FIGURE 6.1: Study level at dropout

Most of the students (68,24%) dropped out during the first year of their studies. This problem had been experienced by other higher education institutions and was explored in the literature study (see Chapter 3, Section 3.4.2). There are different programmes available within the engineering study field at the VUT. The obtained data for the programmes within the engineering study fields for which the students were registered for at the time of dropout are listed in Table 6.2.

TABLE 6.2: Diploma programmes registered for at dropout

FREQUENCY TABLE: DIPLOMA PROGRAMMES REGISTERED FOR AT DROPOUT					
TYPE	CATEGORY	COUNT	CUMULATIVE COUNT	PERCENT	CUMULATIVE PERCENT
INTRO	Chemical	3	3	12.50	12.50
	Civil	6	9	25.00	37.50
	Industrial	3	12	12.50	50.00
	Electronics	3	15	12.50	62.50
	Mechanical	4	24	16.67	79.17
	Power	5	20	20.83	100.00
	Missing	0	24	0.00	100.00
DIRECT	Chemical	23	23	7.28	7.28
	Civil	15	38	4.75	12.03
	Computer	31	69	9.81	21.84
	Industrial	10	79	3.16	25.00
	Electronics	63	142	19.94	44.94
	Instrumentation	5	147	1.58	46.52
	Mechanical	33	284	10.44	56.96
	Metallurgy	9	293	2.85	59.81
	Power	104	251	32.91	92.72
	Missing	23	316	7.28	100.00

Most of the direct students were registered for power engineering (32,91%), while most of the Intro students were registered for civil engineering (25%) during the time dropout occurred. It was expected that the majority of diploma dropout students

would fall within the 18 to 20 year old age group. It was assumed that the majority of students started with their higher education studies directly after completing their final secondary school year (Grade 12). The data generated from the information obtained regarding the age categories are listed in Table 6.3.

TABLE 6.3: Age categories

FREQUENCY TABLE: AGE CATEGORIES							
TYPE	CATEGORY	COUNT	CUMULATIVE COUNT	PERCENT	CUMULATIVE PERCENT	TYPE	CUMULATIVE COUNT
INTRO	18-20	24	24	100.00	100.00	All participants	340
	Missing	0	24	0.00	100.00		
DIRECT	18-20	168	168	53.16	53.16		192
	21-23	80	248	25.32	78.48		80
	24-26	51	299	16.14	94.62		51
	Older	17	316	5.38	100.00		17
	Missing	0	316	0.00	100.00		0.00

The results indicate that most of the students (56,47%) fell between the 18 to 20 year old age group. These results are graphically depicted in Figure 6.2.

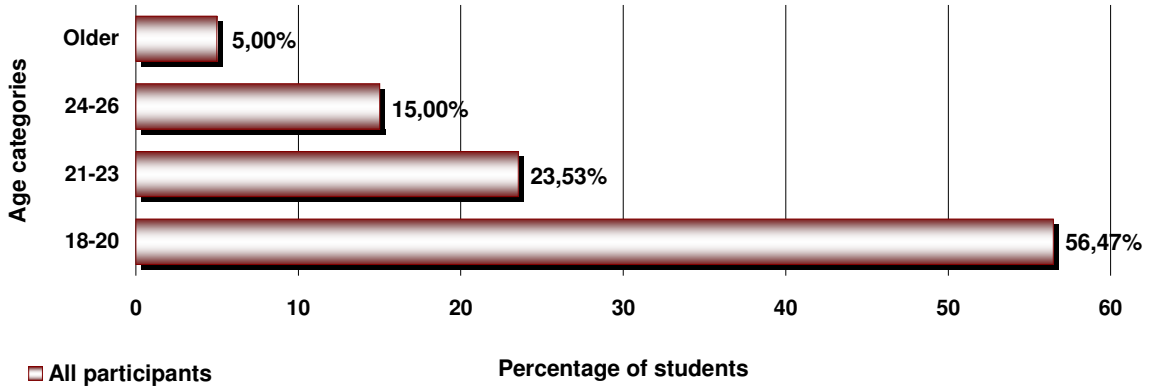

FIGURE 6.2: Age categories

During registration, a gender distribution of 70 percent male and 30 percent female was typically observed. Therefore, the same gender distribution was expected from

the participants. The data generated from the information obtained regarding gender distribution are listed in Table 6.4.

TABLE 6.4: Gender distribution

FREQUENCY TABLE: GENDER DISTRIBUTION					
TYPE	CATEGORY	COUNT	CUMULATIVE COUNT	PERCENT	CUMULATIVE PERCENT
INTRO	Male	19	19	79.17	79.17
	Female	5	24	20.83	100.00
	Missing	0	24	0.00	100.00
DIRECT	Male	225	225	71.20	71.20
	Female	91	316	28.80	100.00
	Missing	0	316	0.00	100.00

There were, as expected, more male (75,18%) than female (24,82%) participants who completed the questionnaire.

6.3 PRE-SELECTING HIGHER EDUCATION INSTITUTIONS

This section of the questionnaire was prepared as an instrument to determine if students explore the different types of higher education institutions available for further studies. The section was originally reserved for the first-year diploma dropout students, but participants that dropped out at other levels were not stopped from completing this section.

The section established if students explored all the higher education institutions available to them for further studies before enrolment into the diploma programmes; if students only explored universities or only universities of technology; or if students already pre-selected the higher education institution to study at after completion of their final school year. Thereafter, it was investigated if students had no other choice but to study at the VUT, and why those students that had a choice to study at any other higher education institution chose to enrol at the VUT. Data generated from this section should shed light on how the majority of prospective students chose the

higher education institution they preferred for further studies. Note that percentages of tables to follow do not always add to a 100 percent, due to rounding-off errors.

Internet allegedly made investigation attempts easier for prospective students, as the results indicated that most of the students (61,98%) attempted to explore all the different higher education institutions available for further studies. Table 6.5 lists the data generated in order to establish if students made an attempt to explore the different universities available for further studies.

TABLE 6.5: Universities explored before enrolment

FREQUENCY TABLE: UNIVERSITIES EXPLORED BEFORE ENROLMENT							
INSTITUTION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 25.8280		df = 3	p = .000010	
Universities	COUNT	Direct	27	79	138	41	285
	ROW %		9.47	27.72	48.42	14.39	100
	MISSING	31	8.54%	25.00%	43.67%	12.97%	90.18%
	COUNT	Intro	1	14	1	0	16
	ROW %		6.25	87.50	6.25	0.00	100
	MISSING	8	4.17%	58.33%	4.17%	0.00%	66.67%
	COUNT TOTALS		28	93	139	41	301

Some students (40,20%) attempted to explore universities. These statistics are graphically depicted in Figure 6.3.

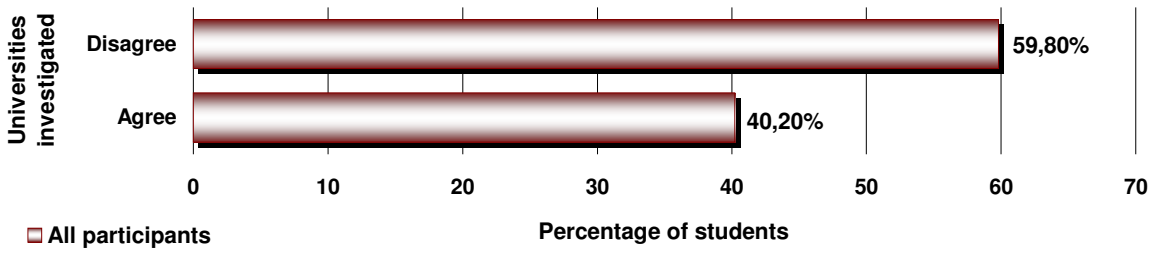

FIGURE 6.3: Universities explored before enrolment

Table 6.6 lists the data generated to establish if students explored the different universities of technology before enrolment.

TABLE 6.6: Universities of technology explored before enrolment

FREQUENCY TABLE: UOTS EXPLORED BEFORE ENROLMENT							
INSTITUTION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 21.3581		df = 3	p = .000089	
UoTs	COUNT	Direct	73	81	96	39	289
	ROW %		25.26	28.03	33.22	13.49	100
	MISSING	27	23.10%	25.63%	30.38%	12.34%	91.45%
	COUNT	Intro	0	4	19	1	24
	ROW %		0.00	16.67	79.17	4.17	100.01
	COUNT TOTALS		73	85	115	40	313

The results indicate that just over half of the students (50,48%) attempted to explore universities of technology. These statistics are graphically depicted in Figure 6.4.

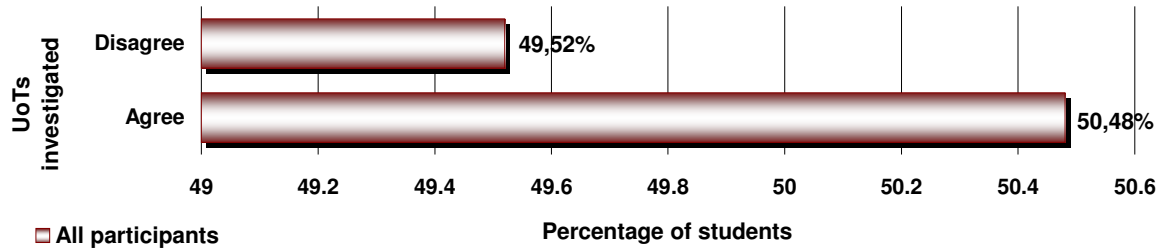

FIGURE 6.4: Universities of technology explored before enrolment

It was suspected that some students had pre-selected the higher education institution to study at. The results indicated that the majority of students (70,65%) knew at which higher education institution they wanted to continue with their studies.

Table 6.7 lists the data generated to establish how students knew at which higher education institution to study.

TABLE 6.7: How students knew where to study

FREQUENCY TABLE: HOW STUDENTS KNEW WHERE TO STUDY			
RESPONSE		**ALL PARTICIPANTS**	**CUMULATIVE TOTALS**
The students acted on word-of-mouth referrals	**COUNT**	150	150
	ROW %	44.12	44.12
The students investigated the different higher education institutions	**COUNT**	65	215
	ROW %	19.12	63.24
The students visited career and/or open days of the higher education institutions	**COUNT**	58	273
	ROW %	17.06	80.30
The students realised that their Grade 12 results were too poor to study at a university and had to attend a UoT	**COUNT**	45	318
	ROW %	13.24	93.54
Students had to study at the VUT as it was close to home	**COUNT**	22	340
	ROW %	6.47	100.01
	MISSING	0	340

These statistics are graphically depicted in Figure 6.5.

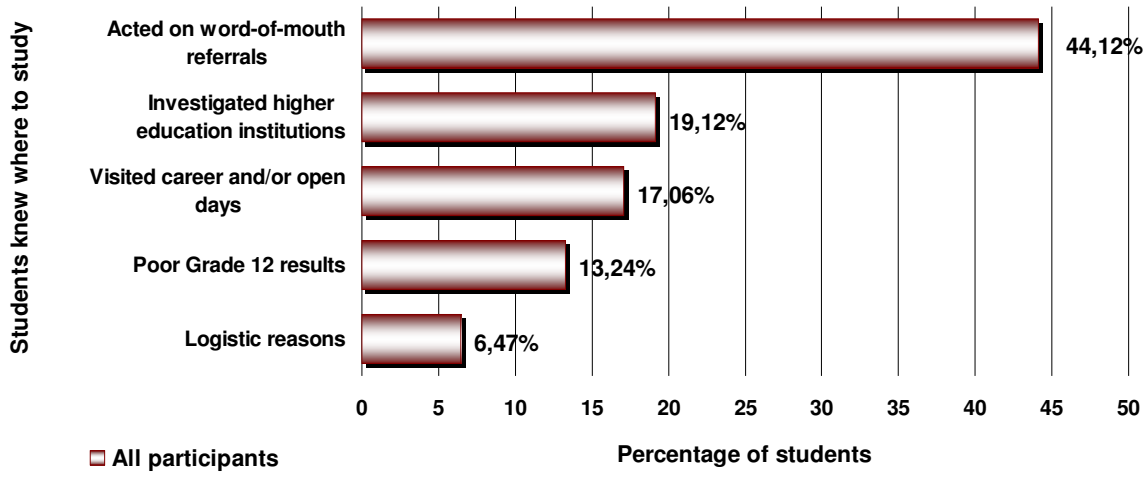

FIGURE 6.5: How students knew where to study

When asked how they knew at which higher education institution to continue with their studies, most of the students (44,12%) responded that it was 'word-of-mouth' referrals, some of the students (19,12%) responded that they knew at which higher education institution to continue with their studies due to their investigation of these institutions, others (17,06%) responded that they knew at which higher education institution to continue with their studies because they visited the career and/or open days of these institutions. A small percentage of students (13,24%) realised that their Grade 12 results were too poor to study at a university and that they had to investigate universities of technology to continue with their higher education studies. A few students (6,47%) knew at which higher education institution to continue with their studies because it was close to home. Here are some of the responses received:

"…My brother studied at VUT"

"…I visited some institutions website"

"…Career exhibitions for more information about national universities"

"…Matric results were not good enough for university, that's when I knew that I have to study in the college of technology"

Table 6.8 lists the data generated in order to establish if students had no other choice but to study at the VUT.

TABLE 6.8: No choice but to study at the VUT

FREQUENCY TABLE: NO CHOICE BUT TO STUDY AT THE VUT							
INSTITUTION		**TYPE**	**STRONGLY AGREE**	**AGREE**	**DISAGREE**	**STRONGLY DISAGREE**	**ROW TOTALS**
Pearson's χ^2 (chi-square) test			χ^2 = 23.1873		df = 3	p = .000037	
No Choice	**COUNT**	Direct	18	44	92	121	275
	ROW %		6.55	16.00	33.45	44.00	100
	MISSING	41	5.70%	13.92%	29.11%	38.29%	87.02%
	COUNT	Intro	1	4	19	0	24
	ROW %		4.17	16.67	79.17	0.00	100.01
	COUNT TOTALS		19	48	111	121	299

The results indicate that only a few students (22,41%) were restricted regarding the higher education institution of their choice. These statistics are graphically depicted in Figure 6.6.

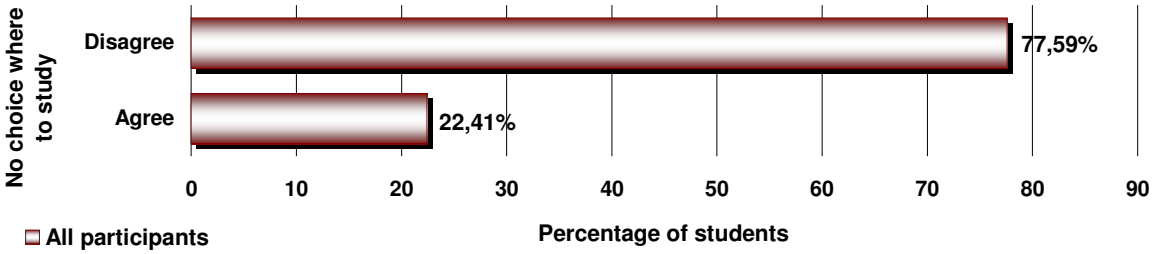

Figure 6.6: No choice but to study at the VUT

Table 6.9 lists the data generated to establish why students were restricted to study only at the VUT.

TABLE 6.9: Why students were restricted to study only at the VUT

FREQUENCY TABLE: WHY STUDENTS WERE RESTRICTED TO STUDY ONLY AT THE VUT			
RESPONSE		ALL PARTICIPANTS	CUMULATIVE TOTALS
The students applied after the closing date and were therefore late	COUNT	117	117
	ROW %	34.41	34.41
The students Grade 12 results were too poor to attend elsewhere	COUNT	117	234
	ROW %	34.41	68.82
The students experienced financial difficulties	COUNT	71	305
	ROW %	20.88	89.7
The students had to abide by parental decisions and attended the VUT	COUNT	24	329
	ROW %	7.06	96.76
	MISSING	11	340

When asked why they were restricted to study only at the VUT, the students responded that they applied late (34,41%), their Grade 12 results were too poor to

attend elsewhere (34,41%), they experienced financial difficulties (20,88%), and some students had to abide by parental decisions (7,06%). These statistics are graphically depicted in Figure 6.7.

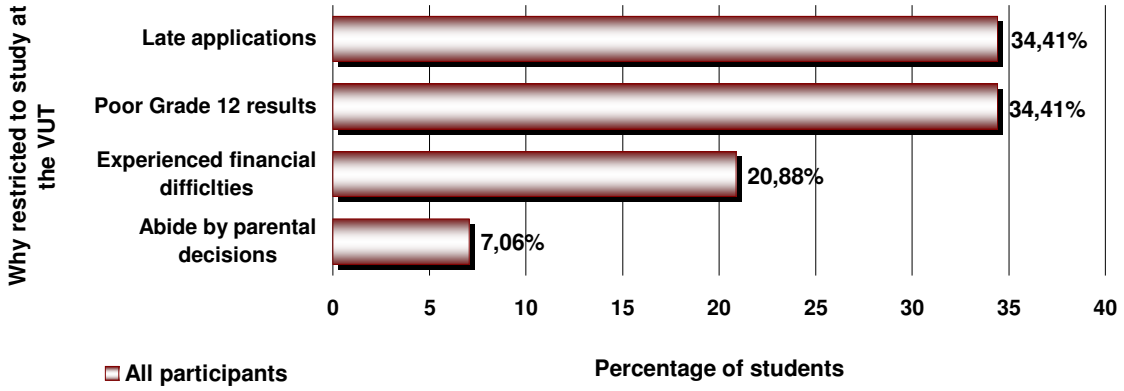

FIGURE 6.7: Why students were restricted to study only at the VUT

Restrictions owing to late registration or poor Grade 12 academic performance, which resulted in rejections by other higher education institutions were not identified as valid reasons regarding higher education institution restrictions. However, financial and parental constraints were identified as valid reasons for not having the freedom of choice to study at any given higher education institution. Here are some of the responses received:

"…Because I applied late"

"…Because other institutions did not accept me"

"…Poor matric results"

"…Because of insufficient funds"

"…My father said I won't study at DRN or CT"

It was suspected that the majority of students who had the freedom of choice to continue with their higher education studies at any given institution, did at first not choose to study at the VUT.

Table 6.10 lists the data generated in order to establish if students preferred to study, as a first choice, at the VUT.

TABLE 6.10: Freedom of choice available and preferred the VUT

FREQUENCY TABLE: FREEDOM OF CHOICE AVAILABLE AND PREFERRED THE VUT							
INSTITUTION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 33.1561		df = 3	p = .000000	
VUT	COUNT	Direct	27	75	96	71	269
	ROW %		10.04	27.88	35.69	26.39	100
	MISSING	47	8.54%	23.73%	30.38%	22.47%	85.12%
	COUNT	Intro	0	0	23	1	24
	ROW %		0.00	0.00	95.83	4.17	100
	COUNT TOTALS		27	75	119	72	293

As suspected, the results indicated that only a few students (34,81%) confirmed that the VUT was their first choice regarding higher education institutions available for further studies. These statistics are graphically depicted in Figure 6.8.

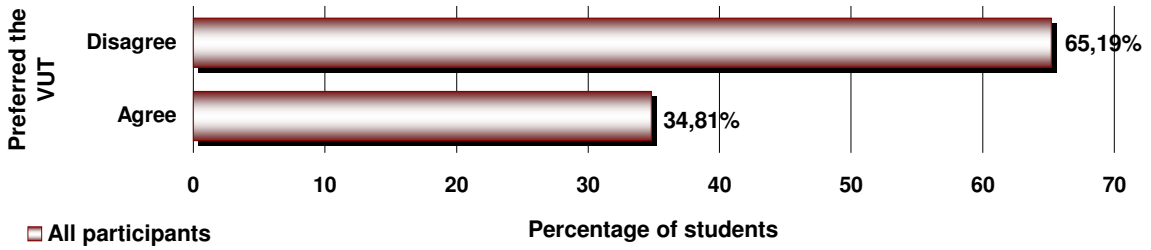

FIGURE 6.8: Freedom of choice available and preferred the VUT

The following responses were received regarding preference for other higher education institutions, as a first choice; University of Johannesburg (UJ) (38,45%), TUT (30,77%), UCT (6,15%), CPUT (6,15%), DUT (4,62%), Central University of Technology (CUT) (3,08%), UP (3,08%), North-West University (NWU) (3,08%), Nelson Mandela Metropolitan University (NMMU) (1,54%), University of South Africa (UNISA) (1,54%) and University of Limpopo (UL) (1,54%). These results established that the majority of students that attended lectures at the VUT originally preferred other higher education institutions as their first choice for further studies.

6.3.1 Summary of pre-selection of higher education institutions

To summarise, only a few students (22,41%) had no other choice but to attend classes at the VUT due to unsuccessful applications to other higher education institutions, personal, financial or logistic reasons. The minority of prospective students explored universities (40,20%), more students explored universities of technologies (50,48%), while the majority of students (61,98%) explored all the higher education institutions available for further studies. The minority students (34,81%) had the freedom of choice to continue with their higher education studies at any given higher education institution, but after unsuccessful application at the higher education institutions of their choice, were accepted at the VUT. Alleged negative attitudes experienced by students (57,22%) towards the institution negatively affect students' academic performance (see Chapter 3, Section 3.3.1).

These statistics are graphically depicted in Figure 6.9.

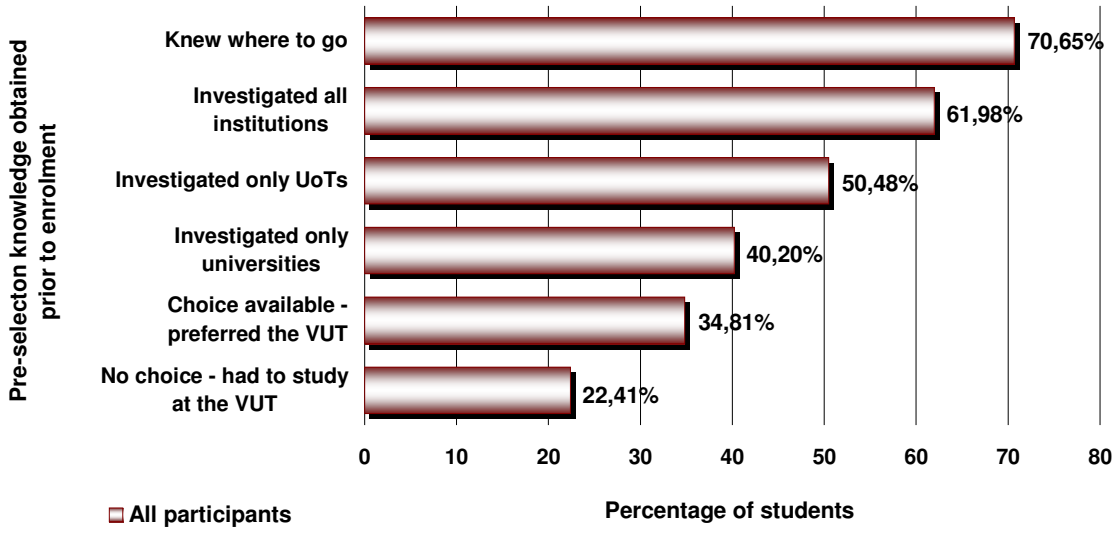

FIGURE 6.9: Section 2 - Pre-selection knowledge of higher education institutions

6.4 ENVIRONMENTAL ISSUES

Some of the assumed reasons for the occurrence of dropout, which had to be statistically proven, were the different environments students were exposed to during their study period. The environment played a vital role regarding the manner in which students deal with things emotionally, such as feelings, values, appreciation,

enthusiasm, motivations and attitudes (see Chapter 3, Section 3.3.1.2). Data generated from this section highlighted how students perceived the programme, as well as the institutional and demographical environments that they were exposed to during their study period at the VUT.

6.4.1 Programme environment

Questions pertaining to the programme environment explored if students had problems adapting to the higher education environment, experienced the workload as excessive, had problems managing their time, and/or experienced problems with study methods. In addition, the students were asked whether they perceived there to be a gap between the school and higher education environment. The students were also asked whether they thought that an EIP would make the transition into the higher education environment easier.

Table 6.11 lists the data generated in order to establish if students experienced difficulties adapting to the higher education environment.

TABLE 6.11: Coping in the higher education environment

FREQUENCY TABLE: COPING IN THE HIGHER EDUCATION ENVIRONMENT							
PROGRAMME		**TYPE**	**STRONGLY AGREE**	**AGREE**	**DISAGREE**	**STRONGLY DISAGREE**	**ROW TOTALS**
Pearson's χ^2 (chi-square) test			χ^2 = 49.1100		df = 3	p = .000000	
HE Environment	**COUNT**	Direct	33	162	80	24	299
	ROW %		11.04	54.18	26.76	8.03	100.01
	MISSING	17	10.44%	51.27%	25.32%	7.59%	94.62%
	COUNT	Intro	15	9	0	0	24
	ROW %		62.50	37.50	0.00	0.00	100
	COUNT TOTALS		48	171	80	24	323

The results indicate that most of the students (67,80%) experienced difficulties in adapting to the higher education environment.

These statistics are graphically depicted in Figure 6.10.

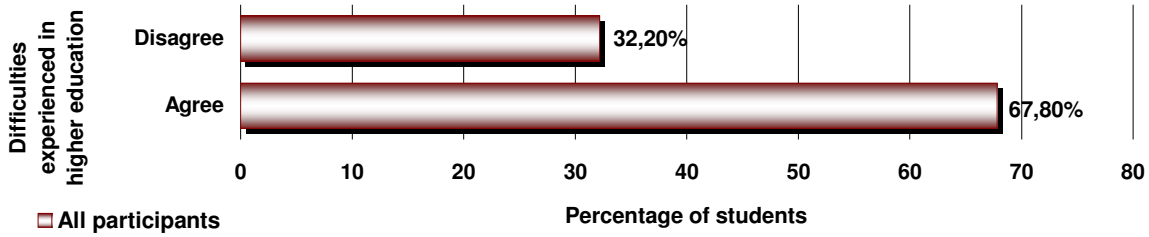

FIGURE 6.10: Coping in the higher education environment

The completed literature study corroborates the fact that students experience difficulties adapting to the higher education environment (see Chapter 3, Sections 3.4-3.6).

Table 6.12 lists the data generated in order to establish if students experienced problems regarding the workload exposed to within their study programmes.

TABLE 6.12: Difficulties experienced with the workload

FREQUENCY TABLE: DIFFICULTIES EXPERIENCED WITH THE WORKLOAD							
PROGRAMME		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 11.5263		df = 3	p = .009198	
Workload	COUNT	Direct	63	160	70	15	308
	ROW %		20.20	52.12	22.80	4.89	100.01
	MISSING	8	19.94%	50.63%	22.15%	4.75%	97.47%
	COUNT	Intro	10	14	0	0	24
	ROW %		41.67	58.33	0.00	0.00	100
	COUNT TOTALS		72	174	70	15	332

The results indicate that the majority of students (74,10%) agreed that the workload was difficult to cope with. These statistics are graphically depicted in Figure 6.11.

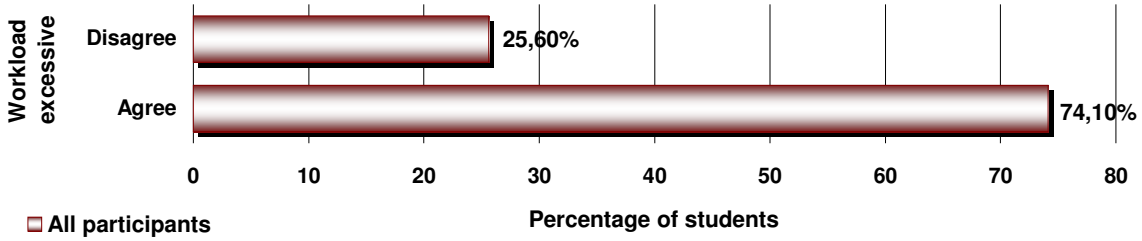

FIGURE 6.11: Difficulties experienced with the workload

Table 6.13 lists the data generated to establish how, from a student's perspective, the workload could be reduced.

TABLE 6.13: Students' views of how the workload could be reduced

FREQUENCY TABLE: STUDENTS' VIEWS OF HOW THE WORKLOAD COULD BE REDUCED			
RESPONSE		**ALL PARTICIPANTS**	**CUMULATIVE TOTALS**
The students had to adapt to the higher education environment	**COUNT**	153	153
	ROW %	45.00	45.00
The students had to learn how to manage their time efficiently	**COUNT**	116	269
	ROW %	34.12	79.12
The students were considering to register for fewer subjects	**COUNT**	42	311
	ROW %	12.35	91.47
The students suggested that the academic year should be extended	**COUNT**	29	340
	ROW %	8.53	100.00
	MISSING	0	340

When asked how the workload could be reduced, most of the students (45,00%) responded that they, as students, needed to adapt to the higher education environment. Some students (34,12%) responded that they had difficulties managing their time and others (12,35%) responded that registering for fewer subjects would help. A few students (8,53%) even suggested that the academic year should be extended. These statistics are graphically depicted in Figure 6.12.

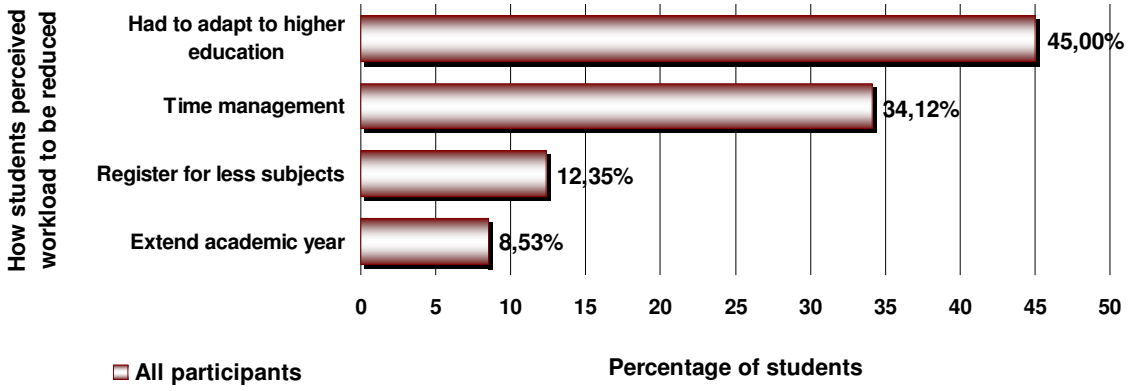

FIGURE 6.12: Students' views of how the workload could be reduced

Here are some of the responses received:

"…By adapting to all changes happening around my background, so as to cope with work"

"…We should be given enough time to study for exams"

"…1st semester I was doing 6 subjects and I failed, students must do 4 subjects"

"…Start the academic year early"

Table 6.14 lists the data generated in order to establish if students experienced difficulties with time management.

TABLE 6.14: Difficulties experienced with time management

FREQUENCY TABLE: DIFFICULTIES EXPERIENCED WITH TIME MANAGEMENT							
PROGRAMME		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 19.1399		df = 3	p = .000256	
Time management	COUNT	Direct	101	140	51	11	303
	ROW %		33.33	46.20	16.83	3.63	99.99
	MISSING	13	31.96%	44.30%	16.14%	31.48%	95.88%
	COUNT	Intro	0	22	2	0	24
	ROW %		0.00	91.67	8.33	0.00	100
	COUNT TOTALS		101	162	53	11	327

The majority of students (80,43%) experienced difficulties regarding time management. These statistics are graphically depicted in Figure 6.13.

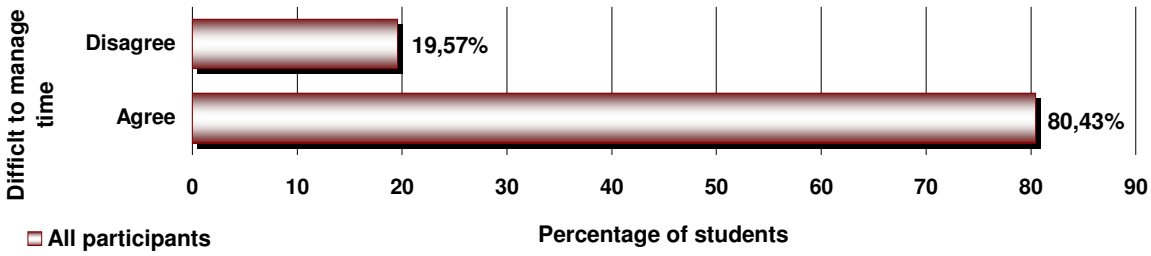

FIGURE 6.13: Difficulties experienced with time management

Table 6.15 lists the data generated to establish students' views as to how time management could be improved.

TABLE 6.15: Students' views as to how time management could be improved

FREQUENCY TABLE: STUDENTS' VIEW AS HOW TIME MANAGEMENT COULD BE IMPROVED			
RESPONSE		ALL PARTICIPANTS	CUMULATIVE TOTALS
The students considered to attend time management workshops	COUNT	274	274
	ROW %	80.59	80.59
The students considered to enrol for lesser subjects	COUNT	33	307
	ROW %	9.71	90.30
The students suggested fewer contact hours so they can cope with the workload	COUNT	33	340
	ROW %	9.71	100.01
	MISSING	0	340

When asked how time management could be improved, students suggested to set up timetables and attend workshops regarding time management (80,59%). Some students (9,71%) suggested enrolling for less subjects per semester, while others suggested reducing contact periods to provide more time for homework and studying (9,71%). These statistics are graphically depicted in Figure 6.14.

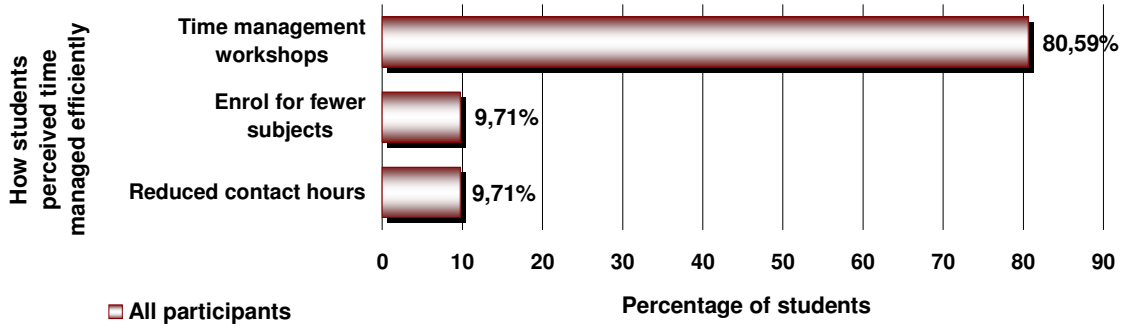

FIGURE 6.14: Students' views as to how time management could be improved

Here are some of the responses received:

"…By prioritising and knowing what to do when to do it and how to do it"

"…Students must finish attend class at 15:00"

"…Take less subjects per semester"

Table 6.16 lists the data generated in order to establish if students experienced difficulties regarding study methods.

TABLE 6.16: Difficulties experienced with study methods

FREQUENCY TABLE: DIFFICULTIES EXPERIENCED WITH STUDY METHODS							
PROGRAMME		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 9.41368		df = 3	p = .024272	
Study Methods	COUNT	Direct	57	131	81	26	295
	ROW %		19.32	44.41	27.46	8.81	100
	MISSING	21	18.04%	41.46%	25.63%	8.23%	93.36%
	COUNT	Intro	0	16	8	0	24
	ROW %		0.00	66.67	33.33	0.00	100
	COUNT TOTALS		57	147	89	26	319

The results established that most of the students (63,95%) experienced difficulties regarding study methods. These statistics are graphically depicted in Figure 6.15.

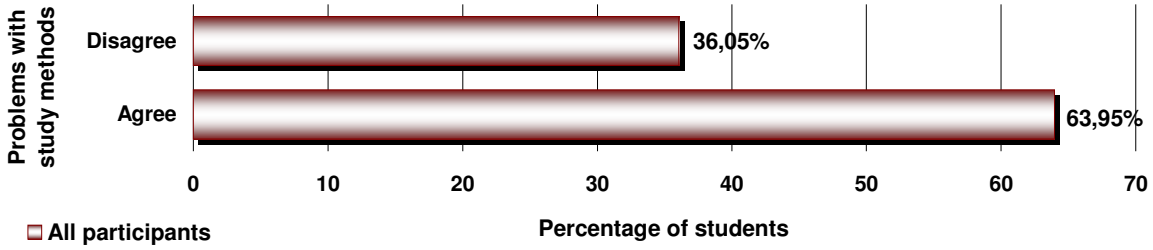

FIGURE 6.15: Difficulties experienced with study methods

Table 6.17 lists the data generated to establish students' views as to how study methods could be improved.

TABLE 6.17: Students' views as to how study methods could be improved

FREQUENCY TABLE: STUDENTS' VIEW AS TO HOW STUDY METHODS COULD BE IMPROVED			
RESPONSE		**ALL PARTICIPANTS**	**CUMULATIVE TOTALS**
The students had to improve their study skills and time management	**COUNT**	180	180
	ROW %	52.94	52.94
The students suggested that lecturing skills were to be improved	**COUNT**	47	227
	ROW %	13.82	66.76
The students suggested extra lectures for subjects they experienced problems with	**COUNT**	38	265
	ROW %	11.18	77.94
The students suggested to form study groups to assist with their studies	**COUNT**	21	286
	ROW %	6.18	84.12
The students suggested that the university should supply a quiet and safe environment	**COUNT**	15	301
	ROW %	4.41	88.53
The students suggested that the university should supply better study material	**COUNT**	13	314
	ROW %	3.82	92.35
	MISSING	26	340

These statistics are graphically depicted in Figure 6.16.

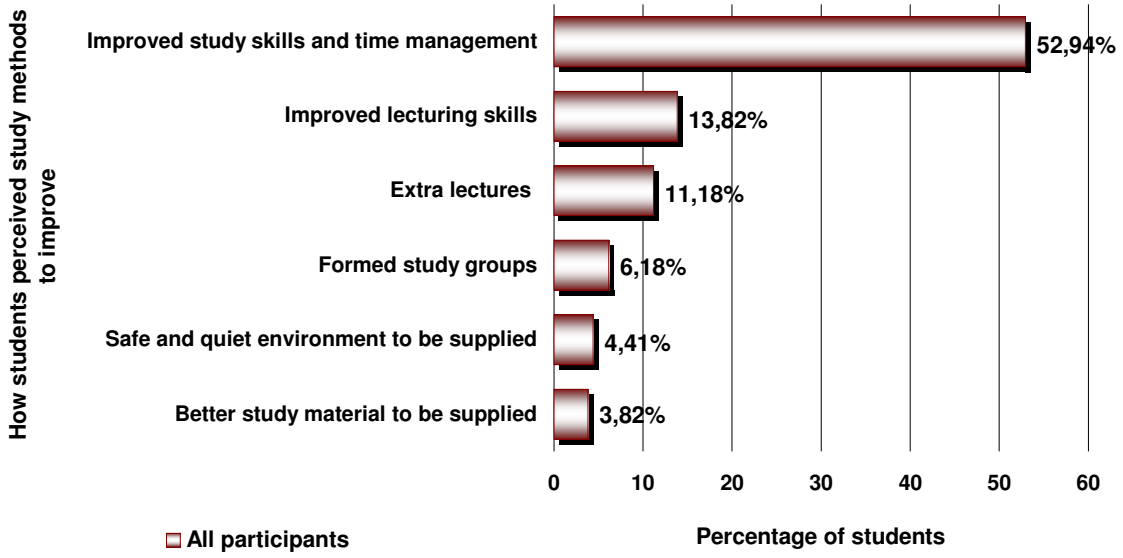

FIGURE 6.16: Students' views as to how study methods could be improved

When asked how study methods could be improved, the students suggested improved time management (26,47%), improved study skills (26,47%), improved lecturing skills (13,82%), attending of extra classes (11,18%), forming of study groups (6,18%). In addition, they suggested that the university should supply a safe and quiet environment (4,41%) and that the university should supply better study materials (3,82%). Here are some of the responses received:

"…By setting your study timetable and follow it"

"…One must not stick to one study method if it's ineffective, consult student counselling maybe"

"…Study group can be an advantage, go to library now and then, asking lecturer after class if you did not understand"

"…Introducing the tertiary concept on high school"

"…Some students don't have study skills; they study hard and fail at the end"

"…Lecturers being lecturers not students"

"…Provide quiet and safe environment"

In order to corroborate the difficulties experienced (workload, higher education environment, study skills and time management), the researcher correlated the results obtained by establishing if there was a gap experienced between the school environment and the higher education environment.

Table 6.18 lists the data generated in order to establish if students experienced a gap between the school environment and the higher education environment.

TABLE 6.18: Gap experienced between the school environment and the higher education environment

FREQUENCY TABLE: GAP EXPERIENCED BETWEEN SCHOOL ENVIRONMENT AND THE HIGHER EDUCATION ENVIRONMENT							
PROGRAMME		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 16.0911		df = 3	p = .001087	
Transition difficult	COUNT	Direct	96	117	85	12	310
	ROW %		30.97	37.73	27.42	3.87	99.99
	MISSING	6	30.38%	37.03%	26.90%	3.80%	98.11%
	COUNT	Intro	16	8	0	0	24
	ROW %		66.67	33.33	0.00	0.00	100
	COUNT TOTALS		112	125	85	12	334

The results indicate that the majority of students (70,96%) experienced a gap between the school environment and the higher education environment. These statistics are graphically depicted in Figure 6.17.

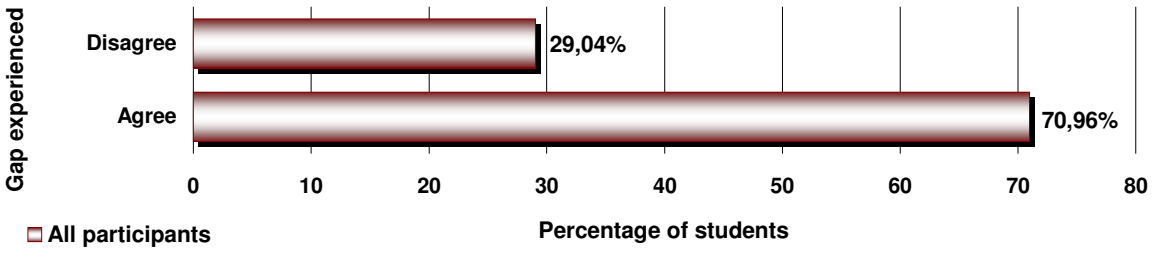

FIGURE 6.17: Gap experienced between the school environment and the higher education environment

It was suspected that the majority students would welcome an EIP to assist them with the transition to the higher education environment. Table 6.19 lists the data

generated in order to establish if students would welcome an EIP to assist them with the transition to the higher education environment.

TABLE 6.19: An EIP can make transition easier

FREQUENCY TABLE: AN EIP CAN MAKE TRANSITION EASIER							
PROGRAMME		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 20.7173		df = 3	p = .000121	
EIP for transition	COUNT	Direct	105	155	24	14	298
	ROW %		35.23	52.01	8.05	4.70	99.99
	MISSING	18	33.23%	49.05%	7.59%	4.43%	94.30%
	COUNT	Intro	0	24	0	0	24
	ROW %		0.00	100.00	0.00	0.00	100
	COUNT TOTALS		105	179	24	14	322

The results indicate that the majority of students (88,20%) perceived that an EIP would make the transition to the higher education environment easier. These statistics are graphically depicted in Figure 6.18.

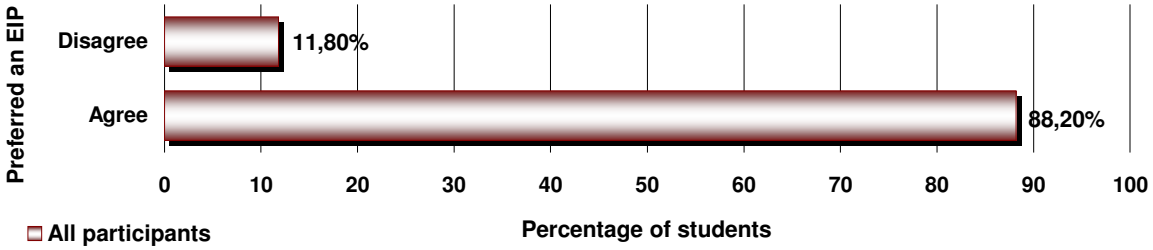

FIGURE 6.18: An EIP can make transition easier

6.4.1.1 Summary of the programme environment

To summarise, the majority of students experienced difficulties adapting to the higher education environment (67,80%), managing the workload (74,10%), managing study methods (63,95%), and managing time (80,43%). These alleged factors seemingly played major roles in negatively affecting students' academic performance.

The fact that the majority of students recognised that a gap exists between the school environment and the higher education environment (70,96%) and identified the need for an EIP (88,20%) supports the rationale of the study. These statistics are graphically depicted in Figure 6.19.

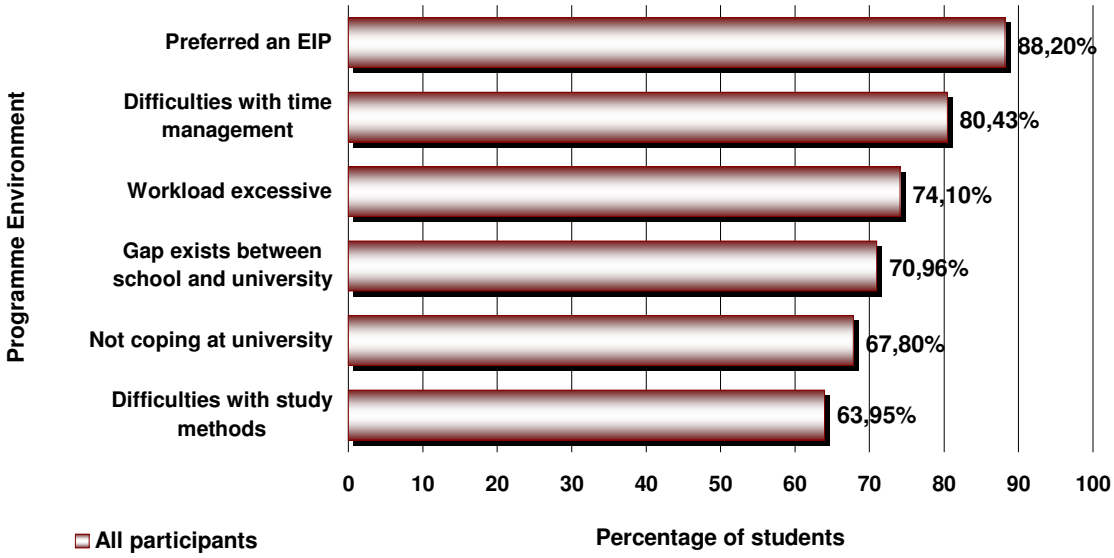

FIGURE 6.19: Section 3.1 - Programme environment

6.4.2 Institutional environment

Questions pertaining to the institutional environment explored if the VUT, as a higher education institution, maintained a healthy study environment, experienced minor suspensions of classes due to student demonstrations, had a library with ample study material available for student usage and had a computer room that supplied ample computers for students to work on. In investigating these factors, it was also necessary to determine if students had at least explored these areas before enrolling.

The majority of students (71,01%) indicated that the VUT maintained a healthy study environment. However, when asked what problems they experienced that affected the study environment negatively, most of the students indicated that there were not enough study halls available in the library to accommodate the student population registered at the VUT (27,91%). The students also indicated that they experienced overcrowding and dirty lecture rooms during lectures (27,91%), that the noise pollution at the institution was extremely high (20,93%), and that the sanitary

conditions were unhygienic (13,95%). In addition, they indicated that overcrowding and high noise pollution were experienced at residences (9,30%). The VUT had its fair share of student demonstrations and it was suspected that some classes were affected by these actions. The results obtained indicated that most of the students (66,57%) experienced class suspensions at some stage of their study period. It was also necessary to investigate if the library was at least able to supply ample study material to students. Table 6.20 lists the data generated in order to establish if the library was able to support the students with ample study material.

TABLE 6.20: The library offered ample study material

FREQUENCY TABLE: THE LIBRARY OFFERED AMPLE STUDY MATERIAL							
INSTITUTIONAL		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 19.3589		df = 3	p = .000231	
Library Materials	COUNT	Direct	70	144	83	14	311
	ROW %		22.51	46.30	26.69	4.50	100
	MISSING	5	22.15%	45.57%	26.27%	4.43%	98.42%
	COUNT	Intro	0	8	16	0	24
	ROW %		0.00	33.33	66.67	0.00	100
	COUNT TOTALS		70	152	99	14	335

The results indicate that most of the students (66,27%) agreed that there was ample study material available in the library. These statistics are graphically depicted in Figure 6.20.

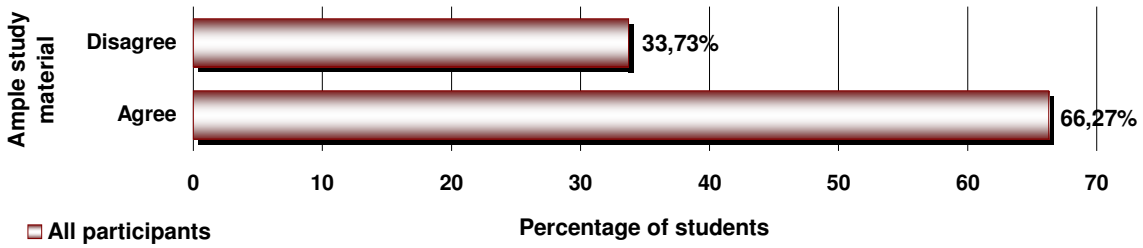

FIGURE 6.20: The library offered ample study material

The VUT student numbers were around 17 000 (see Chapter 2, Section 2.4.3) and there is only one computer room within the library where students have access to computers. Therefore, it was predicted that not enough computers were available for students to work on. Table 6.21 lists the data generated in order to establish if the library was able to support the students with sufficient computers to work on.

TABLE 6.21: The library provides sufficient computers to work on

FREQUENCY TABLE: THE LIBRARY PROVIDES SUFFICIENT COMPUTERS TO WORK ON							
INSTITUTIONAL		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 11.5664		df = 3	p = .009029	
Computers	COUNT	Direct	42	51	84	138	315
	ROW %		13.33	16.19	26.67	43.81	100
	MISSING	1	13.29%	16.14%	26.58%	43.67%	99.68%
	COUNT	Intro	0	0	12	12	24
	ROW %		0.00	0.00	50.00	50.00	100
	COUNT TOTALS		42	51	96	150	339

The results obtained indicate that the majority of students (72,57%) responded that there were not enough computers for them to work on. These statistics are graphically depicted in Figure 6.21.

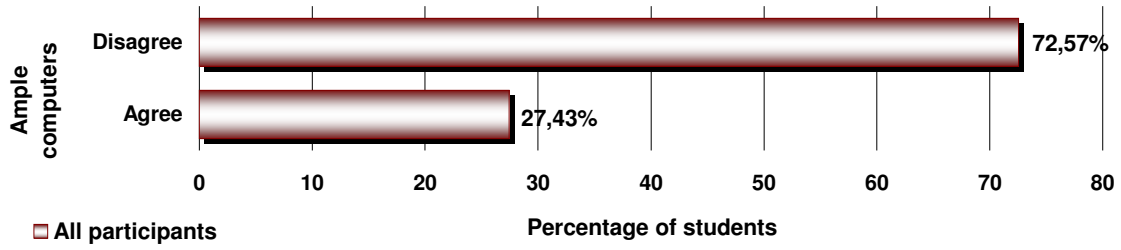

FIGURE 6.21: The library provides sufficient computers to work on

As this was not a new problem, it was necessary to establish if the students at least explored these problem areas before enrolling.

The results indicate that only a few students (26,27%) took the time to explore the library and its facilities prior to enrolling.

6.4.2.1 Summary of the institutional environment

To summarise, the results indicate that the majority of students (71,10%) perceive the VUT to be a provider of a healthy study environment. However, excessive noise pollution and overcrowded unclean facilities at the institution and its residences (86,05%) were alleged factors that played major roles in negatively affecting the students' academic performance. The results obtained regarding the library, indicate that the library is too small to accommodate the amount of students registered at the VUT; however, most of the students responded that ample study material (66,27%) was available, but that a huge shortage of computers (72,57%) existed. Most of the students (66,57%) responded that the suspension of classes, due to student demonstrations, occurred at some stage during their study period at the VUT. These statistics are graphically depicted in Figure 6.22.

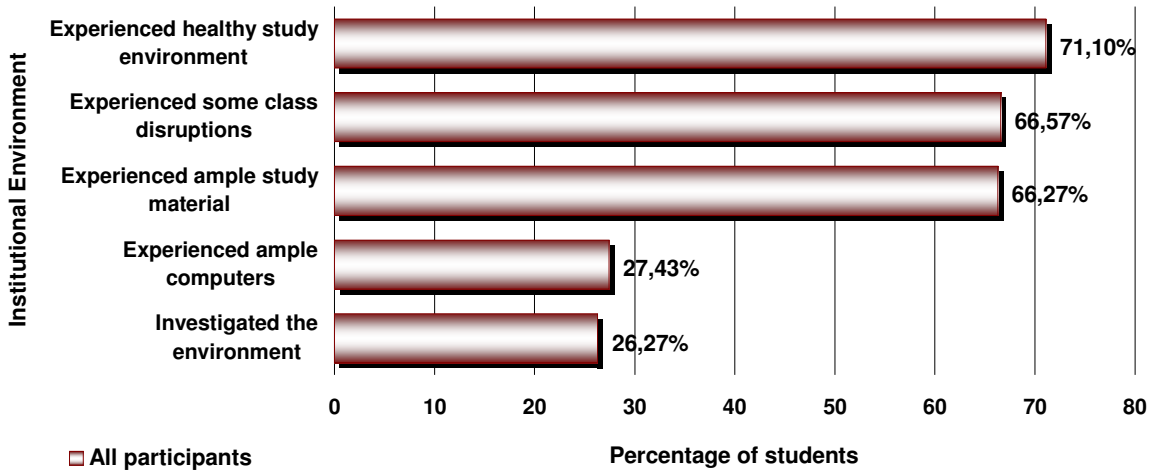

FIGURE 6.22: Section 3.2 - Institutional environment

6.4.3 Demographical Environment

The questions in this section explored what effect the demographical environment had on the students during their study period. To summarise, the results obtained from this section indicate the environment that students were accommodated in during their study period at the VUT. The results indicate that the majority of students (64,86%) resided outside the Gauteng province, and the majority of students

(61,83%) preferred to be accommodated in the hostels. Students were asked where they originally resided. Students' responses included the Limpopo (43,42%), Free State (13,16%), Mpumalanga (11,84%), North-West (10,53%), Eastern Cape (9,21%), KwaZulu-Natal (7,8%), Northern Cape (2,63%) and Western Cape (1,32%) province.

It has been previously established that students experienced problems regarding their accommodation in the residences, due to extremely high noise pollution and overcrowding. With the majority of students residing in residences, these alleged factors played major roles in negatively affecting the students' academic performance. These statistics are graphically depicted in Figure 6.23.

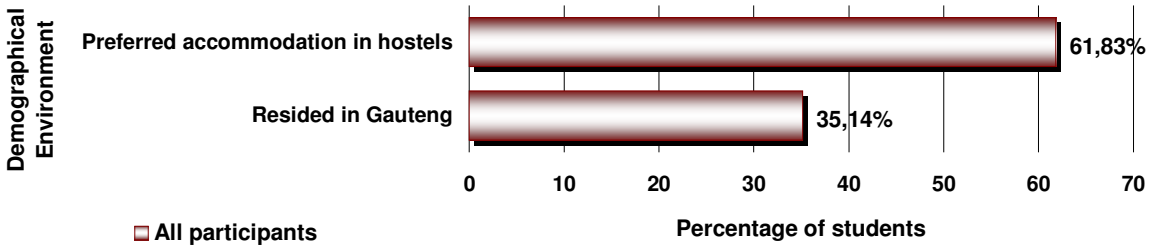

FIGURE 6.23: Section 3.3 - Demographical environment

6.5 OTHER REASONS FOR DROPPING OUT

Students also had other reasons for dropping out of the diploma programmes, which had to be explored. This section explored reasons such as financial, health, and partner obligations, as well as course materials, teaching and learning. Furthermore, this section looked at the personal reflections of students who had dropped out of the diploma programmes. Data generated from this section sheds light on the specific causes that students have identified as preventing them from completing their studies.

6.5.1 Financial obligations

The financial obligation questions explored if students had bursaries during their study period, and whether they were self-sufficient or dependent on their parents or a guardian for financial assistance. It was then necessary to determine if students

had to drop out of the diploma programmes because of financial constraints. Many students had to apply for bursaries in order to financially support their studies. It was suspected that the majority of students that applied for bursaries had been unsuccessful due to their poor academic achievements. Table 6.22 lists the data generated in order to establish if the students had bursaries during their studies.

TABLE 6.22: Students had bursaries during their studies

FREQUENCY TABLE: STUDENTS HAD BURSARIES DURING THEIR STUDIES							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 19.8980		df = 3	p = .000178	
Finance related	COUNT	Direct	23	22	78	187	310
	ROW %		7.42	7.10	25.16	60.32	100
	MISSING	6	7.28%	6.96%	24.68%	59.17%	98.09%
	COUNT	Intro	0	0	16	8	24
	ROW %		0.00	0.00	66.67	33.33	100
	COUNT TOTALS		23	22	91	195	334

As suspected, only a small percentage of students (13,47%) obtained bursaries. The majority of students had to look elsewhere for financial support. These statistics are graphically depicted in Figure 6.24.

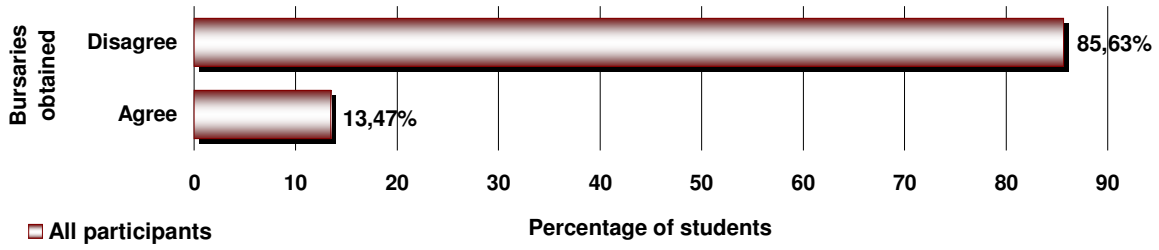

FIGURE 6.24: Students had bursaries during their studies

It was suspected that only a few students had been able to support themselves financially, as employment without relevant experience is hard to obtain. The results

indicated that only a few students (24,17%) were financially independent. These results indicate that the majority of students had to be financially dependent on either their parents or a guardian.

Table 6.23 lists the data generated in order to establish if the students had been supported by their parents or a guardian during their studies.

TABLE 6.23: The students were financially dependent on their parents or a guardian

FREQUENCY TABLE: THE STUDENTS WERE FINANCIALLY DEPENDENT ON THEIR PARENTS/GUARDIAN							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 28.9972		df = 3	p = .000002	
Finance related	COUNT	Direct	132	124	34	23	313
	ROW %		42.17	39.62	10.86	7.35	100
	MISSING	3	41.77%	39.24%	10.76%	7.28%	99.05%
	COUNT	Intro	0	23	1	0	24
	ROW %		0.00	95.83	4.17	0.00	100
	COUNT TOTALS		132	147	35	23	337

As expected, the results indicate that the majority of students (82,79%) were financially dependant on their parents or a guardian. These statistics are graphically depicted in Figure 6.25.

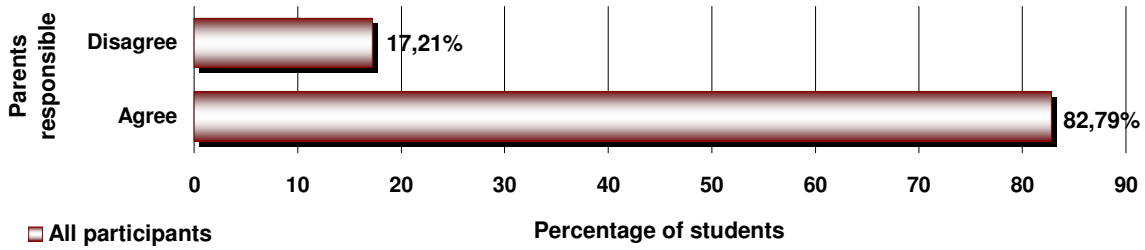

FIGURE 6.25: The students were financially dependent on their parents or a guardian

Table 6.24 lists the data generated in order to establish if the students had to drop out of the diploma programmes due to financial difficulties.

TABLE 6.24: Studies not completed due to financial constraints

FREQUENCY TABLE: STUDIES NOT COMPLETED DUE TO FINANCIAL CONSTRAINTS							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 18.9861		df = 3	p = .000275	
Finance related	COUNT	Direct	90	79	81	58	308
	ROW %		29.22	25.65	26.30	18.83	100
	MISSING	8	28.48%	25.00%	25.63%	18.35%	97.46%
	COUNT	Intro	14	10	0	0	24
	ROW %		58.33	41.67	0.00	0.00	100
	COUNT TOTALS		104	89	81	58	332

The results obtained indicate that students (58,13%) that dropped out of the diploma programmes responded that it was due to financial constraints. These statistics are graphically depicted in Figure 6.26.

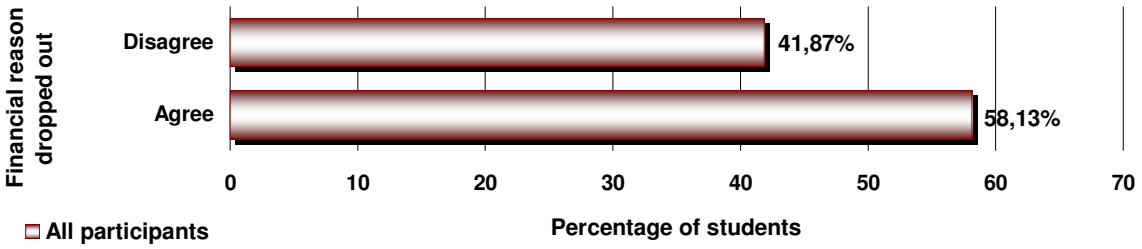

FIGURE 6.26: Studies not completed due to financial constraints

The following responses were obtained when the reasons for their financial constraints were requested:

"…I have two children who are at school"

"…I have a single parent we are 5 children, my mother cannot afford all of us"

"..I have other siblings who are also studying"

"…My parents earn the salary less than R5 000 a month, combined"

"…I am currently unemployed and I don't have parents to support me"

"…My father died this year, he was paying for me"

6.5.1.1 Summary of the financial obligations

To summarise, the results obtained from this section shed light on the financial obligations students had to experience. It was established that only a few students had bursaries (13,47%), or were self-sufficient (24,17%), while the majority of students (82,79%) were dependent on their parents or a guardian to support them financially through their higher education studies.

A high number of students (58,13%) had to drop out due to financial constraints. Alleged financial constraints had a clearly negative effect on academic performance, as it was suspected that students were aware of this constraint in advance or at least just before dropout occurred. These statistics are graphically depicted in Figure 6.27.

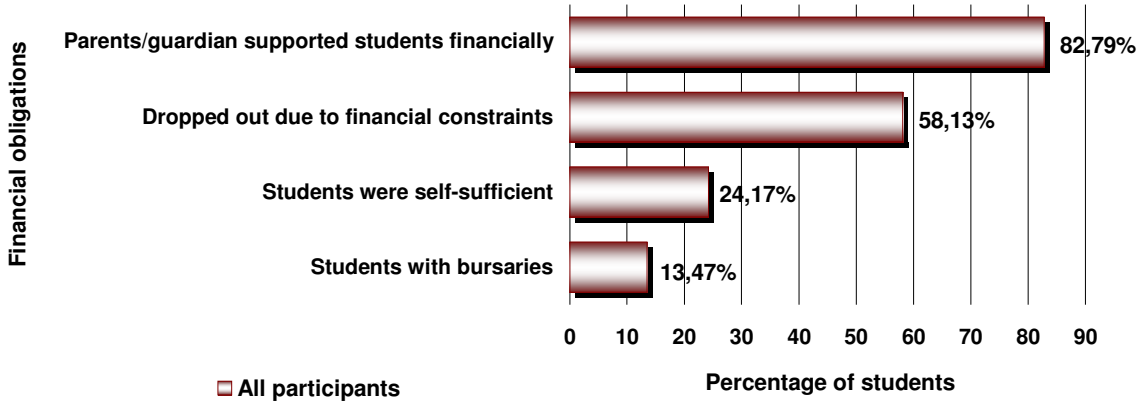

FIGURE 6.27: Section 4.1 - Financial obligations

6.5.2 Health obligations

The health obligation questions explored if students were unhealthy or had to take care of unhealthy family members during their study period, which allegedly has negatively affected their academic performance.

The results indicated that there were some students who were either unhealthy themselves (14,07%) or had to attend to unhealthy family members (22,32%) and, therefore, had to drop out of the diploma programmes.

These statistics are graphically depicted in Figure 6.28.

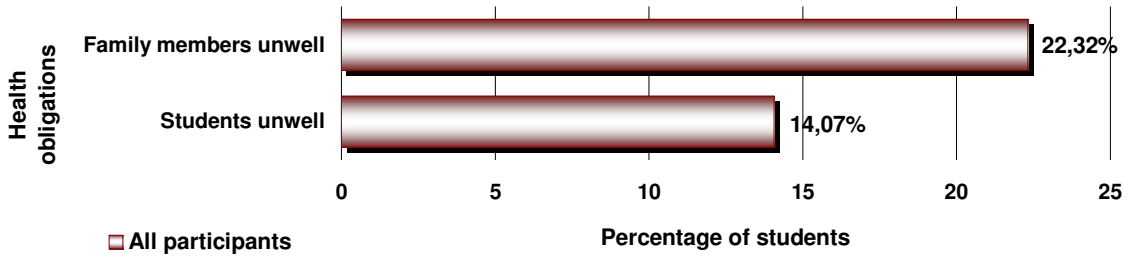

FIGURE 6.28: Section 4.2 - Health obligations

6.5.3 Partner obligations

The partner obligation questions explored if students with minor dependants, pregnant students or students' pregnant girlfriends necessitated that the students drop out of the diploma programmes. In summary, the results indicate that a few students were married (6,06%) with minor dependants. However, more students were unmarried (41,92%) with the responsibilities of minor dependants. The alleged extra domestic and financial responsibilities played a major role in negatively affecting students' academic performance. A few students (11,02%) had to drop out due to pregnancy, while fewer students (3,45%) had to drop out because their girlfriends were pregnant during their study period. These statistics are graphically depicted in Figure 6.29.

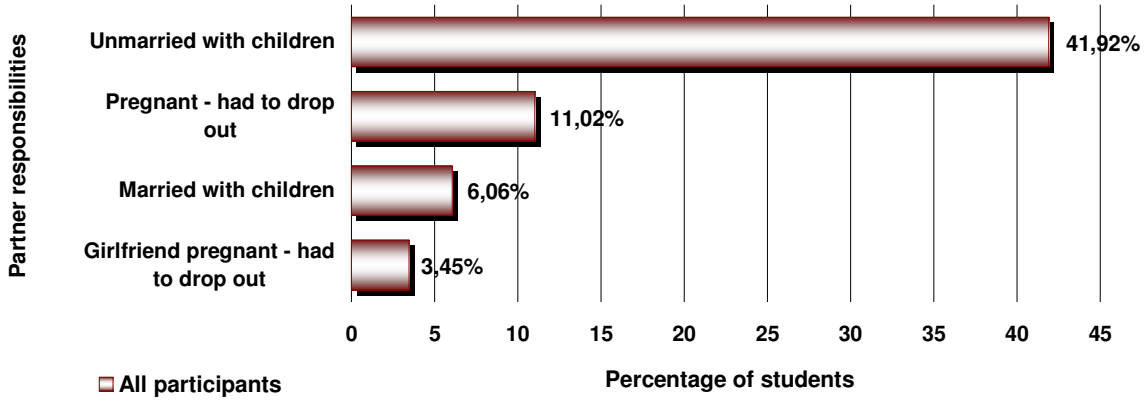

FIGURE 6.29: Section 4.3 - Partner obligations

6.5.4 Course material

The questions in this section explored the course material students were exposed to during their study period at the VUT. To corroborate the results obtained from the section on financial obligations, it was necessary to establish if students bought the prescribed textbooks for the different subjects during their study period.

However, there was also a need to determine if the majority of students utilised the prescribed textbooks. If not, what were the reasons for not exploiting the textbooks? In addition, it was necessary to determine if language was perhaps the main drawback, as the textbooks prescribed for the diploma programmes were all in English.

Table 6.25 lists the data generated in order to establish if students could not afford some of the prescribed textbooks during their study period.

TABLE 6.25: Students could not afford some of the prescribed textbooks

FREQUENCY TABLE: STUDENTS COULD NOT AFFORD SOME OF THE PRESCRIBED TEXTBOOKS							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 11.4679		df = 3	p = .009449	
Course material	COUNT	Direct	112	101	60	37	310
	ROW %		36.13	32.58	19.35	11.94	100
	MISSING	6	35.44%	31.96%	18.99%	11.71%	98.10%
	COUNT	Intro	8	15	1	0	24
	ROW %		33.33	62.50	4.17	0.00	100
	COUNT TOTALS		120	116	61	37	334

The results indicate that the majority of students (70,66%) could not afford to purchase all of the prescribed textbooks.

These statistics are graphically depicted in Figure 6.30.

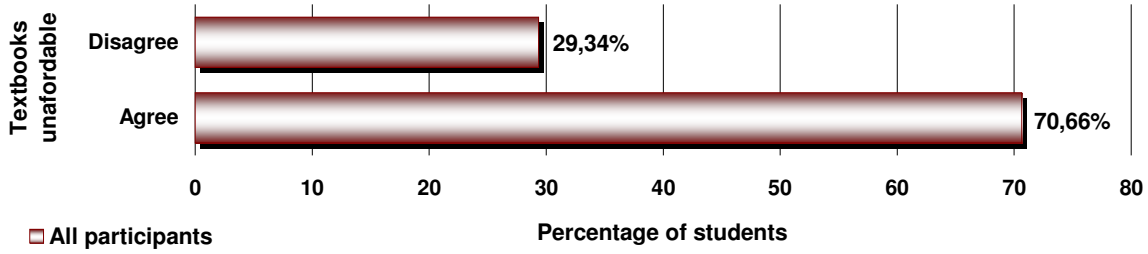

FIGURE 6.30: Students could not afford some of the prescribed textbooks

It was assumed that the majority of students would have made use of the prescribed textbooks, as it forms a vital part of the course material.

However, the researcher also suspected, based on personal lecturing experience, that some of the students would not have made use of the prescribed text books at all.

Table 6.26 lists the data generated in order to establish if students utilised the prescribed textbooks during their study period.

TABLE 6.26: Students hardly ever utilised the prescribed textbooks

FREQUENCY TABLE: STUDENTS HARDLY EVER UTILISED THE PRESCRIBED TEXTBOOKS							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 43.5935		df = 3	p = .000000	
Course material	COUNT	Direct	37	35	100	137	309
	ROW %		11.97	11.33	32.36	44.34	100
	MISSING	7	11.71%	11.08%	31.65%	43.35%	97.79%
	COUNT	Intro	0	0	24	0	24
	ROW %		0.00	0.00	100.00	0.00	100
	COUNT TOTALS		37	35	124	137	333

The results indicate that only a few of the students (21,62%) hardly ever utilised the prescribed textbooks. These statistics are graphically depicted in Figure 6.31.

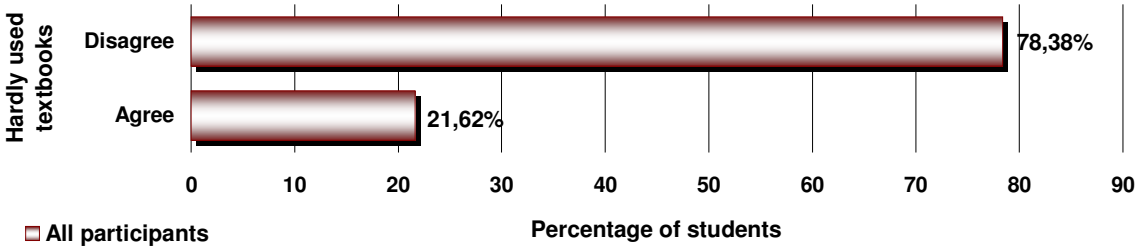

FIGURE 6.31: Students hardly ever utilised the prescribed textbooks

It was also necessary to determine why there were some students who did not make use of the prescribed textbooks, as it seemed improbable to obtain positive academic performance without these textbooks. The results indicate that few students (21,62%) did not utilise textbooks at all.

When asked why textbooks were not utilised, the students responded, as suspected, that the textbooks were too expensive (33,33%). The majority of students (66,67%) responded that they were not used to having a textbook in school, as teachers never used textbooks and, therefore, did not understand how to use the textbooks.

Here are some of the responses received:

"…I can't afford to buy them"

"…Because of this some complicated words probably useless for my studies"

"…Sometimes they are complicated"

"…They are full on unnecessary information"

"…It was my habit at school because my teachers never used them"

These responses strengthened the necessity for the subject of language literacy in an EIP, where students were taught how to utilise textbooks correctly and were made aware of the importance of textbooks, not only the prescribed ones, but also those books and other forms of literature available for further research into specific subject matter.

Table 6.27 lists the data generated in order to establish if students would prefer textbooks in their home language.

TABLE 6.27: Students preferred textbooks in their home language

FREQUENCY TABLE: STUDENTS PREFERRED TEXTBOOKS IN THEIR HOME LANGUAGE							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 15.5446		df = 3	p = .001406	
Course material	COUNT	Direct	65	56	106	80	307
	ROW %		21.17	18.24	34.53	26.06	100
	MISSING	9	20.57%	17.72%	33.54%	25.32%	97.15%
	COUNT	Intro	0	0	12	12	24
	ROW %		0.00	0.00	50.00	50.00	100
	COUNT TOTALS		65	56	116	92	331

Only a few students (36,56%) perceived that textbooks in their home language would have positively affected their academic performance. These statistics are graphically depicted in Figure 6.32.

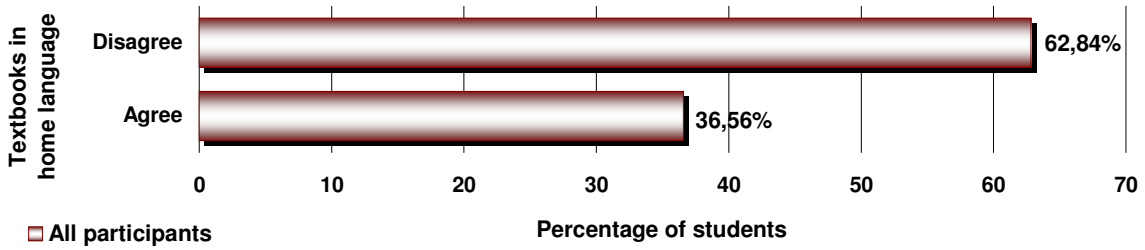

FIGURE 6.32: Students preferred textbooks in their home language

6.5.4.1 Summary of the course material

To summarise, the results obtained from this section highlight the course material students were exposed to during their study period. It was established that the majority of students (70,66%) could not afford to buy the prescribed textbooks. Therefore, these students had to allegedly borrow textbooks from the minority who had textbooks. However, during study periods (tests and examinations) the minority students would not have been prepared to lend out their textbooks as they needed them themselves. This factor had a definite negative impact on the majority students'

academic performance. A few students (21,62%) indicated that they never utilised textbooks. The fact that the textbooks were only available in the English language only bothered a few students (36,56%).

These statistics are graphically depicted in Figure 6.33.

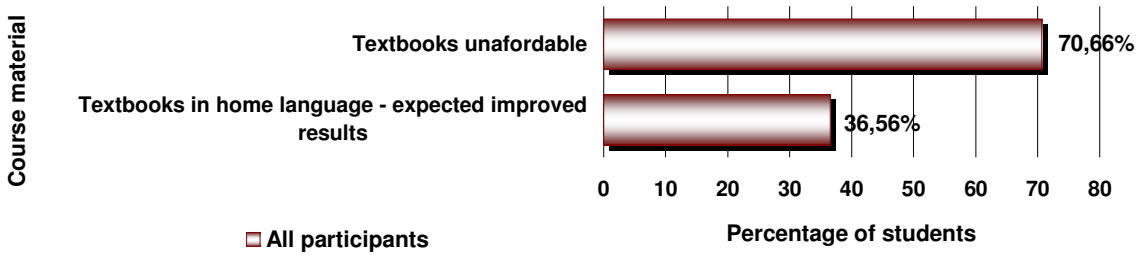

FIGURE 6.33: Section 4.4 - Course material

6.5.5 Teaching and learning

Teaching and learning strategies and methodologies demarcate the strengths of any academic programme. The questions explored whether students understood their lecturers' explanations of the subject matter and whether the lecturers explained the content of the subject matter or only restricted lectures to context explanations and expected students to investigate further in order to enhance active learning. In addition, the questions sought to determine if lecturers only read from the textbooks and if lecturers provided time for questions after lectures. Thereafter, it was necessary to determine if large classes affected the students negatively. If students experienced major problems within this section, it would negatively affect their academic performance.

This section explored what effect the teaching and learning methodologies that students received had on their academic performance. Lecturers prefer to utilise their personal teaching methodologies, which they apply during lectures. Immaterial of what these methodologies embody, they differ from the teaching methodologies students were exposed to in school.

Table 6.28 lists the data generated in order to establish if students understand lecturers' explanations of the subject material.

TABLE 6.28: Students not understanding lecturers' explanations

FREQUENCY TABLE: STUDENTS NOT UNDERSTANDING LECTURERS' EXPLANATIONS							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 18.0428		df = 3	p = .000431	
Teaching and learning	COUNT	Direct	58	155	64	34	311
	ROW %		18.65	49.84	20.58	10.93	100
	MISSING	5	18.35%	49.05%	20.25%	10.76%	98.41%
	COUNT	Intro	12	12	0	0	24
	ROW %		50.00	50.00	0.00	0.00	100
	COUNT TOTALS		70	167	64	34	335

The results indicated that the majority of students (70,75%) did not understand some of the lecturers' explanations of the subject matter. This factor was a main concern and was corroborated by the literature study, which highlighted that lecturers teach the same way that they were taught (see Chapter 2, Sections 2.4.4, 2.4.5). These statistics are graphically depicted in Figure 6.34.

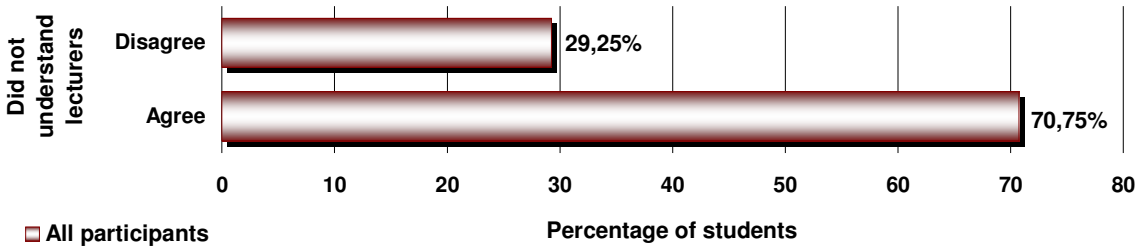

FIGURE 6.34: Students not understanding lecturers' explanations

It was suspected that some lecturers did not explain certain concepts within subject matter to students, mainly because these lecturers assumed that the concepts were taught at school level. Table 6.29 lists the data generated in order to establish if, according to the students, some lecturers did not explain the subject material.

TABLE 6.29: Lecturers did not explain subject material

FREQUENCY TABLE: SOME LECTURERS DID NOT EXPLAIN SUBJECT MATERIAL							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 2.72352		df = 3	p = .436248	
Teaching and learning	COUNT	Direct	54	109	108	39	310
	ROW %		17.42	35.16	34.84	12.58	100
	MISSING	6	17.09%	34.49%	34.18%	12.34%	98.10%
	COUNT	Intro	7	6	9	2	24
	ROW %		29.17	25.00	37.50	8.33	100
	COUNT TOTALS		61	115	117	41	334

The results indicate just over half of the students (52,69%) experienced problems with some lecturers not explaining the subject content. These statistics are graphically depicted in Figure 6.35.

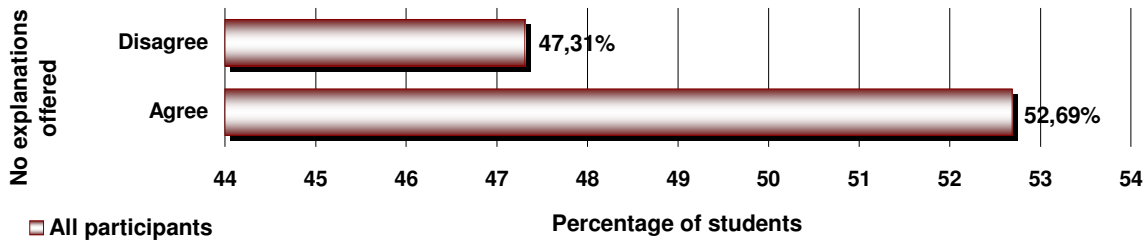

FIGURE 6.35: Lecturers did not explain subject material

It was anticipated that concepts that were supposed to have been taught at school level would not be repeated by some lectures; however, it was unexpected to find that some lecturers do not explain their subject content.

Table 6.30 lists the data generated in order to establish if students found that some lecturers only taught new concepts regarding their subject matter.

TABLE 6.30: Lecturers only taught new concepts

FREQUENCY TABLE: LECTURERS ONLY EXPLAINED CONCEPTS - STUDENTS HAD TO DO THE REST							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 45.1600		df = 3	p = .000000	
Teaching and learning	COUNT	Direct	64	158	66	21	309
	ROW %		20.71	51.13	21.36	6.80	100
	MISSING	7	20.25%	50.00%	20.89%	6.65%	97.79%
	COUNT	Intro	0	4	20	0	24
	ROW %		0.00	16.67	83.33	0.00	100
	COUNT TOTALS		64	162	86	21	333

The results indicated that, according to most of the students (67,87%), lecturers only explained new concepts and that the students then had to build on these concepts through further investigation and research.

These statistics are graphically depicted in Figure 6.36.

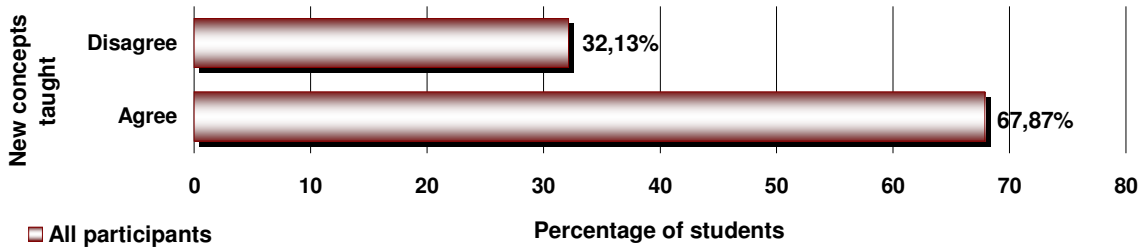

FIGURE 6.36: Lecturers only taught new concepts

Table 6.31 lists the data generated in order to establish if students found that lecturers only read from the textbooks.

TABLE 6.31: Lecturers only read from textbooks

FREQUENCY TABLE: LECTURERS ONLY READ FROM TEXTBOOKS							
INCOMPLETION		TYPE	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	ROW TOTALS
Pearson's χ^2 (chi-square) test			χ^2 = 9.25627		df = 3	p = .026075	
Teaching and learning	COUNT	Direct	68	130	74	37	309
	ROW %		22.01	42.07	23.95	11.97	100
	MISSING	7	21.52%	41.14%	23.42%	11.71%	97.79%
	COUNT	Intro	10	12	2	0	34
	ROW %		41.67	50.00	8.33	0.00	100
	COUNT TOTALS		78	142	76	37	333

It was not anticipated that any lecturer would fail to explore their subject matter in any other way than to only read information out from the textbook. The results indicated that most of the students (66,07%) indicated that lecturers only read out from the textbooks.

These results were not expected and the source of the alleged problem has to be investigated after the completion of the study.

These statistics are graphically depicted in Figure 6.37.

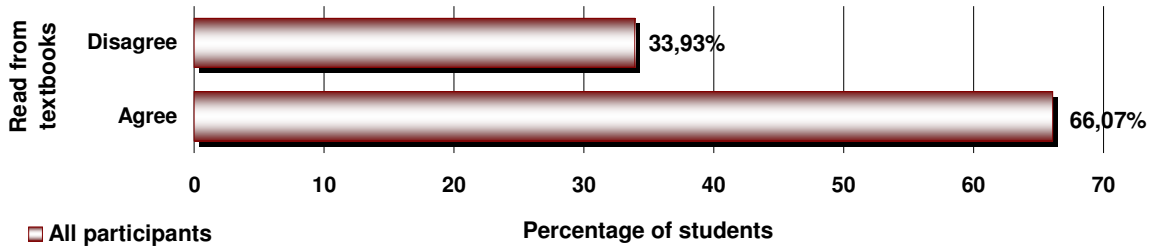

FIGURE 6.37: Lecturers only read from textbooks

Table 6.32 lists the data generated to establish how students perceive teaching and learning methodologies could be improved.

TABLE 6.32: How students perceive teaching and learning could be improved

FREQUENCY TABLE: HOW STUDENTS PERCEIVE TEACHING AND LEARNING COULD BE IMPROVED			
RESPONSE		ALL PARTICIPANTS	CUMULATIVE TOTALS
The students suggested that lecturers elaborate more on their subject content	COUNT	153	153
	ROW %	45.00	45.00
The students suggested that lecturers improved the effort they put into the subject taught	COUNT	86	239
	ROW %	25.29	70.29
The students suggested that the university employed more qualified lecturers	COUNT	62	301
	ROW %	18.24	88.53
The students suggested tutorials to be added to those subjects that do not offer them	COUNT	39	340
	ROW %	11.47	100.00
	MISSING	0	340

When asked how teaching and learning methodologies could be improved, various suggestions were received. The majority of students (45,10%) responded that lecturers should elaborate more on the subject content they teach. Others (25,49%) responded that lecturers should put a better effort into the subject taught, while others (17,65%) responded that the university should employ more qualified lecturers. A few (11,76%) suggested that tutorials should be added to subjects that do not offer them already. These statistics are graphically depicted in Figure 6.38.

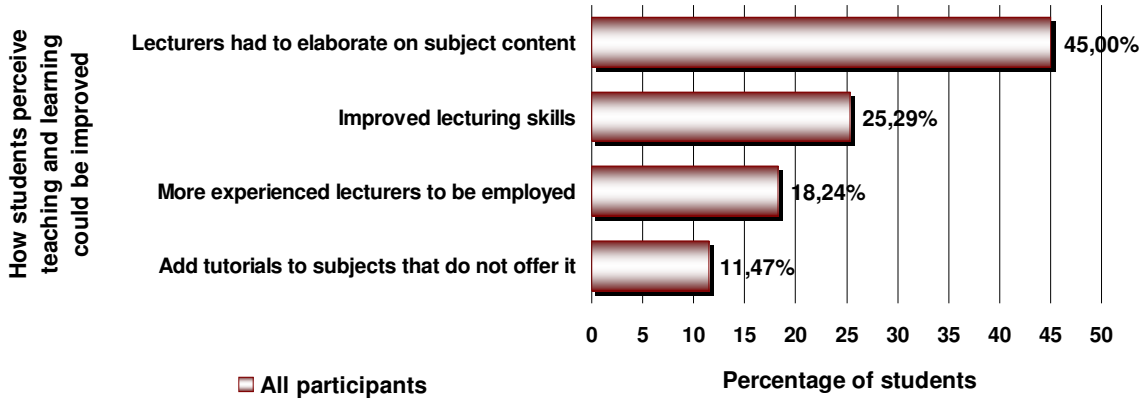

FIGURE 6.38: How students perceive teaching and learning could be improved

Here are some of the responses received:

"...Lecturers should find means to explain concepts materials clearly to students"

"…Lecturers putting more effort and energy explaining the subject to the student"

"…By letting learners enjoy the classes and be interested in what is being taught"

"…The appointment of lecturers must be conducted in a way that their competence is exposed"

"…Hire qualified lecturer and who know how communicate in English"

"…By having tutors I have seen that subjects where there are tutorials classes students perform better"

Lecturers normally have scheduled consultation hours (over and above the normal contact hours) and expect students to discuss their problems and ask questions, regarding the subject matter, during this time period. The results indicate that the students (55,89%) consider the time allocated for questions during lecturing hours to be insufficient.

It has previously been established that students experienced overcrowding during lectures, which also caused high noise pollution during lectures. Table 6.33 lists the data generated in order to establish if students experienced overcrowding during lectures.

TABLE 6.33: Overcrowded classes

FREQUENCY TABLE: OVERCROWDED CLASSES							
INCOMPLETION		**TYPE**	**STRONGLY AGREE**	**AGREE**	**DISAGREE**	**STRONGLY DISAGREE**	**ROW TOTALS**
Pearson's χ^2 (chi-square) test			χ^2 = 23.6379		df = 3	p = .000030	
Teaching and learning	**COUNT**	Direct	39	122	120	26	307
	ROW %		12.7	39.75	39.09	8.47	100.01
	MISSING	9	12.34%	38.61%	37.97%	8.23%	97.15%
	COUNT	Intro	9	15	0	0	24
	ROW %		37.50	62.50	0.00	0.00	100
	COUNT TOTALS		48	137	120	26	331

Just over half of the students (55,89%) indicated that classes were overcrowded during lectures. These statistics are graphically depicted in Figure 6.39.

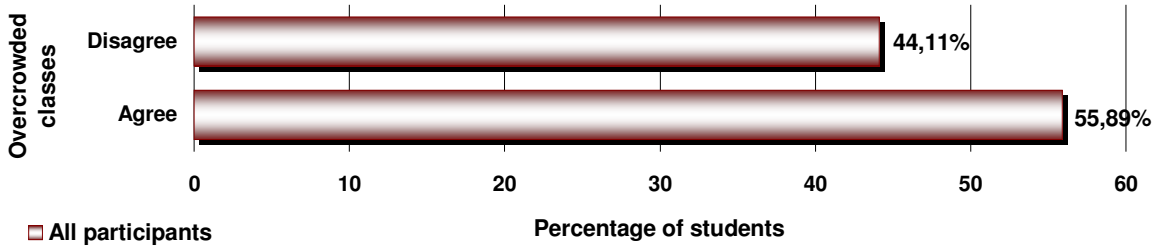

FIGURE 6.39: Overcrowded classes

6.5.5.1 Summary of teaching and learning

To summarise, the teaching and learning section established that the majority of students (70,75%) had difficulties with their lecturers' explanations regarding subject matter. In addition, some students (52,69%) indicated that lecturers that did not explain their subject matter in class. A number of students (66,07%) indicated that their lecturers only read out subject matter directly from the textbooks. A number of students (67,87%) also indicated that lecturers explained subject matter concepts and then expected the students to explore these further in order to actively participate during the learning process.

Furthermore, some students (39,82%) indicated that the time available for asking questions during lecture periods to be insufficient. The teaching and learning methodologies applied by lecturers negatively influenced the students' academic performance.

The majority of students (55,89%) experienced overcrowding during lecturing periods, which also increased the noise pollution in class. Alleged overcrowding and a high noise pollution during lectures definitely influenced the academic performance of the students negatively. These alleged logistic problems will need to be investigated after completion of the study.

These statistics are graphically depicted in Figure 6.40.

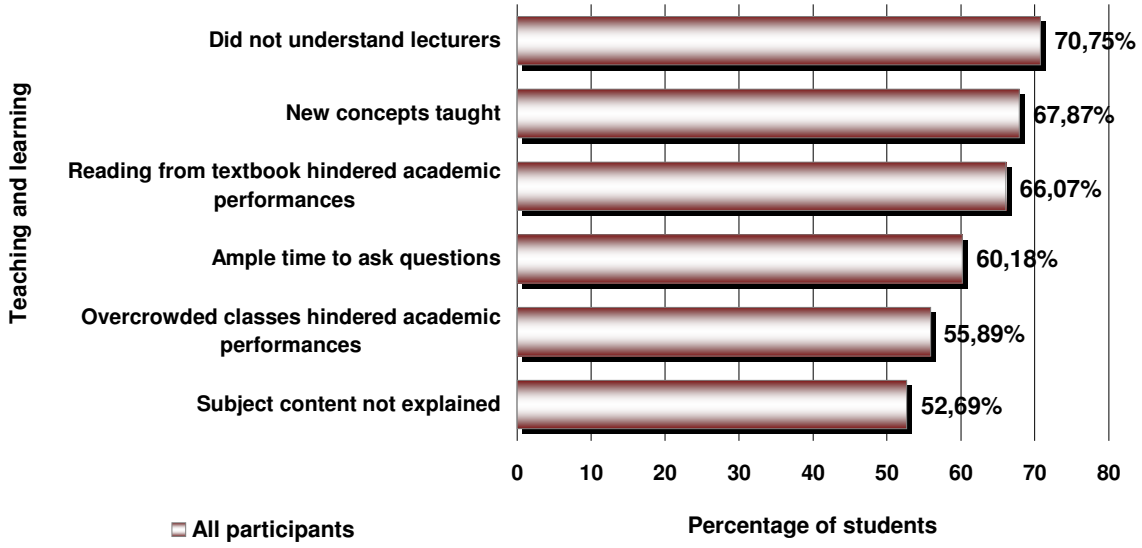

FIGURE 6.40: Section 4.5 - Teaching and learning

6.5.6 Personal reflections

The questions in this section explored the personal reflections of students regarding their study period at the VUT. To summarise, when asked what activities kept students from performing academically better, various answers were received.

However, the majority of students (43,48%) responded that sport and hobbies kept them from their studies, others (34,78%) had more serious complaints - that of parties and, therefore, excessive noise pollution in the area where they resided, and a few students (21,71%) indicated problems regarding the demonstrations that took place on campus.

Here are some of the responses received:

"…Extra mural activities"

"…Sports, soccer"

"…Netball"

"…Gumbas, bashes"

"…Strikes and parties around"

"…Loud music, strike on campus"

"…Strikes and parties around"

The personal reflection section established that most of the students (68,69%) indicated that the lack of exposure to certain subjects at school level contributed to their failure at the VUT. Although some students (43,48%) indicated that they had no time to play sports or indulge in their hobbies, these activities were not identified as valid reasons that negatively affect the academic performance of students. However, the problem of parties, gumbas or bashes in the vicinity of residences, indicated by some students (34,78%), was considered a valid reason that could play a major role in negatively affecting the students' academic performance. It has previously been established that these factors have a negative impact on students' academic performance. These statistics are graphically depicted in Figure 6.41.

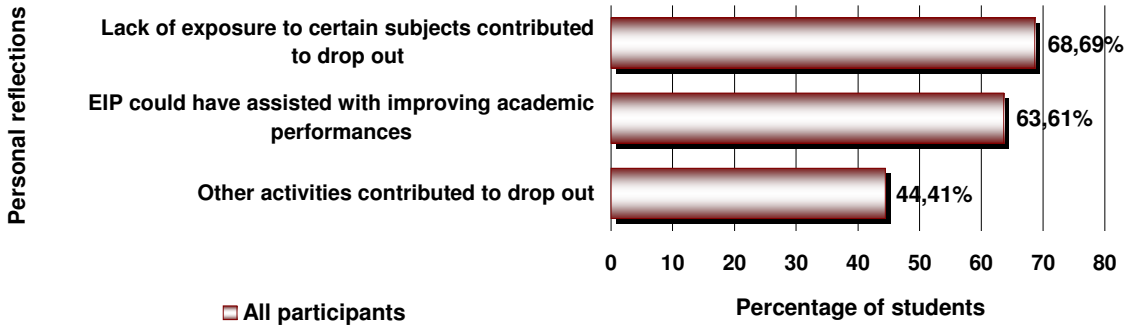

FIGURE 6.41: Section 4.6 - Personal reflections

6.6 HIGHER ORDER ANALYSIS OF DATA AND IDENTIFICATION OF EMERGING PATTERNS

The qualitative analysis began with the predetermined categories, which were guided by the conceptual framework, to summarise and repack the data obtained from the open-ended questions of the questionnaire survey. The data were scrutinised, analysed, classified, summarised and tabulated to complete the basic content analysis. These codes were descriptive and entailed little interpretation as they were contributing a class of phenomenon to a segment of the text. During the basic analyses, recurring patterns or themes, which pulled together the separate pieces of data, were noted. These were followed by the higher level of data analysis, which was interpretive and it was concerned with what was meant by the response, what was inferred or implied. It was aimed at identifying patterns or themes concerning the findings of Phase 2 of the empirical study.

6.6.1 Pattern 1: The importance of pre-selection knowledge of higher education institutions before enrolment

Students seemed to favour word-of-mouth referrals for their choice of higher education institution (see Section 6.3 and Table 6.7). Some students' apparent lack of research into the higher education sector resulted in them applying too late for entry into their preferred higher education institution. This, along side poor Grade 12 results, resulted in negative responses from the higher education institutions of their choice (see Section 6.3 and Table 6.9). The pattern that transpired indicated that students were not enrolled in the institution regarded as their first choice, mainly due to poor Grade 12 results.

6.6.2 Pattern 2: The importance of environmental issues

The lack of a healthy study environment was highlighted in the responses that described the academic environment in terms of the programme, institutional and demographical environments. Students apparently experienced problems adapting to the higher education environment, managing their time sufficiently (see Section 6.4 and Tables 6.13, 6.17). In addition, they seemingly experienced problems with their study skills (see Section 6.4 and Table 6.15). Many of the responses centred on the unclean and overcrowded facilities, mainly lecture rooms and the library facilities. The pattern observed was that the respondents not only perceived unclean and overcrowded facilities as negative influences on academic performance, but also the excessive noise pollution caused by students loitering outside the lecture rooms and the library facilities (see Section 6.4, in particular 6.4.2).

6.6.3 Pattern 3: Why students did not complete their studies

The first pattern that emerged from the responses was that constraints regarding financial, health and partner obligations hindered students' academic performance (see Section 6.5). It became apparent that the majority of students were dependent on their parents/guardian for financial assistance (see Section 6.5.1). Students perceived the cost of textbooks as high (see Section 6.5.4) and evidently experienced problems relating to teaching and learning (See Section 6.5.5). The pattern that emerged from the responses regarding teaching and learning highlighted lecturing constraints, which have to be further investigated after completion of the study (see Table 6.32).

From the above identification of emerging patterns, it became evident that the reason for students dropping out of the diploma programmes was independent of the EIP, but dependent on the academic support services provided by the institution.

6.7 CONCLUSION

This chapter presented the findings obtained from the questionnaire survey completed by students who dropped out of the diploma programmes. The results indicated that the following factors had a negative effect on students' academic performance:

- Students do not sufficiently explore the higher education institutions available for further studies. The majority of students preferred to study at other higher education institutions, not at the VUT.
- Students are not coping with the higher education environment, mainly due to problems experienced with study methods, time management and an excessive workload. A gap exists between the school environment and the higher education environment. According to the students' perceptions, an EIP would make the transition into the higher education environment easier.
- The library supplied ample study material. However, the students indicated a significant shortage of computers and study halls. Owing to the overcrowded conditions in the library, excessive noise pollution and unclean facilities were experienced by students.
- The majority students resided outside the Gauteng province and, therefore, lived in the residences. The students indicated that they experienced overcrowding and excessive noise pollution (due to parties, gumbas and bashes) near their residences.
- Students experienced financial constraints because the majority of students were financially dependent on their parents or a guardian.
- A few students had to drop out due to health reasons.
- There were students who indicated that they had to contend with extra domestic responsibilities and financial constraints because they had minor dependants.
- The majority of students could not afford the prescribed textbooks. Many students did not have any experience of how to utilise a textbook as they never used them in school.

- The majority of students experienced major problems within the teaching and learning area. Students experienced difficulties with lecturers allegedly applying ineffective teaching and learning methodologies and some of the results obtained here have to be investigated after completion of this study. Owing to overcrowding in the classes, excessive noise pollution (also from students loitering outside lecture rooms) and unclean facilities were experienced by students.

The next chapter provides the synthesis, conclusions and recommendations of the study, which includes a curriculum framework for the EIP in the engineering study field at the VUT.

CHAPTER 7

SYNTHESIS, CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The EIP was designed as an AD programme and implemented to broaden access through alternative admission to accommodate under-prepared engineering students at the VUT. There are students who have the potential to succeed within the higher education sector. In order to justify the development of the curriculum framework for the EIP at the VUT, this study included a literature overview, data from the comparison group post-test only design and data from a questionnaire survey. The empirical study was undertaken with the intention of developing a curriculum framework for an EIP that can possibly also be utilised by other higher education institutions.

Chapter 1 dealt with the orientation to the study, introducing the relevant background information relating to the identified research problem. Chapter 2 provided a broad literature review to obtain perspectives on the current higher education environment in South Africa. Chapter 3 offered a literature overview to obtain perspectives on curriculum development and reflected on aspects of importance regarding EIPs (national and abroad). The research design, methodology and data collection procedures were discussed in Chapter 4. Chapter 5 presented the quantitative data analysis for Phase 1 of the empirical study, while Chapter 6 provided the quantitative and the qualitative data analysis for Phase 2.

Investigating the social phenomenon of an EIP from diverse angles and perspectives permitted triangulation of the comprehensive literature with the obtained dual set of empirical data. This enabled the researcher to corroborate, elaborate and shed light on the findings to accomplish the rationale of the study that comprised the development of a curriculum framework for an EIP at the VUT. The final chapter deals with the synthesis of the study, provides the conclusions and recommendations of the empirical study, which includes the framework for the EIP in the engineering study field at the VUT.

7.2 SYNTHESIS OF THE STUDY

The main objective of the study was the formulation of a curriculum framework for an EIP at a higher education institution. Therefore, the main research question was formulated as: *what comprises a curriculum framework aimed at prospective engineering students at the VUT?*

From the background to the problem investigated in this study, it seemed that students attempting their higher education academic studies were under-prepared. This is mainly due to a lack of life, communication, numeric and literacy skills (see Sections 1.2, 1.3, 1.4). An AD programme for prospective engineering students has to comprise high-quality curriculum development procedures to ensure these students' academic success throughout their engineering studies. Consequently, an AD programme leads to participation within the higher education sector and eventually assists in providing quality graduates. This, in turn, helps to redress the significant shortage experienced within the engineering and technology sectors (see Sections 1.4, 1.5, 1.6).

The study was contextualised within the South African higher education environment as well as the legislative changes that recently occurred therein (see Sections 1.5, 1.6). Throughout the last decade, the government has implemented various legislative changes within the higher education sector and, consequently, provided a basis for AD programmes to be implemented within the sector. If these legislative changes were taken into consideration properly, curriculum development of an EIP could potentially be of a high quality (see Sections 1.5, 1.6).

An overview of the higher education landscape in South Africa (see Section 2.2) highlighted the notion of transformation in higher education as a process of establishing a higher education system that is planned, governed and funded as a single coordinated entity (see Section 2.2.1). It positively established that higher education institutions had to widen access opportunities for students. However, not all applicants are suitable regarding the entrance requirements of higher education institutions (see Section 2.4). National benchmark tests are not yet available for selecting students who are most likely to succeed with their academic studies at higher education institutions. The study therefore concentrated on those students

who were unsuccessful with their applications, but showed potential in becoming successful higher education students within the study field of engineering. The fact that different skills and competencies exist for different stages within academic programmes was recognised and these were compared to trainee engineers who work with the acceptable standards set and to expert engineers who work with the acceptable standards set, although not set on the same level of competency (see Sections 2.4, 2.5, 2.6).

The study further linked the EIP curriculum to generic learning outcomes specifically set at the NQF Level 4, suggesting the application of continuous assessments in line with OBE criteria and related quality assurance to fit the HEQC and ECSA audit criteria respectively (see Sections 2.5, 3.2). Learning constructs signified the teaching, learning and skill training features resulting in critically reflective students who ‘want to’ learn. The DAD model (in conjunction with Bloom’s taxonomy) approach was taken as being particularly applicable to the EIP subjects (mathematics, science, computer and language literacy) which rely on the pedagogy of PBL and learning that is not confined to disciplinary boundaries. PBL encourages an integrative approach to learning. Furthermore, PBL is based on requirements of the problem, as perceived by the students themselves (see Section 3.3).

Data from the FET band confirmed the causes underlying student failure to graduate within the engineering study field, which justifies the need for intervention programmes at higher education institutions (see Section 3.4). It became evident that schooling inequalities had a profoundly negative impact on academic performance of students in higher education and that the responsibility to overcome these inequalities had been transferred to higher education institutions. The poor success rate of current EIPs emphasised the need for a sound curriculum framework for an introduction to science, engineering and technology programme at higher education institutions (see Sections 3.5, 3.6). It was established that EIPs similar to the Intro SET programme have to provide the necessary scaffolding to construct sustainable strategies for the successful expansion of the South African school system. In addition, they should be accountable for having a lasting effect on programme improvements. Moreover, they should offer successful returns over time (see Section 3.7).

Results obtained for the first empirical phase of the study was statistically analysed and described. The appropriate assumptions were made and these included the following:

- Direct students performed academically better in the subject of Mathematics I than the Intro students. However, the Intro students needed fewer attempts to pass the subject of Mathematics I than the direct students needed (see Sections 2.3, 2.4, 2.5; Sections 3.4, 3.5, 3.6; Section 5.2; Chapter 6).
- Intro students performed academically better in the subject of Electrical Engineering I than the direct students did. The Intro students also needed fewer attempts to pass the subject Electrical Engineering I than the direct students did (see Sections 2.3, 2.4, 2.5; Sections 3.4, 3.5, 3.6; Section 5.2; Chapter 6).
- Intro students performed academically as well as the direct students. The Intro SET subjects of mathematics, science, computer and language literacy had a positive effect on the mainstream diploma programmes subjects (see Sections 2.3, 2.4, 2.5; Sections 3.4, 3.5, 3.6; Section 5.2; Chapter 6).
- Intro students dropped out of the diploma programmes as often as the direct students did. However, there was a small, but positive, percentage difference in the Intro students continuing with the diploma programmes (see Sections 2.3, 2.4, 2.5; Sections 3.4, 3.5, 3.6; Section 5.4; Chapter 6).
- Intro students graduated from the diploma programmes at the same rate as that of the direct students. This statistically supported the results that the Intro students performed as well as the direct students did within the academic diploma programmes. However, there was a small, but positive, percentage difference in the Intro students graduating from the diploma programmes. Therefore, the assumption was made that the EIP had been well conceptualised and properly implemented and that a sound programme framework can be formulated to conclude the rationale of the study (Sections 2.3, 2.4, 2.5; Sections 3.4, 3.5, 3.6; Section 5.4; Chapter 6,).

Results obtained for the second phase of the empirical study were statistically analysed and described.

The appropriate assumptions were made and these included:

- The majority of students preferred to study at other higher education institutions, rather than the VUT (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Section 5.2; Section 6.2).
- Students were not coping with the higher education environment, mainly due to problems experienced with study methods, time management and an excessive workload. A gap was experienced between the school education environment and the higher education environment and it was perceived that an EIP would make the transition into the higher education environment easier (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.3).
- The library did supply ample study material but there is a significant shortage of computers and study halls. Owing to overcrowding in the library, the students experienced excessive noise pollution and unclean facilities (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.4).
- The majority of students resided outside the Gauteng province and, therefore, resided in the residences. The students experienced overcrowding and excessive noise pollution (owing to parties, gumbas and bashes) in their residences (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.4).
- Students experienced financial constraints because the majority of them were financially dependent on their parents or guardian (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.5).
- A few students had to drop out due to health reasons (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.5).
- Certain students had experienced extra domestic responsibilities and financial constraints because they had minor dependants (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.5).
- The majority of students could not afford the prescribed textbooks. Many students did not have any experience in how to utilise a textbook, as they have never used textbooks in school (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.5).
- The majority of students experienced major problems within the teaching and learning area. Students experienced difficulties with lecturers applying ineffective teaching and learning methodologies. Owing to overcrowding in the lecture rooms, the students experienced excessive noise pollution and unclean

facilities (see Sections 2.3, 2.4; Sections 3.4, 3.6, 3.7; Sections 5.3, 5.4; Section 6.5).

7.3 CONCLUSIONS

Based on the findings of the study, several conclusions could be drawn and are consequently discussed.

The EIP subjects of mathematics, science, computer and language literacy had a positive effect on the diploma programme subjects. This statement correlates with the completed literature overview and, in particular, with the findings of Amos and Fisher (1988: 17-23); Amos (1999: 177-182); Doolittle and Camp (1999: 25); King and Kitchener (2004: 5-18); Woollacott and Henning (2004: 2-7); Dicks *et al*. (2006: 7). The findings of these researchers indicate that higher education institutions need to have engineering AD programmes that focus on developing students with knowledge of mechanical practices and techniques, as well as on developing students with higher level thinking, problem-solving skills and the skills required to cooperate with others. Therefore, it was concluded that the subject of mathematics integrated well with the other subjects on offer (EIP and diploma); however, the pure mathematical sections of the subject had a negative effect on the subject of Mathematics I in the diploma programmes.

Another conclusion was that the EIP was seemingly successfully constructed and properly implemented, as there were a slightly higher percentage of Intro students graduating from the diploma programmes than direct students. This conclusion was supported by other attempts to assess the success of EIPs in increasing the post-secondary opportunities of under-prepared students (Jawitz, 1992; Hayward, Brandes, Kirst & Mazzeo, 1997; Raubenheimer, 1998; Bloomer & Hodkinson, 2000; Pearce, 2000a; Nozaki & Shireman, 2001: 49-50; Coffield, 2002; Perna, 2002: 64-83; Aldridge & Tuckett, 2003; Crossan *et al*., 2003; Dockrell *et al*., 2006: 82-90; CORE, 2007: 1-2; Kerbal, 2008: 1-18; UNAM, 2008: 1-2; UTP, 2008: 1-12).

The main aim of increasing the number of successful engineering students and, therefore, positively influencing the Faculty's throughput rate has been successfully accomplished at the VUT. Therefore, the EIP positively assisted in producing

additionally qualified technical individuals to participate in the industrial sector that is currently experiencing a critical shortage of technical-skilled workers (Beute, 1996; Gibbons, 1999: 11; Kelly III, 2008).

In comparison to the direct students, fewer Intro students dropped out of the diploma programmes. This supports the conclusion made that the EIP at the VUT was seemingly successful and developed according to the higher education sector's needs (HEQC, 2002a: 3; HEQC, 2002b: 7; CHE, 2004a: 97-98; DoE, 2007: 9; ECSA, 2007: 9; SA, 2007: 1-3; NQF, 2008: 1-4; SAQA, 2008: 2). The slight percentage difference in the dropout figures between Intro students and direct students in the diploma programmes did not reflect negatively on the EIP as other reasons, independent of the EIP, for dropping out were identified during the second phase of the empirical study.

An analysis of the reasons for students dropping out of the diploma programmes led to further conclusions.

It was concluded that the intake criteria of the VUT differed from that of other higher education institutions, given that students whose applications were unsuccessful at these institutions were accepted at the VUT. Brennan and Lebeau (2002: 4) also considered placement in higher education institutions as fundamental to the long-term impact of higher education on the future direction of society.

Another conclusion was that the VUT apparently has unclean facilities and overcrowding (library and lecture rooms) in areas of great importance to the academic wellbeing of students. In addition, constraints were experienced within teaching and learning (diverse problems regarding lecturers, prescribed textbooks and lecture rooms), an area considered as being of extreme importance to the successful academic wellbeing of students. It can therefore be concluded that the VUT has apparently not yet accomplished the shift in emphasis from teaching to learning (O'Banion, 1996: 22; Digest, 1997: 1-6; Barr & Tagg, 1995: 13; 2007: 1-2).

Extreme noise pollution was experienced at the institution (loitering students) and at the residences (parties, gumbas and bashes). These areas are supposed to be maintained as healthy study environments as they are considered important to the

academic wellbeing of students. This conclusion suggests that universities need to be more closely involved in the analysis, exploration and experimentation of a wide range of ideas and values regarding the consequences of social interaction in order to design and maintain healthy study environments (Chomsky, 2003: 278).

The majority of the conclusions reached within the second phase of the empirical study regarding the reasons for students dropping out of diploma programmes concurred with the results obtained by the Total Quality Management Office's report on support services at the VUT (Brits, 2007: 1-22).

7.4 RECOMMENDATIONS

Curricula refer to both individual and collective learning experiences. The growing recognition of professional fields as well as the attendant expansion of professional education has fostered curriculum adaptation and evolution (see Chapter 3). In order to overcome the identified problems, higher education institutions, in particular the VUT, need to consider the following recommendations stemming from the conclusions reached in this study.

7.4.1 Recommendation 1

The intake criteria of the VUT should be benchmarked against other comparable higher education institutions. In order to maintain consistency and transparency across the higher education sector, students who, due to poor Grade 12 results, were unsuccessful in their application to one institution, should be unacceptable at all the other institutions. This will aid in ensuring the academic integrity of all qualifications within the South African higher education sector, including engineering qualifications.

7.4.2 Recommendation 2

From an institutional perspective, the VUT has to consider expanding the lecture rooms as well as the library and its facilities, as overcrowding of these facilities leads to noise pollution in areas that were supposed to be quiet. Students need a safe and quiet environment to commence with their academic studies. Currently, no such environment is available, as even the residences suffer overcrowding and high noise pollution. The shortage of lecturer personnel experienced within the engineering

faculty also added to the overcrowding of lecture rooms, as the existing lecturer personnel had to accommodate the excess students who were allocated to the vacant lecturing positions. The institution should perhaps consider dropping the affirmative action approach within the scare skill area (specifically engineering) if no suitable affirmative action applications are received. The VUT needs to cultivate an environment of learning. Too many students are loitering outside the lecture rooms during lecture hours. Students have to learn to respect the educational environment and commit themselves to learning. A positive change in the educational environment of the institution can change students' perceptions and attitudes towards their own academic responsibilities, which may lead to a healthier study environment and, consequently, to fewer dropout students within the diploma programmes. Higher education institutions have to ensure that the institutional environment can maintain the number of students enrolled at the institution.

7.4.3 Recommendation 3

The VUT has to consider placing engineering students together in the same residence. The engineering diploma programmes consist of an extensive workload, resulting in many hours of homework, self-study and additional research. Therefore, these students need a safe and quiet environment to reside in during their study period in order to complete their academic studies successfully. Currently, residences experience high levels of noise pollution due to parties. Ensuring that residences only accommodate students from within the same study fields may lead to lower levels of noise pollution. Authorities also have to ensure that the institutional residences can maintain the number of students enrolled at the institution.

7.4.4 Recommendation 4

The VUT's EIP subject of mathematics has to be revised in order to determine whether the curriculum needs to change. It was concluded that the pure mathematical sections of the subject had a negative effect on the subject of Mathematics I in the diploma programmes.

Mathematics 1 is a compulsory subject for all the first-year engineering students and it is imperative that they successfully pass this subject on their first examination attempt. Currently, students tend to be unsuccessful in passing this subject on their first examination attempt.

7.4.5 Recommendation 5

An increase in the pass rate of Intro students in the VUT's engineering diploma programme over a period of five years served as an indicator of the success of the EIP. The main recommendation from the findings of this study is the formulation of a curriculum framework. A framework that aims at providing structured guidance, in the form of a skeleton profile, that provides strength to the inner sub-structures of curriculum development, institutional development and programme development. Hence, the curriculum framework can be described as a sustainable practice that comprises a methodology, technique and innovative use of resources that has a proven record of success in providing continuous improvements in academic performance, quality performance or other measurable factors. This might enable a higher education institution to deliver best value to their prospective students, which, in turn, has a positive impact on the overall success of the institution. A curriculum framework providing introductory learning experiences for prospective students in the study field of engineering at the VUT is depicted in Figure 7.1.

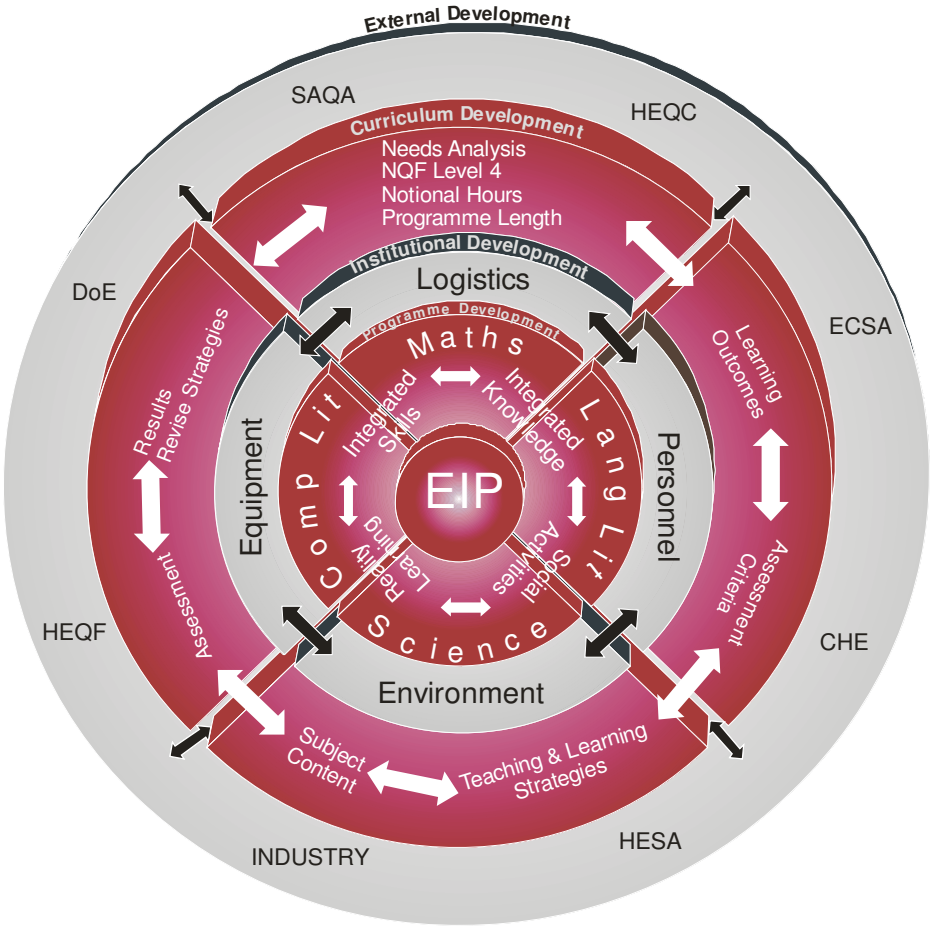

FIGURE 7.1: A curriculum framework for an EIP at a higher education institution

The proposed curriculum framework depicts the EIP as the focus of the framework. On the periphery of the frame (External Development) and influencing all the other layers in the frame, are the contextual role players responsible for legislation and regulations, as well as statutory bodies and providers of education. National and international trends that have an impact on the student and the learning in focus are of importance and provide a backdrop to the curriculum activities within (see Chapter 2).

The next layer in the framework represents the curriculum development activities. These activities were determined from the literature (see Chapter 3). The subsequent layer in the framework represents the institutional development activities. Higher education institutions need to provide the logistics, personnel, environment and educational equipment in order for an EIP to succeed. The central layer of the framework represents the programme development activities, all directed at prospective students and their learning activities as the focus of the framework. These activities were determined from the literature (see Chapter 3).

The two-way arrows are indicative of integration and reciprocal functioning. The openness of the layers represents flexibility and the ability to allow for diversity of students, but also depicts that external developments influence curriculum development, institutional development and programme development.

7.4.5.1 External development (peripheral layer)

Curriculum is contextually shaped and cannot be adequately understood or substantially changed without attention to setting or context. A contextual and conceptual overview of the legislative changes and the changing structures within higher education during the post-apartheid era was outlined (see Chapter 2). The main role players within this layer are the DoE, HEQC, HESA, CHE, ECSA and the industry. The legislative changes within the HEQF and SAQA have to be taken into account before the next layer (curriculum development) can be considered.

7.4.5.2 Curriculum development (second layer)

Curriculum design and curriculum development are issues that are increasingly linked to the sound description of developmental learning outcomes, assessments and quality assurance procedures. These developmental outcomes, assessments

and quality assurance procedures should inevitably be supported by scientific literature and policy concerns as has been indicated in Chapter 3. The EIP curriculum is linked to generic learning outcomes specifically set at the NQF Level 4, suggesting the application of continual assessments in line with OBE criteria and pertinent quality assurance to fit the HEQC and ECSA audit criteria respectively for higher education institutions. Several feedback techniques may be utilised, such as eliciting feedback from students, peers, superiors, alumni and role players in industry. The information obtained should be analysed and both positive and negative feedback should be acted upon to improve EIPs.

7.4.5.3 Institutional development (third layer)

Data from the FET band confirmed the causes underlying student failure to graduate within the engineering study field, which justifies the need for an intervention programme at higher education institutions. Schooling inequalities have a negative impact on academic performance in higher education and the responsibility to overcome these inequalities appears to have been transferred to higher education institutions. Higher education institutions that offer introduction programmes as independent sustainable programmes are in need of a sound institutional development culture.

7.4.5.4 Programme development (central layer)

Learning constructs signify the teaching, learning and skill training features resulting in critically reflective students who ‘want to’ learn. The application of Bloom’s taxonomy in parallel with the DAD model increasingly enhances a deep approach to learning and links the emotional aspects of experience to memory. This approach is highly applicable to the introduction programme subjects (mathematics, science, computer- and language literacy), which rely on the pedagogy of PBL. PBL is unconfined by discipline boundaries, encourages an integrative approach to learning, and is based on requirements of the problem as perceived by the students themselves.

7.5 UNIQUE CONTRIBUTIONS OF THE STUDY

The study highlighted specific aspects regarding the redressing and broadening of access to the higher education environment, as well as curriculum development

theories that contributed towards the success of the VUT's EIP programme. Although no specific examples were supplied under the literature studies comprising Chapters 2 and 3, the following sections provide specific examples of the redress and curriculum theories applied in the VUT's EIP programme.

7.5.1 Access criteria

The access criterion of the EIP differs from that of the diploma programmes. The EIP caters for those students who were unsuccessful in their diploma programme applications (see Section 1.2 and Section 3.8). The respective differences between the entrance requirements of the EIP and the diploma programmes for 2009 are depicted in Figure 7.2.

EIP ENTRANCE CRITERION	
Points	21
English	3
Mathematics	3
Physical science	3
Life orientation	3

DIPLOMA PROGRAMMES ENTRANCE CRITERION	
Points	24
English	4
Mathematics	4
Physical science	4
Life orientation	3

FIGURE 7.2: Entrance requirements for the EIP and the diploma programmes

EIP students did not qualify for entrance into the diploma programmes. Therefore, the entrance criterion for the EIP was set lower than that for the diploma programmes. Through gaining access into the EIP programme, the rejected students have a chance to re-apply for entrance into the diploma programmes after successfully completing the EIP. The exit level outcomes of the EIP subjects are high (60% per subject) to ensure that well prepared students enter into the first-year diploma programmes (Section 3.8.2). The mere fact that the alumni Intro students graduated at a slightly higher percentage rate than the direct students (see Section 5.4) is an indication that the EIP contributed positively towards the decreasing engineering workforce (see Section 1.2 and Section 7.3) and increased the faculty's throughput rate.

Fewer Intro students dropped out of the diploma programmes, indicating that, in comparison to direct students, these students may handle the pressures of higher education better (see Section 5.3; Sections 6.4.1.1; 6.4.2). Even so, this does not indicate how the EIP can be defined as a programme that may suit international needs.

7.5.2 Internationalisation

During the study, no statistical evidence was available from any country to prove scientifically that their introduction programmes were successful (Section 3.5). An international conferences attended (2007) by the researcher resulted in great interest in the VUT's EIP, as the UK is starting to experience the same scenario as South Africa regarding academic under preparedness and skill shortages within higher education programmes. These countries currently have a high percentage of immigrants (whose first language is not necessarily English) attending their higher education institutions.

Nationally, only three higher education institutions claimed successes with their introduction programmes. One of these institutions discontinued their introduction programme (see Table 3.6). Hence, no statistical evidence was available to prove that these programmes delivered a higher graduation rate for their faculties.

The results obtained from this study seem to be the first conclusive evidence published within the field of engineering education. The next section describes specific actions taken within the VUT's EIP to accommodate the curriculum development and theories specified within the completed literature study. Some of the reasons that contributed to the success of the VUT's EIP are discussed next.

7.6 RELATING THE STUDY TO APPLICABLE CURRICULUM THEORY

The success of the EIP can be contributed to the curriculum developers and the methodologies applied within teaching and learning. All examples provided are applied within the EIP at the VUT and are implicitly linked to the curriculum theory as well as the teaching and learning interventions developed and described in the literature overview in Chapter 3.

Owing to the fact that the EIP was designed to accommodate the prospective students from the entire engineering spectrum, the curriculum developers first had to complete a needs analysis. This needs analysis had to be completed in order to determine the specific academic shortcomings of the prospective students and to establish which generic skills would have to be included to provide a well-prepared student for the first-year diploma programmes. Means-end rationality led to the curriculum developer's decision that the institutional method (cf. Bloom's taxonomy and resulting methodology) and the content (generic) was technical; therefore, the technical production method was followed to construct the subjects and the curriculum of the EIP (see Section 3.2.1).

The themes to curriculum development that are prevalent in the EIPs classroom practice are best described with a practical example. Constructivism (see Section 3.2.2) merely describes how learning should happen and can be seen as a description of human cognition. Social constructivism (Derry, 1999; McMahon, 1997) emphasises the importance of cultures and context in understanding what occurs in society (see Section 3.2.2). The Department of Minerals and Energy supplied the EIP science lecturers with several untested energy (electricity) saving tips. The EIP students are divided into groups and each group receives a different energy saving tip to experiment with. The aim of this experiment is to determine if the supplied tip actually saves energy (calculated in rands and cents), and, if not, rephrase the savings tip according to the results obtained. Owing to the diverse student intake experienced at the VUT, not all students had access to electricity where they resided and improvisations to the supplied tips are discussed by the students. Should a group concur and decided to adapt the supplied energy saving tip to suit their own social experiences; they approach the lecturer and argue the 'new' saving tip. Should the argument prove valid and useful within the society, in other words lead to a valid energy saving result, the group is allowed to alter the tip and establish a new tip (see Sections 3.2.2; 3.2.3; 3.3.3).

There is an increasing movement to consider student outcomes, improve student assessment and refocus the institutional mission onto student learning. The paradigm shift from teaching to learning led to the development of the DAD model (see Section 3.3.1.2), and the application thereof within the theory classes. Bloom's taxonomy is the general instruction methodology applied within the VUT. However,

research conducted indicated that the majority of the EIP students were right brain dominant learners. Methodologies applied to right brain dominant learners need to differ from that of left brain dominant learners. However, both types of students need to be accommodated during lectures, in order to obtain the best possible academic results. The DAD model was developed and is applied within the theory classes. Theory classes comprise visual, audio and kinaesthetic equipment to accommodate the diverse student population.

It is also important to mention that halfway through each lesson the lecturer takes a break and lets the students do brain gym exercises. The exercises always produce spurs of laughter many students do not get them right on their first attempt. The students are positively motivated and an attitude change towards the academic lessons starts to occur. Positive emotions are experienced by the students, changing their frame of mind from ‘have to learn’ to ‘want to learn’. With a more positive frame of mind, the students start to enjoy the lectures and begin to participate actively with the lecturers. Therefore, perceptions towards the academia change. Deep learning approaches are characterised by intrinsic motivation and work concurrent with the DAD model through linking the emotional aspects to memory (see Sections 3.3.1.2; 3.3.2).

7.7 RECOMMENDATIONS FOR ADDITIONAL RESEARCH

The identified problems regarding the VUT’s institutional academic support systems affected the students’ academic performance. The lack of academic support given to students and/or lecturers needs to be investigated. In addition, further research into the specific problems identified needs to be undertaken.

An assumption was also made that the teaching and learning environment negatively affected the students’ academic performance. In order for this to be rectified, further research into the preferred shift in emphasis from teaching to learning should be conducted from an institutional point of view.

The VUT currently has no entrance tests to help the institution select students who are most likely to succeed at their academic studies and to measure how well the new national school curriculum prepares learners for higher education. Further

research needs to be conducted into formulating entrance tests that are benchmarked against other comparable higher education institutions.

The problems relating to massification within the institution seems to pose huge challenges to an institution such as the VUT. Therefore, the logistical problems and noise pollution identified within this study need to be investigated further in order to ascertain whether the growth rate of institutional capacity realistic matches the growth rate of the student population.

7.8 CONCLUDING REMARKS

The study attempted to identify new knowledge that may be exploited to address the problems experienced within the higher education sector regarding the broadening of access to higher education and diverse student participation. Furthermore, the study identified a significant need for an EIP at the VUT and concluded with a curriculum framework for an EIP that might be utilised by other higher education institutions, in addition to the VUT.

Within the context of this study, it is relevant to highlight the famous words of John F Kennedy, the late president of the United States of America, who once said: "*Let us think of education as the means of developing our greatest abilities, because in each of us there is a private hope and dream which can be translated into benefit for everyone and greater strength for our nation*." (http://www.quoteopia.com)

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ANNEXURE 1

TABLE A-1: The post-apartheid national landscape of the South African higher education sector

INSTITUTIONAL TYPE		INSTITUTIONS
UNIVERSITIES	**8** Separated and incorporated universities	**University of Cape Town** (UCT) **University of Fort Hare** (UFH) UFH + Rhodes University (East London Campus) **University of the Free State** (UFS) UFS + Vista University (Bloemfontein) + University of the North (Qwa-Qwa) **University of Pretoria** (UP) UP + Vista University (Mamelodi) **Rhodes University** **University of Stellenbosch** (US) **University of the Western Cape** (UWC) UWC +University of Stellenbosch Dental School **University of the Witwatersrand** (Wits)
	3 Merged universities	**University of KwaZulu-Natal** (UKZN) University of Durban-Westville (UDW) + University of Natal **University of Limpopo** (UL) University of the North (UNIN) + Medical University of South Africa (MEDUNSA) **North-West University** (NWU) Potchefstroom University for Higher Education (PUCHE) + University of North-West (UNW) + Vista University (Staff and students of Sebokeng)
UNIVERSITIES OF TECHNOLOGY	**2** Separate and incorporated (Technikons) UoTs	**Central University of Technology** (CUT) Technikon Free State (TFS) + Vista University (Welkom) **Vaal University of Technology** (VUT) Vaal Triangle Technikon + Vista University (infrastructure and facilities of Sebokeng)
	3 Merged (Technikons) UoTs	**Cape Peninsula University of Technology** (CPUT) Cape Technikon + Peninsula Technikon (Pentech) **Durban Institute of Technology** (DIT) Mangosuthu Technikon + infrastructure and facilities of the Umlazi campus of the University of Zululand **Tshwane University of Technology** (TUT) Technikon Pretoria (TP) + Technikon Northen Gauteng (TNG) + Technikon North-West

TABLE A-1: The post-apartheid national landscape of the South African higher education sector (…continued)

INSTITUTIONAL TYPE		INSTITUTIONS
COMPREHENSIVE UNIVERSITIES	**2** Separate universities	**University of Venda for Science and Technology** **University of Zululand**
	4 Merged institutions	**University of Johannesburg** (UJ) Rand Afrikaans University (RAU) + Technikon Witwatersrand + Vista University (East Rand and Soweto) **Nelson Mandela Metropolitan University** (NMMU) University of Port Elizabeth (UPE) + Port Elizabeth Technikon (PET) + Vista University (Port Elizabeth) **University of South Africa** (UNISA) Technikon South Africa (TSA) + Vista University Distance Education Centre (VUDEC) **Walter Sisulu University of Technology and Science** University of Transkei (Unitra) + Border Technikon + Eastern Cape Technikon
NATIONAL INSTITUTES		**Mpumalanga Institute for Higher Education** **Northern Cape Institute for Higher Education**

(Source: Adapted from CHE, 2004a: 50)

The post-apartheid national landscape of the South African higher education sector, which was established through mergers and campus incorporations, are listed above. However, the information from this source is incorrect regarding the DIT merger.

Durban Institute of Technology (DIT) Natal Technikon + Technikon ML Sultan + infrastructure and facilities of the Umlazi campus of the University of Zululand

(Source: SA, 2007: 20-21)

The DIT is supposed to be the Durban University of Technology (DUT), but very few sources refer to DUT (SA, 2003: 2; World Education and News Reports (WENR), 2004: 7; CHE, 2004a: 50; CHE, 2004b; Wikipedia, 2007: 1; SA, 2007: 20-21; DUT, 2008: 1).

ANNEXURE 2

TABLE A-2: The critical cross-field outcomes: criteria specified by SAQA

CRITICAL CROSS-FIELD (GENERIC) OUTCOMES	
1	Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.
2	Work effectively with others as a member of a team, group, organisation and/or community.
3	Organise and manage oneself and one's activities responsibly and effectively.
4	Collect, analyse, organise and critically evaluate information.
5	Identify and solve problems in which solutions display that responsible decisions have been made, using critical creative thinking.
6	Use science and technology effectively and critically, showing responsibility towards the environment and the health of others.
7	Communicate effectively using visual, scientific and/or language skills in the modes of oral and/or written presentations.
In order to contribute to the full personal development of each student and the social and economic development of the society at large, it must be the intention underlying and programme of learning to make an individual aware of the importance of:	
1	reflecting and exploring a variety of strategies to learn more effectively;
2	participating as responsible citizens in the life of local, national and global communities;
3	being culturally and aesthetically sensitive across a wide range of social contexts;
4	exploring education and career opportunities; and
5	developing entrepreneurial opportunities and business skills based on sound management principles.

(Source: SAQA, 2000: 18-19)

ANNEXURE 3

TABLE A-3: Goals and strategic objectives of the National Plan for Higher Education, 2001, as linked to the Higher Education White Paper 3

	GOALS	STRATEGIC OBJECTIVES
1	Provide a full spectrum of advanced educational opportunities for an expanding range of the population, without any form of discrimination. (cf. White Paper 1.27)	Produce graduates with skills and competencies to meet the human resource development needs of South Africa.
2	Promote equity of access and fair chances for success, and advance redress for past inequalities. (cf. White Paper 1.14)	Reflect demographic realities in South Africa in student and staff composition and ensure that the race and gender profile of graduates reflect the profile of student enrolments.
3	Diversify the system in terms of mission and programme mix to meet national and regional needs. (cf. White Paper 1.27)	Ensure diversity through mission and programme differentiation.
4	Secure and advance high-level research capacity to ensure intellectual equity and application to research for technological improvement and social development. (cf. White Paper 1.27)	Sustain current research strengths and promote research required to meet national development needs and build competitive capabilities.
5	Build new institutional and organisational forms and new institutional identities and cultures as part of a coordinated national higher education system. (cf. White Paper 2.42-2.45)	Foster collaboration at regional level and restructure the institutional landscape.

(Source: CHE, 2004a: 28)

ANNEXURE 4

TABLE A-4: The NQF qualification structure

NQF LEVEL	BAND	QUALIFICATION TYPE
8	Higher Education and Training	Post-Doctoral Research Degrees Doctorates Masters Degrees
7		Professional Qualifications Honours Degrees
6		National First Degrees Higher Diplomas
5		National Diplomas National Certificates
4	Further Education and Training	National Certificates
3		
2		
1	General Education and Training	Grade 9 | ABET Level 4 National Certificates

(Source: Adapted from CHE, 2001: 122)

ANNEXURE 5

TABLE A-5: NQF objectives as outlined in the SAQA Act No. 58 of 1995

	OBJECTIVES
1	Create an integrated international framework for learning achievements
2	Facilitate access to, as well as mobility and progression within education, training and career paths
3	Enhance the quality of education and training
4	Accelerate the redress of past unfair discrimination in education, training and employment opportunities
5	Contribute to the full personal development of each learner, and the social and economic development of the nation at large

(Sources: Adapted from RSA, 1998; SAQA, 2008: 1)

ANNEXURE 6

TABLE A-6.1: Issues of context to be taken into consideration for a QA system

ISSUES OF CONTEXT TO BE TAKEN INTO CONSIDERATION FOR A QA SYSTEM
The imminent reconfiguration of higher education in terms of size and shape, which is likely to require a more explicit mission specification and its effective delivery, within the context of national needs. This, in turn, will require the development of a more evenly capacitated and resourced higher education system to provide high quality education and training within a range of diverse institutional missions.
An uneven QA landscape with a range of un-integrated initiatives at national, institutional and regional levels.
The challenges that public and private higher education institutions face in responding to the requirements of the NQF.
The increased demands on higher education to deliver knowledge resources and services as well as higher-level skills and competencies for social and economic development.
The required role of higher education in facilitating social justice through enhanced participation opportunities in higher education for formerly disadvantaged constituencies.
The development of a higher education system whose objectives are delivered by public and private providers in a context of competition and collaboration.
The growing role of technology in teaching and learning, the expansion of higher education opportunities through distance and open-learning, and increasing arrangements for workplace learning at higher education levels.
The rapid internationalisation of higher education and the increasing mobility of graduates and professionals across national boundaries.

(Source: CHE, 2001: 2)

TABLE A-6.2: Criteria for HEQC audit judgements

CRITERIA FOR HEQC AUDIT JUDGEMENTS
The HEQC will take the institution's own specification of mission and objectives as a starting point for both the self-evaluation report and the external audit. It is assumed that institutional missions have taken national imperatives into account as articulated in the Higher Education Act, the National Plan for Higher Education, the Human Resource Development Strategy and other policy frameworks.
The HEQC will operate within the minimum standards requirements for general institutional efficiency set by the DoE and institutional governance structures.
The HEQC criteria for the areas of focus in relation to effective teaching and learning, research and service learning will be finalised in consultation with providers in time to be used during pilot audits in 2003.
The HEQC will also take into account institutionally set requirements and guidelines for effective teaching and learning, research and service learning.
The purpose of the audit is strongly linked to producing evidence-based information to be used by the institution for the planning, implementing and monitoring of quality development and improvement. Such information will be used by the HEQC to make a judgement on the effectiveness of the institution's internal quality systems for teaching and learning, research and service learning programmes, and makes recommendations for improvement.
The HEQC does not allocate any funds to institutions or programmes, nor does it make any direct input into decision-making on the funding and financing of higher education. HEQC audit outcomes therefore are not directly linked to funding. Funding for public institutions is the responsibility of the DoE, and for private providers it is the responsibility of their owners or governors.
A positive audit judgement could contribute to a decision by the Accreditation Committee of the HEQC to grant self-accreditation status to the institution for a six-year period. This status will enable the institution, under specified conditions, to re-accredit existing programmes in all areas not covered by a professional council or SETA ETQA.
There will be no ranking of higher education institutions.

(Source: CHE, 2002: 3-4; HEQC, 2002a; HEQC, 2002b; HEQC, 2003)

ANNEXURE 7

TABLE A-7: HEQF characteristics of generic programmes

HEQF CHARACTERISTICS OF GENERIC PROGRAMMES
– Be sufficiently flexible to accommodate different types of higher education institutions and enable institutions to pursue their own curriculum goals with creativity and innovation
– Facilitate the education of graduates who will contribute to the social, cultural and economic development of South Africa and participate successfully in the global economy and knowledge society
– Enhance the development of a vibrant, high quality research system
– Be compatible with international qualification frameworks in order to ensure international recognition and comparability of standards
– Be suitably flexible to accommodate the development of new qualification types and specialisations as the need arises
– Be simple, clear, easy to understand and user-friendly for the higher education system and its clients
– Facilitate qualification articulation across the higher education system and assist students to identify potential progression routes, particularly in the context of lifelong learning
– Articulate with the rest of the NQF

(Source: DoE, 2007: 10)

ANNEXURE 8

TABLE A-8: Entrance criteria applicable to the Faculty of Engineering and Technology at the VUT

COMPARISON OF RATINGS				
Year end 2008			1 January 2009	
Symbol	Rating		Symbol	Rating
	HG	SG		
A	8	7	7	8
B	7	6	6	7
C	6	5	5	6
D	5	4	4	5
E	4	3	3	4
F	3	2	2	3
FF	2	1	1	2

(Source: Adapted from Smit, 2008: 4)

The arrows are based on the entrance criteria for the Faculty of Engineering and Technology's diploma programmes (→) and the introduction programme (→) respectively.

ANNEXURE 9

TABLE A-9: The HEQF levels as applied in higher education institutions from January 1, 2009

NQF LEVEL	BAND	QUALIFICATION TYPE
10	Higher Education and Training	Doctorate Degrees
9		Masters Degrees
8		Bachelor Degrees Honours Post-Graduate Diplomas
7		Bachelor Degrees National Advanced Diplomas
6		National Diplomas National Advanced Certificates
5		National Higher Certificates

(Source: Adapted from DoE, 2007: 19-29)

ANNEXURE 10

TABLE A-10.1: Functions of a UoT, as provided by the CTP

THE FUNCTIONS OF A UOT
UoTs should provide greater learning opportunities, i.e. what do students need to make them more skilled, more competent and more employable; be more employer-centred: provide constant upgrading through short courses; take the institution into the workplace; liaise regularly with employers to ensure that the prospective employees receive relevant education.
UoTs should become specialists in 'just-in-time' education - experts in providing a continuous upgrading of knowledge and skills.
UoTs will have to provide leadership in 're-skill', 'up-skill' and 'multi-skill' activities, which will have to be creatively distributed over the careers and lifetime of students.
UoTs should be seen as institutions with a greater commitment of service to community upliftment than has previously been the case.
UoTs should solve society problems with communities and not for communities.

(Source: Adapted from Du Pré, 2004: 15-19)

TABLE A-10.2: Characteristics of a UoT, as provided by the CTP

CHARACTERISTICS OF A UOT
– A strong corporate-orientation/ focus
– Service to industry and the community
– Own characteristic roles and values
– Responsiveness to, and fulfilment of the needs of industry, community and society
– Appointment of experts acknowledged by industry (not necessarily by academics)
– Strong attention to niche areas
– Emphasis on scholarship, relevance of programmes, innovation as well as research and development
– Transfer of technology
– Preparation of a new generation of knowledge workers

(Source: Du Pré, 2004: 19-20)

TABLE A-10.3: Brook's outlook of UoTs

BROOK'S OUTLOOK ON UOTS
– Research informed
– Curriculum developed around the graduate profiles defined by industry and professions
– Focus on strategic research, applied research into professional practice
– Multi-level entry and exit points for students
– Concerned primarily with the development of vocational/professional education
– Technological capabilities important as cognitive skills

(Source: Du Pré, 2004: 26)

ANNEXURE 11

TABLE A-11: The three learning domains frequently used at the VUT

COGNITIVE DOMAIN	LEVELS OF LEARNING
Bloom's cognitive model: The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns and concepts that serve in the development of intellectual abilities and skills. **Anderson and Krathwohl's** revised cognitive model: The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns and concepts that serve in the development of intellectual abilities and skills.	Preparatory from bottom to top: Knowledge Comprehension Application Analysis Synthesis Evaluation Preparatory from bottom to top: Remembering Understanding Applying Analysing Evaluating Creating
AFFECTIVE DOMAIN	**LEVELS OF LEARNING**
Bloom's affective model: The affective domain includes the manner in which individuals deal with things emotionally, such as feelings, values, appreciation, enthusiasm, motivations and attitudes.	Preparatory from bottom to top: Receiving Responding Valuing Organising and conceptualising Characterising from value and value concepts
PSYCHOMOTOR DOMAIN	**LEVELS OF LEARNING**
Dave's psychomotor model: The psychomotor domain includes physical movement, coordination and the use of motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures or techniques in execution.	Preparatory from bottom to top: Imitation Manipulation Precision Articulation Naturalisation

(Source: Adapted from Atherton, 2005: 1-5)

ANNEXURE 12

The questionnaire completed by all the dropout students that could be persuaded to participate in the study.

VAAL UNIVERSITY OF TECHNOLOGY

FACULTY OF ENGINEERING & TECHNOLOGY

ENGINEERING DEVELOPMENT AND SUPPORT UNIT

2008

RESEARCH - QUESTIONNAIRE

STUDENT NUMBER: _____

Please note that your name or student number will never be revealed, as all the information collected is for research purposes only

To be completed by all

SECTION 1: GENERAL INFORMATION **Only tick (√) or cross (x) the applicable answer**

1 Study level:

1.1	S1	
1.2	S2	
1.3	S3	
1.4	S4	
1.5	P1	
1.6	P2	
1.7	I have graduated and obtained my Diploma	

2 Study field registered within the Faculty of Engineering & Technology at VUT:

2.1	Chemical	
2.2	Civil	
2.3	Computer Systems	
2.4	Industrial	
2.5	Electrical: Electronics or Electronic Communication	
2.6	Electrical: Instrumentation	
2.7	Electrical: Power	
2.8	Mechanical	
2.9	Metallurgy	
2.10	Process & Control	
2.11	Other: _____	

3 What is your home language?

3.1 _____

4 Is English your first, second, third or fourth language?

4.1	1st	
4.2	2nd	
4.3	3rd	
4.4	4th	

5 Where you in an English High School?

5.1	Yes	
5.2	No	

6 Age:

6.1	18 - 20	
6.2	21 - 23	
6.3	24 - 26	
6.4	Other:	

7 Population group (for research purposes only):

7.1 Black ☐

7.2 Coloured ☐

7.3 Indian ☐

7.4 White ☐

7.5 Other: _____

8 Gender (for research purposes only):

8.1 Male ☐

8.2 Female ☐

9 Did you write an aptitude test before entering VUT?

9.1 Yes ☐

9.2 No ☐

10 Was VUT your first choice when selecting a university?

10.1 Yes ☐

10.2 No ☐

Selected completetion only

SECTION 2: PRE-SELECTION KNOWLEDGE OBTAINED PRIOR TO ENROLMENT

Only tick (√), colour (■) or cross (x) the applicable answer.

Answer questions applicable to you, relating to your answers

		Strongly Agree	Agree	Disagree	Strongly Disagree
1	**Higher Education Institution Selection**				
1.1	I have investigated all the available Institutions				
1.2	I only investigated the Universities				
1.3	I only investigated the Universities of Technology				
1.4	I knew where I wanted to study				
1.5	How did you know where you wanted to study?				
1.6	I had no choice where to study				
1.7	Why did you have no choice?				
1.8	The VUT was my only choice				
1.9	The VUT was not my first choice				
1.10	Which Institution(s) did you wanted to go to? 1st choice: 2nd choice:				
1.11	The VUT came highly recommended				
1.12	Who recommended the VUT to you?				
2	**Engineering Discipline Selection**				
2.1	I have investigated the disciplines offered				
2.2	I did not know there was different disciplines				
2.3	I have investigated my choice of discipline				
2.4	My choice of discipline is offered at the VUT				
2.5	My choice of discipline is NOT offered at the VUT				
2.6	I was enrolled in my disciple of choice				
2.7	I was NOT enrolled in my disciple of choice				
2.8	Why could you not enrol in your discipline of choice?				
2.9	What was your discipline choice(s)? 1st choice: 2nd choice:				

To be completed by all

SECTION 3: ENVIRONMENTAL ISSUES

Only tick (√), colour (■) or cross (x) the applicable answer.

Answer questions applicable to you, relating to your answers

		Strongly Agree	Agree	Disagree	Strongly Disagree
1	**Programme Environmental**				
1.1	It was difficult to cope with the workload				
1.2	How can the workload be reduced?				
1.3	It was difficult to transform to higher education				
1.4	Can this transformation be made easier with an introduction to engineering programme?				
1.5	I had difficulties with study methods				
1.6	How can study methods be improved?				
1.7	I had difficulties managing time				
1.8	How can time management improve?				
1.9	There was a gap between what you were taught at school and what is expected to be known at university				
2	**Institutional Environmental**				
2.1	VUT offers a healthy study environment				
2.2	VUT does NOT offer a healthy study environment				
2.3	Why is the environment not seen as healthy?				
2.4	The library has ample study materials				
2.5	The library does NOT offer enough study materials				
2.6	There are enough computers to work on				
2.7	There are NOT enough computers to work on				
2.8	I investigated the environment before enrolment				
2.9	I was never introduced to the library or the computer facilities				
2.10	There are seldom interruption of classes				
2.11	There are major interruptions of classes				
2.12	There are never interruptions of classes				

3	**Demographical Environmental**					
3.1	I am an international student					
3.2	I am NOT an international student					
3.3	I come from Gauteng					
3.4	I am NOT from Gauteng					
3.5	From which province did you come from?					
3.6	I investigated all options where to stay					
3.7	I wanted to stay in the hostel					
3.8	I did NOT want to stay in the hostel					
3.9	I wanted to rent a private room					
3.10	I did NOT want to rent a private room					
3.11	I wanted to stay with relatives near campus					
3.12	I did NOT want to stay with relatives near campus					
3.13	My parents/guardian live near campus					
3.14	My parents/guardian live far from campus					
3.15	Where did you eventually stay?					
3.16	Was this accommodation your choice?					

To be completed by all

SECTION 4: WHY THE STUDY WAS NOT COMPLETED

Only tick (√), colour (■) or cross (x) the applicable answer.

Answer questions applicable to you, relating to your answers

		Strongly Agree	Agree	Disagree	Strongly Disagree
1	**Financial obligations**				
1.1	I had a bursary				
1.2	I did NOT have a bursary				
1.3	I support myself financially				
1.4	My parents/guardian support me financially				
1.5	I cannot financially afford to continue my studies				
2	**Health Obligations**				
2.1	I am unwell and cannot continue my studies				
2.2	I have family member(s) who are unwell and need to be attend to				
3	**Partner Obligations**				
3.1	I am married				
3.2	I am single				
3.3	I am married with child(ren)				
3.3.1	I have too many responsibilities at home				
3.3.2	Did these force you to stop your studies?				
3.3.3	Can you list some of the responsibilities?				
3.4	I am unmarried with child(ren)				
3.4.1	I have too many responsibilities at home				
3.4.2	Did these force you to stop your studies?				
3.4.3	Can you list some of the responsibilities?				
3.5	I fell pregnant during my period of study				
3.5.1	I have too many responsibilities at home				
3.5.2	Did these force you to stop your studies?				
3.5.3	Can you list some of the responsibilities?				
3.6	My girlfriend got pregnant during my study period				
3.6.1	I have too much responsibilities at home				
3.6.2	Did these force you to stop your studies?				

3.6.3 Can you list some of the responsibilities?

		Strongly Agree	Agree	Disagree	Strongly Disagree
4	**Course materials**				
4.1	I could not afford some of the textbooks				
4.2	I could not afford most of the textbooks				
4.3	I did not understand some of the textbooks				
4.4	I did not understand most of the textbooks				
4.5	I hardly ever used textbooks				
4.6	I never used textbooks				
4.7	Why did you prefer not to use textbooks?				
4.8	If course materials and text books were in my home language, I would have performed better				
5	**Teaching & Learning**				
5.1	I did not understand some of the explanations by the lecturers				
5.2	I did not understand most of the explanations by the lecturers				
5.3	Some of the lecturers did not explain the subject content at all				
5.4	Most of the lecturers did not explain the subject content at all				
5.5	Some of the lecturers only explain a concept and expect me to complete the rest				
5.6	Most of the lecturers only explain a concept and expect me to complete the rest				
5.7	Some of the lecturers only read the information from the textbook and give no explanation at all				
5.8	Most of the lecturers only read the information from the textbook and give no explanation at all				
5.9	How can teaching and learning be improved?				
5.10	There was enough time to ask questions during lectures				
5.11	Large classes hindered my performance				
5.12	Lecturers spent individual time with me				
6	**Personal Reflections**				
6.1	I would have been able to succeed if I attended an introduction programme before enrolment				
6.2	I only struggled with certain subjects				

		Strongly Agree	Agree	Disagree	Strongly Disagree
6.3	I was denied further access due to the continuation policy				
6.4	I can complete my studies, if given the opportunity				
6.5	Can you list the opportunities you require?				
6.6	I cannot complete my studies, even if I get the opportunity				
6.7	There is too many subjects				
6.8	There is too much work				
6.9	I had enough time to cover all the work				
6.10	There are other activities which distracted me from studying				
6.11	Can you list these activities?				
6.12	Enough time is spent on induction for first year students				
6.13	The lack of exposure to certain subjects at school level contributed to failure at university				
6.14	Hostel environment enhances studies				
6.15	Intro SET helped me through my first-year studies				

Thank you for your honest inputs and time!