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Identification and Classification of Incoming Learning Behaviours amongst a Sample of First Year, English Second Language, Engineering Students: A Case Study

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A Dissertation Submitted to the Faculty of Humanities,
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for the Degree Master of Education
2007

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Education at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

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Zanele Faith Simelane

_____

Date

DEDICATION

To my loving husband, Dan Ntokozo Simelane

In appreciation of your understanding and continuous encouragement and for always believing in me.

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ABSTRACT

This research identifies and classifies incoming learning behaviours found amongst a sample of English second language first year engineering students. During the research process, it was discovered that students entering university for an engineering/science based degree tend to struggle with the English lecture style and the pace of work at a first year level due to their having been taught in their mother tongue or through the use of code switching in their school years. It was further identified that the students who took part in the sample were highly reliant on notes and lecturers for 'obtaining knowledge' that could be utilized in the answering of problems. The findings indicate that English second language students who had been taught in Black schools had a limited view of knowledge that was dependant on received knowledge. It was further found that with the exception of students who had been taught in English only schools, there appeared little correlation between the matriculation aggregates of the students and their first year engineering marks. Where English second language first year engineering students exhibited some learning behaviours that suggest an aptitude for success in higher education, the findings suggest that the students who took part in the study do not feel supported at university. The findings, while complicated in nature, also suggest that university structures and procedures are not responsive to the specific needs of the sample group. It is the recommendation of this study that further research be undertaken amongst a larger sample group if curricular changes amongst first year engineering courses are to be considered.

KEY WORDS

English second language students, engineering, first year, learning behaviours, language

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ABBREVIATIONS AND ACRONYMS

ANC	African National Congress
CSEI	The Coopersmith Self-Esteem Inventory
DET	Term used to describe Black schools
DOE/DoE	Department of Education (South Africa)
ESLES	English Second Language Engineering Students
FET	Further Education and Training Band
INP	Information Processing
LASSI	The Learning and Study Strategies Inventory
MLE	Mediated Learning Experiences
NQF	National Qualifications Framework
PRME	School of Process and Materials Engineering
RAPM	The Raven's Advanced Progressive Matrices
TST	Testing Strategies
USA	United States of America
Wits	University of the Witwatersrand
ZPD	Zone of Proximal Development

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CHAPTER ONE

INTRODUCTION TO THE RESEARCH

Introduction to the Chapter

This chapter actuates with a brief historical background of the racial inequalities of the education sector under the apartheid era in South Africa. It also provides information regarding general education policy developments post 1994 as indicative of the democratic government's desire for the transformation of a previously elitist education system into one that is open, unrestrictive and free of inequality. Ensuing this, the chapter explores the impact of the legacy of apartheid on the achievement of Black students studying in science related fields in higher education and introduces the rationale and aim of this study which seeks to identify and classify incoming learning behaviours of a sample of first year, English second language, engineering students at the University of the Witwatersrand. The chapter concludes with an overview of the remainder of the thesis, describing how the thesis will unfold and indicating the main topics that are discussed in each of the remaining chapters.

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1.1 Historical Background to the Study

Prior to 1994, in South Africa, Black South African citizens were severely and negatively affected by the education system which actively and purposefully sought to place a ceiling on 'Black' educational, social, political and economic advancement during the apartheid era 1948 – 1994 (Carter, 1958; Harrison, 1981). The result of the policy of apartheid education was to embed different educational provision across different racial groups in South Africa. This resulted, in particular, in restricted Matric[1] achievement for Black South African students. This is evident in the 1982 statistics (Christie, 1985) where it is indicated that only 1.4 percent of Black students (out of a total of 5 303 542 students enrolled in school) were in Standard Ten. According to Christie, African students did not pass the Matriculation examination because they were unable, but rather because the nature of the established schooling system provided for Black students under the apartheid system disabled them. Additionally, information obtained from Christie (1985) statistics further suggests that most Black children, who went to school, stayed in the schooling system for approximately only four years. During this time, they would be taught in their mother tongue as well as basic English, Afrikaans and Arithmetic skills along with craft, gardening and singing. In comparison, the majority of White children in the South African schooling system at this time attended well resourced schools, learnt in their mother tongue – either English or Afrikaans - and studied a range of subjects including mathematics, history, geography, biology and science (Christie, 1985). In

[1] Matric is the term used to describe the South African Senior Certificate Examination (which will be phased out in 2008) – matric exemption is required by institutes of higher education to obtain entry to a university.

addition, most White learners had at least ten years of schooling, and the 1982 statistics for school enrollment indicate that 5.7 percent of White learners (out of a total of 975 414 students enrolled in the schooling system) were in Standard Ten.

Indians and Coloureds were classified along with Blacks as 'non-Whites' during the apartheid era. However, while the educational opportunities for these two groups were inferior to those offered to White students at the level of the general schooling sector and the level of higher education opportunity, they were superior to that of Blacks in terms of per capita expenditure, teacher-pupil ratio, and opportunity for high school study (Christie, 1985).

The information set out above serves to indicate to some extent the massive inequality between primary and secondary education for Black South Africans and that of White South Africans during the apartheid era in South Africa. It further indicates how social control, discrimination and segregation in the schooling sector spilled over into the university sector and impacted on the academic success of Black South African students due largely to restricted access to quality education. To further complicate matters, universities themselves, during the apartheid era were divided along racial grounds and access to the educational and social life of universities were strictly governed by a strict 'colour bar' for admission to tertiary education which meant that it was very difficult for Black students to gain admission to university study at historically White universities for which they needed special permission from the government to attend (Thompson, 1977).

While some universities, such as the University of the Witwatersrand, called themselves 'open universities' and admitted Black students to almost all faculties on the principle of '*academic non-segregation*', Black students were excluded from residences and sport related activities as the university complied with the 1950 *Population Registration, Immorality and Group Areas Act* which prohibited any institution in South Africa from accommodating students of different colour within an 'area not designated for them' (Bhana, 1977). This meant that while some Black students had the opportunity to attend classes held within the university, they could not live on or near the campus and were excluded from the social life of the university as a whole.

On the 10th of May 1994, the first Black president of South Africa, Nelson Rolihlahla Mandela, was sworn in at the Union Building grounds in Pretoria and ended his inaugural address, with the words that put an end to apartheid: "*never, never, and never again shall it be that this beautiful land will again experience the oppression of one by another and suffer the indignity of being the skunk of the world*". South Africa entered a new era, one led by the African National Congress (ANC), which paved the way for the reconstruction and transformation of the apartheid system in line with the democratic vision of the new government. (Sehoole, 2005)

Since 1994, there have been a number of educational policy changes, at all levels of education across South Africa,all of which have been aimed at redressing past imbalances and creating equal opportunities for all South Africans irrespective of race, colour,

ethnicity, gender and religion. Some of these policy changes, particularly aimed at redressing the general schooling sector, can be seen in the examples listed below:

1.2 Transformative South African Education Policy: 1994 - 2002

- Schools were opened to all racial, cultural and linguistic groups with the policy change described in the *White Paper on Education and Training* (Department of Education 1995a) which aimed to restore respect for diversity and the culture of teaching and learning in South African Schools.

- *The National Qualifications Framework* (NQF) (Department of Education, 1995b) was designed to give recognition to prior knowledge and the concept of life long learning.

- In 1996, *The South African Schools Act*, Section 5.1 stated that public schools "must admit learners and serve their educational requirements, without unfairly discriminating in any way".

- A new *Outcomes Based Curriculum* was implemented in schools and declared a national policy in South Africa (Curriculum 2005: Department of Education, 1997a).

- A *Language Policy in Education* was formulated in 1997 with the aim of promoting language equity and multilingualism in education. This policy includes recognition of the 12 official languages of South Africa, including Sign Language (1997).

- In 1997, the *White Paper on an Integrated National Disability Strategy* was published by the Ministerial Office of the Deputy President. With regard to education, the report made recommendations for the provision of life skills for independent living, as well as for assistive devices such as Sign Language and Braille, to facilitate access to the curriculum.

- In 1998, corporal punishment was abolished (Department of Education (1998a) *Edusource Data* News, No 23).

- The White Paper on Education titled *Education for ALL* was published in 1998 based on the principles of the Constitution which prescribe for all learners: the right to equality; protection from discrimination; redress of past inequalities faced by previously disadvantaged groups in order to create equal opportunity for all people; an education system that is accessible and responsive to all learners; human rights and social justice for all learners; participation and integration; equal access to a single, inclusive education system; access to the curriculum; the right to equal benefit; and equity and redress. (Education for All: 1998: 8-10)

- *White Paper 6: Special Needs Education* promoting the building of an Inclusive Education and Training System was published in July 2001.

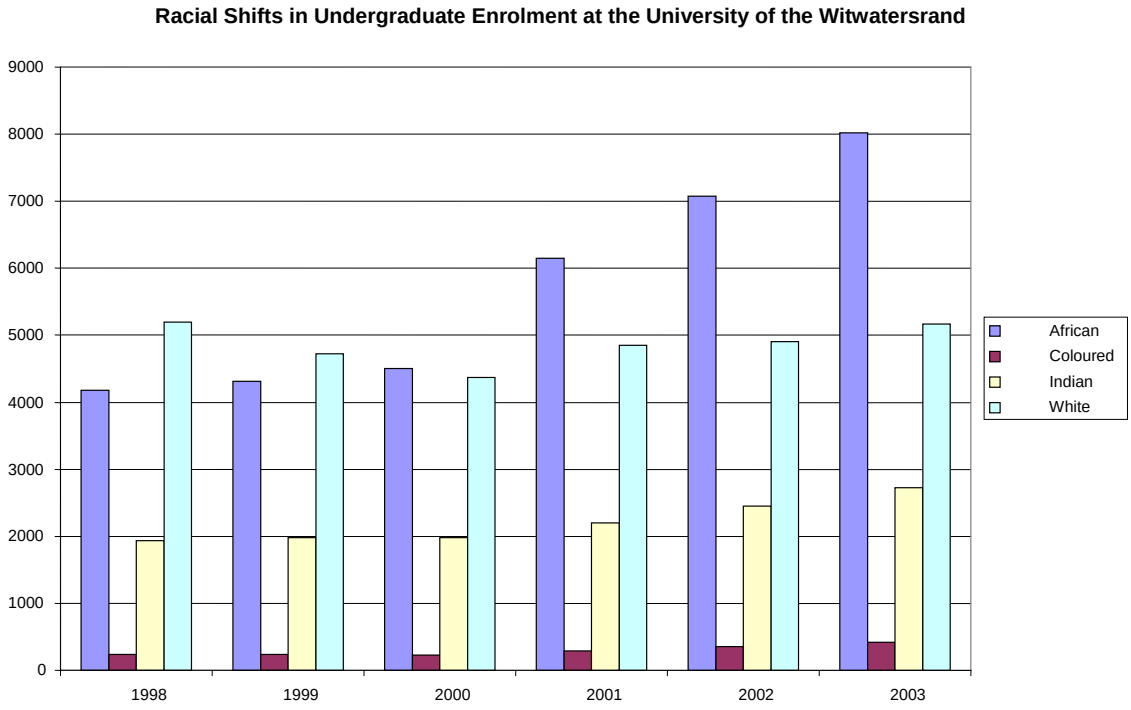
- A *Draft Revised National Curriculum Statement* for all Learning Areas and Grades was put out by the Department of Education (July 2001).

Despite the above mentioned policy changes, the legacy of apartheid has continued to disadvantage many learners. There are continuing inequalities for the majority of Black learners in the schooling sector in South Africa such as shortages of qualified educators in all schools, and particularly township schools and schools in rural areas, overcrowded classrooms, inadequate supply of textbooks and facilities which continue to create unequal opportunity for success in tertiary education, (de Villiers, 1997; Sidiropoulis, 1997; The South African Institute of Race Relations 2001/2002).

With the broadening of access for Black students at the level of tertiary education, in line with *White Paper 3 – A Programme for the Transformation of Higher Education* (1997) and subsequent policy documents relating to the transformation of higher education such as *Higher Education Act* of 1997, the *National Plan for Higher Education* (2001) and the *Report of the National Working Group: The Restructuring of the Higher Education System in South Africa* (2001), universities around the country have strived to meet the equity and demographic targets for size and shape of the transforming higher education landscape. Enrolment statistics provided by Wits Transformation Office on the 3rd of

November 2003 indicate in figure 1 that, to a large extent, the University of the Witwatersrand (Wits) has achieved these goals.

Figure 1: Racial Shifts in Undergraduate Enrolment at the University of the Witwatersrand



The broadening of access along racial lines within a framework of equity as a means of selecting suitable students to reflect the demographic composition of South African society has created not only a large increase in student numbers but also a high rate of drop out and failure amongst first year, particularly Black, university students – a challenge that has become of increasing concern to the Wits School of Chemical and Metallurgical Engineering.

As engineering courses require students to have good foundations in science and mathematics, the legacy of 'Black schooling's' lack of capacity and facilities to teach science adequately has had severe consequences for Black students entering science based careers at a tertiary level of study where they exhibit 'underpreparedness' for the tasks required of them which in turn has led to failure, attrition and drop-out (Vernon, 1979, Rushton, Skuy & Fridjhohn, 2003; Seabi, 2004; Woollacott & Snell; 2004a). The term underpreparedness is used to describe students who have met the formal requirements for access to university study, but who, due to insufficient schooling experience, experience a steep learning curve when attempting to engage with the specialized content and form of academic knowledge at the level of tertiary study (Craig, 2001).

In addition to inadequate preparation for tertiary study in a science career based on poor teaching and lack of resources, Taylor (1993) suggests that an additional contributing factor to socio-economic disadvantage and poor schooling opportunities is the persisting teaching approach used under apartheid that promoted the notion that learning was marked by passive acceptance of authority and a lack of the provision of conceptual tools necessary for creative, critical and independent thinking.

1.3 Rationale for the Study

Seabi (2004) states, "a high rate of failure has been documented among Black university students in the Engineering Faculty, and in particular in the first year chemical and metallurgical engineering course". Since 2000, numerous efforts by researchers, teaching staff and support staff within the School of Chemical and Metallurgical Engineering to combat the effects of adverse educational and sociopolitical systems which existed under, particularly through the use of mediated learning experiences (Skuy 2002), have been undertaken which involve organization and transformation of environmental stimuli by a mediator, in order to enable the mediate to perceive the environment in a more meaningful way. Despite these measures, the failure rate of Black first year engineering students persists as can be seen from the 2005 statistics that indicate a failure rate of 45% amongst first year students enrolled in the Process and Materials Engineering Course (PRME) offered within the School of Chemical and Metallurgical Engineering.

As a result of this continued failure on the part of students to succeed in the first year of their studies, despite interventions by academic and support staff that take into account the legacy of apartheid education and the socioeconomic status, it is becoming clear that there are other reasons, perhaps yet uncovered, resulting in students' apparent inability to succeed comfortably in the engineering courses they have been selected for and admitted to.

Further, when one takes into account the fact that South Africa is twelve years into educational transformation, one needs to consider how educational change at the primary and secondary levels of education, which includes the introduction of outcomes-based education and revised national curriculums, have impacted on students who are currently entering the university sector. This is especially important when one considers that by 2008, the Matriculation examination will be succeeded by a new coded senior certificate examination assessing the newly revised Further Education and Training Band of Education.

Without dismissing the legacy of apartheid , this research aims to investigate and classify incoming learning behaviours found amongst first year, English second language, Engineering Students (ESLES)[2] as a means of identifying the learning behaviours students are currently entering tertiary study with from the current schooling sector, within the School of Process and Materials Engineering at Wits. The rationale for the research is embedded in the notion that such knowledge may assist in providing a greater understanding of how current students in PRME approach teaching and learning situations, what they consider to be appropriate learning behaviours, and whether learning behaviours developed under the revised national curriculum statement for the general schooling sector are in line with the learning behaviours expected by the higher education sector.

[2] For the purpose of this thesis, English Second Language Engineering Students refers to Black, South African Engineering students who have identified an African language as their first language as such, the terms 'Black' and 'English Second Language Students' are used interchangeably throughout the thesis.

1.4 Aim of the Study

In general the study seeks to investigate the extent to which learnt schooling behaviours, derived from school experiences within the current South African educational setting, consolidate reproductive rote learning and surface learning approaches amongst students enrolled in a science orientated, engineering first year university programme.

More specifically, the study seeks to investigate and classify entry learning behaviours found amongst a small sample of first year, English second language speaking, engineering students at the University of the Witwatersrand.

The study will utilize and explore the results of a full assessment battery together with biographical student questionnaires in order to determine what these tests inform us about incoming student learning behaviours. It is envisaged that the use of in-depth interviews with the students in their home language will assist in the interpretation of the tests and provide additional insights and information relating to the type of learning behaviours that students enter the university with.

To meet the above aim, the research question identified for this study consists of two main questions:

I. What are the learning behaviours a sample group of English second language, first year engineering students bring with them into the university environment?

II. Once identified, how can these learning behaviours be classified in order to provide the academic teaching staff who work with these students an understanding of the academic needs of this sample group of students?

In the pursuit of answers to these questions, this study has been divided into specific thematic sections.

1.5 Chapter Overview

Chapter 1:- provides the introduction to the research and outlines the rationale for and aims of the study.

Chapter 2:- provides a review of relevant literature relating to key issues that have informed the study.

Chapter 3:- documents the design and methodology used in the collection of data for the study.

Chapter 4:- presents the results of the research relating to the identification of incoming learning behaviours found amongst the research sample and organizes the findings into a system of classification of common learning behaviours found amongst the research sample.

Chapter 5:- provides a discussion around the findings of the research, indicates the relevance of the study, highlights gaps and uncertainties that require further scholarship, and concludes with recommendations for future research.

CHAPTER TWO

LITERATURE REVIEW

Introduction to the Chapter

This chapter provides a theoretical framework which identifies key landmark studies, authors and sources relating to scientific teaching and learning within the current South African schooling context. It further highlights the key concepts around which the study is located, such as the notion that learning behaviours are not fixed and can, on identification be modified (Feuerstein's 1979 theory) and acknowledges the questions and debates at the level of higher education regarding the South African transformation agenda for increasing Black graduates in science related fields. In addition, current schools of thought pertaining to learning strategies, learning behaviours and student behaviours are reviewed within the context of how they impact on academic achievement.

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2.1 Schooling in South Africa in the Past

Black South Africans were adversely affected by the Apartheid Education System. Murphy (1977) highlights how traditionally Black and White South Africans have been educated in vastly different schooling systems. After the Nationalist Government came into power, statutes passed in the 1950s and in the early 1960s divided the schooling system into separate racial authorities.

Under apartheid different laws were passed to provide separate education for the different population registration groups. These included the Bantu Education Act of 1953, the Coloured Persons Education Act of 1963 and the Indian Education Act of 1965. In 1967 the National Education Policy Act was passed, which laid down the guiding principles for White education in South Africa. This Act was welcomed by apartheid politicians as a milestone in the history of South Africa, and it remained the basis of White education until the late 1980's (Christie, 1985). While segregation of schooling in and of itself is not necessarily bad, the apartheid system sought through its segregated education policies to provide both separate and unequal educational opportunities for different racial groups in South Africa. Under this system, White students were advantaged and 'non White' students were disadvantaged by the educational provision and unequal resources allocated to the different racial groups, with Black students being the most disadvantaged of the system.

Seabi (2005) highlights some of the discrepancies between education for Whites and that provided for Blacks. Within Black Schools during the apartheid era, minimal qualifications were required by educators and as a result many teachers were under-qualified (Seabi, 2005). In addition classrooms in Black schools were overcrowded and many schools lacked basic necessities such as running water and electricity as well as the types of equipment and sporting facilities that White schools had (Seabi, 2005). Further, while White learners were taught in their home language as the medium of instruction, Blacks were forced to learn in English (and for some years Afrikaans) which increased their difficulties (Adams, 1996). Curriculum differences between White and Black education was also unequal with Black learners expected to master trade related skills that would equip them to serve the White population of South Africa (Seabi, 2005). These factors left Black students ill equipped with the necessary cognitive skills and knowledge to succeed in tertiary education (Harthone, 1992). From the above information, it is apparent that the social, economic and political disadvantages incurred at the level of Black education during the apartheid era impacted on the quality of education Black students received.

Christie (1985) argues that the problem and inequalities of apartheid education are well known, they include shortage of money, overcrowded classes, unqualified teachers and poor facilities for Black schooling. A further difficulty experienced by Black students during the apartheid era was the Bantu Education Department regulation that Afrikaans be used as one of the languages of instruction in secondary school. This regulation proved to be unworkable due to a shortage of teachers proficient in the language of

Afrikaans and the difficulty experienced by Black students in coping with three languages of instruction at the level of secondary schooling (Baskin, 1991). Black students expressed their discontent regarding poor conditions and low standards through stay always, protests and riots, one of the most famous being the 1976 Soweto Uprising (Pebco, 1981).

2.2 Schooling in South Africa in the Present

The demise of apartheid in 1994 was heralded nationally and internationally as a victory for democracy and human rights. It offered unique opportunities and responsibilities to reconstruct a fragmented and deeply discriminatory education system underpinned by democracy, equity, redress, transparency and participation (DOE, 1997).

The vision of the democratically appointed National Department of Education was one which sought to provide ALL people in South Africa with equal access to lifelong education and training opportunities in order that these opportunities would contribute towards improving the quality of life of all South Africans and build a peaceful, prosperous and democratic society (DOE, 1996). In line with this vision the Department of Education introduced programs to improve education among Blacks. They introduced an Outcomes Based Education system embedded in Curriculum 2005 with the objective being to break the learning barriers experienced by Black students in schools.

Curriculum 2005 was developed through an extensive process of participation that involved a number of technical committees, wide consultation and assistance by international leaders in curriculum design. Draft documents were offered for public discussion during 1997 and the policy was released that year. Curriculum 2005 is arguably one of the most progressive of all education policies aimed at redressing past discriminatory practices within the world. Guided by principles of outcomes based education and learner centered education and the critical outcomes of the National Qualifications Framework (NQF), Curriculum 2005 defined specific outcomes and standards of achievement across eight learning areas. The critical and specific outcomes together presented major shifts in what was to be learned in schools, emphasizing competencies rather than particular knowledge. The specific outcomes delineated learning areas more broadly than traditional subjects: building links from subject knowledge to social, economic and personal dimensions of learning and the multicultural character of South African society (DOE, 1997). While many criticisms have been leveled at Curriculum 2005 this policy gave hope for a quality and equal educational opportunities to Black South Africans who had previously been deprived of their educational rights.

While there has been much debate around the appropriateness of outcomes based education in South Africa, and where the National Curriculum has been revised on a number of occasions, it appears that Curriculum 2005 was the starting point of advancement for Black learners in the democratic schooling system. This claim is backed by the increase in the number of Black matriculants in South Africa over the

period 2001 – 2005. Enrolment statistics provided by Wits Transformation Office in 2003 (See Figure 1) indicate that the number of Black matriculants enrolled at the University of the Witwatersrand was higher than the number of Whites, Coloureds and Indians. Such statistics suggest that changes in the South African general schooling sector have had a positive impact on educational opportunities provided for Blacks post 1994. It also indicates that the colour bar used under apartheid to separate access to higher education has fallen away in line with Higher Education Policy.

White Paper 3: A Program for the Transformation of Higher Education (1997) mandated that within institutions of higher education, student registration needed to reflect the diversity of the South African population. This was a direct attempt to ensure that students of all races would have the opportunity to become graduates and take their places in a transformed and more racially representative economy that met the government's policy of redress and equality. Since 2001, as figure 1 indicates, the University of the Witwatersrand has made a commendable effort to meet the targets for size and shape with regard to demographic enrolment as stated in the *National Plan for Higher Education* (2001). However, despite the broadening of access to institutes of higher education in South Africa, universities still face high failure rates among Black students in their first year of university study.

Research conducted by Skuy (2003), Hennin (2005), and Seabi (2004) indicate that in the final examination results of first year Chemical and Metallurgical Engineering students, in the respective years of the various studies, the performance of Black students reflected

the highest failure and dropout rate compared to the results of White and Indian students in the same year of study. These results suggest that the legacy of Apartheid Education continues to impact on Black students' opportunities for success in higher education and questions the quality of educational opportunities provided for Black students in the current general and further education sectors. It further suggests that the inequalities of schooling resources under apartheid have not been redressed to the extent where learners are entering higher education with similar foundations in critical subject knowledge or in the types of learning behaviours required for success in university study. Rushton, Skuy & Fridjhon (2003) suggest that this may be due to prevailing inequality resulting from many years of inadequate funding provided for the education of Blacks, Coloureds and Indians under the apartheid system.

As has been mentioned previously, apartheid was aimed at limiting the educational provision of Black learners. A limited number of schools catered for a small percentage of the Black population with a different and inferior syllabus to that of the White population (Devilliers, 1997). A shortage of qualified teachers, overcrowding due to lack of classrooms, and inadequate supply of books and lack of facilities was the experience for most Black learners (Sidiropoulis, 1997). Further, while it cannot be contested that South Africa has entered into its second decade of democratic educational provision, inequality of schooling opportunities can still be found in current schooling conditions. Statistics provided by the South African Institute of Race Relations shows that as recently as 2000, 22% of Black teachers were under-qualified and 45% of Black schools were without electricity, with a shortfall of over 67,000 classrooms (South African Institute of

Race Relation 2001/2002). Despite these inequalities a number of Black students have managed to meet the entry requirements of higher education institutions. While access of Black students to university study reveals the potential Black students have to gain entry to higher education, the high failure and attrition rate of Black students accepted into universities within their first year of study have required tertiary institutions to take responsibility for the provision of a smooth transition for students entering the university setting in their first year. Bird et al (1992) contends that the commitment to access for Black people is often rhetorical, implying that while changes in the general and further education schooling sectors have provided students with access to higher education, it has not ensured success within higher education. As a result, Bird et al (1992) suggests that institutes of higher education have need to evaluate their retention[3] and throughput[4] figures amongst first year students as a means of attempting to identify a way forward that ensures equal opportunities for success for students of all racial groups.

2.3 Critical Perspectives

Professor Kader Asmal, former Minister of Education, acknowledged that South Africa had committed excellent educationally-based policies and laws for a newly democratic country at the start of the 21st century. At the same time, however, Asmal cautioned that large parts of the system were dysfunctional, that major inequalities existed, that educator

[3] Retention refers to students remaining in the course they have started, despite initial failure in a course or programme. Failure that is exclusionary in nature and student drop out affect retention levels.

[4] Throughput refers to the number of students who graduate from a programme compared with the number of students who initially enrolled for a programme. Throughput figures are influenced by failure that excludes students from returning, student drop-out and students who take a long time to pass through the system.

morale was low, that governance and management were yet to strengthen and that quality pertaining to learning outcomes was poor (DOE, 1999). Such factors appear to have a continuing impact on higher education opportunities for Black students as academic underpreparedness appears to be a major factor in failure and attrition rates among Black university students in their first year of study as compared to other population groups.

Although past educational experiences have not been explicitly referred to as being directly related to university failure or dropout, studies in the United States of America show that high school grade point averages and individual student rank in class have proved important predictors of tertiary performance (Asten, 1971). Further, characteristics of high schools from which students enter university, such as a school's facilities and the qualifications of its academic staff, are important factors in the individual's achievement (Dyer, 1968). Nelson (1972) asserts that the characteristics of schooling prior to university study are also important as they directly and indirectly affect the individual's aspirations, expectations and motivations for tertiary education.

During the apartheid era, an authoritarian and epistemically rigid approach to teaching and learning was the norm in many schools (Christie, 1985). Unfortunately, such an approach to teaching and learning, based on the transmission of knowledge still persists in a number of schools across the country despite changes in education policy which have sought to promote a more learner centered approach to teaching and learning. Such pervasive methodological entrenchment results in educators transmitting knowledge in a closed system where the functional imperative for learners is to reproduce knowledge

taught to them and not question or critique the knowledge or the source of knowledge in any way. From such a perspective, learners' goal directed actions are orientated to reproducing information encountered in lectures and texts. Consequently learners studying within such a system became adept at reproducing knowledge (Slominsky & Shalem, 2005) rather than working with or producing knowledge.

The information provided in the preceding paragraphs suggests that the schooling experiences of Black students may play a significant role in the learning behaviours with which they approach university study.

According to Woollacott and Snell (2004a) a number of institutes of higher education in South Africa are struggling with the problem of student underpreparedness, particularly at a first year level. In seeking a solution to the problem of student underpreparedness, Woollacott and Snell claim that it is possible that part of the problem of high failure and attrition rates amongst first year engineering students may be a combination of inappropriate student preparedness for a course compounded by a course curriculum that does not adequately meet the academic development needs of students. Viviers (2004) suggests that the challenge facing higher education today is to understand the complex nature of academic underpreparedness within each learning area and then modify the existing teaching and learning approaches accordingly.

Further, having noted that the facilities available at a school together with the qualifications of teaching staff at high school have an impact on school and university

performance, it stands to reason that a further aspect of underpreparedness of students which needs to be looked at from the perspective of higher education is the composition of the university itself. Tinto (1971) suggests that it is the characteristics of the institution – its resources, facilities, structural arrangements, and composition of its members that places limits upon the development and integration of individuals within the institution that lead to the development of academic and social climates, with which the individual must come to grips. Such a view places emphasis on social integration and the need for students to become enculturated into a university system in order for them to succeed and suggests that student failure and attrition may result predominantly from a lack of congruence between the individual and the social climate of the institution rather than from any specific failure on the part of the individual.

The notion of an institution being underprepared to meet the needs of students is especially pertinent in the current South African higher education situation. Falron (2005) highlights that as greater numbers of previously disadvantaged learners enroll as students of tertiary institutions, many of these students fail and a number are excluded on the basis of low marks. As a consequence of this, attrition rates are increasing and the throughput numbers of Black graduates is in jeopardy. Such a situation, if it continues, will pose a significant threat to the employment equity quota that the government is in the process of implementing across all sectors of South African economy and may result in negative subsidy implications for institutes of higher education.

2.4 Science Education

Chemical and Metallurgical Engineering at the University of the Witwatersrand is a science orientated discipline. Admission to the field of engineering studies in South Africa requires a certain number of matriculation points that are generally higher than prerequisites for other faculties. Admission to the field of engineering studies also requires students to be proficient in Mathematics, Physics and Chemistry while proficiency in English is emphasized (Strous, 2003).

Robotton and Harly (1993) emphasize the importance of a country having science graduates. They claim that large numbers of science graduates result in a more skilled and therefore more productive workforce, which in turn contributes to an internally more competitive nation which has the potential to redress the balance of trade problems in developing countries. This belief in the benefits of science graduates as a means of enhancing the economy is strongly reiterated in the South African *White Paper on Science and Technology* (1996:10) which states that "science is considered to be amongst the requirements for creating wealth and improving quality of life".

The South African Ministry of Education strongly supports the growth of career-oriented programs in Science, Engineering and Technology within the transforming higher education sector (DOE, 1996, 1997a). Such a focus is considered imperative to the government's quest for redress and equality as apartheid education had its worst consequences in denying Black people access to science based careers and the legacy of

apartheid education continues in the racial inequalities which are mostly pronounced at the senior study levels in the areas of Natural Sciences, Technology and Engineering, areas of study where Black students are consistently under-represented (DACST, 1996).

Such inequalities, as mentioned above, can be seen in the areas of identified need by the University's newly established Marang Centre for Science and Maths Education at Wits.

According to Professor Adler, these include:

- Poor matriculation results nationally in Mathematics and Science with very small numbers of African candidates obtaining university exemption in these subjects;
- A majority of learners in secondary school learning mathematics and science learning in English, a language they are still learning;
- An internalized consciousness that 'our people cannot do high level mathematics and science' and lack of leadership and role models to change these perceptions;
- Mathematics and Science teachers' inadequate prior training and limited understanding of the subject they are teaching;
- No teachers trained for the introduction of mathematical literacy as a new learning area in the FET schooling curriculum; and
- Limited public awareness in science.

(Graduate News, Issue 6, September 2005: pg 5)

Such views are clearly supported in the survey carried out by Johnnie and Muwanga - Zake in 2005 in the Eastern Cape where it was revealed that educators in high school were unable to identify the difficulties they experienced in teaching science. The survey suggested that teachers' problems, such as the inability to teach practically were underpinned by the teachers' lack of understanding of science concepts and processes. In addition, the survey revealed that practical science experiments were apparently undermined and in cases neglected in high schools due to the foreignness of apparatus and the irrelevance of the science curriculum particularly in rural settings.

It is believed that Black South African students admitted to Engineering courses at institutes of higher education are victims of this type of schooling system and many enter into higher education engineering study inadequately prepared for the science-orientated field they have elected to study in. With the literature providing an indication of the type of schooling experiences many Black students are entering higher education courses with, it can be argued that some form of mediation needs to be incorporated into the engineering course curriculum to counteract the deficiencies found at a schooling level. The question as to what type of mediation is required remains an area of uncertainty.

Zaaiman (1998) argues that calls for more Black South African Scientists, Engineers and Technologists can only be answered if disadvantaged students with potential for science-based studies are identified and given adequate academic support. As such, Zaaiman proposes that existing admission practices and study programs offered in South African institutions of higher education should be re-evaluated and modified where necessary.

Zaaiman further suggests that the selection of Black students with potential for Mathematics and Science study will play an important role in both achieving the Department of Education's aims to increase access for previously disadvantaged groups and to achieve growth in Science, Engineering and Technology study programme graduates.

Many attempts have been made to redress the issue of the under-preparedness of Black students in Science and Engineering courses at the University of the Witwatersrand and yet, the programmes that have been initiated have failed to satisfactorily solve the problem of apparent under-preparedness. This research intends to add to the body of knowledge around understanding the problem of apparent student underpreparedness by exploring the past and current learning experiences and behaviours of Black students studying in a science related field.

2.5 Engineering

Kotecha (1993) states that the failure rate within engineering courses for all students has been unacceptably high at the University of the Witwatersrand and this appears to have been the case over an extended period of time. Proof of this claim is found in the Jawitz's 1992 (in Kotecha, 1993) statistics which indicate that only 25% of all students and 6% of DET students registered for a first year engineering degree at Wits between 1980 and 1986 graduated in the minimum period of 4 years. Kotecha (1993) further articulates how such high failure rates within the Faculty of Engineering resulted in the

faculty deeming it necessary to explore ways in which to improve the retention and pass rate of engineering students.

A high failure rate amongst students working towards completing engineering degrees is not a problem limited to South Africa – it is an international problem. According to Felder (2005) the U.S.A. has seen a declining interest in engineering as a career choice amongst high school students in recent years that have led to a steep decrease in enrolment in engineering schools. Limited applicants and decreasing enrolments have been exacerbated by high dropout rates that have characterized engineering schools for decades.

Based on the above information, Felder (2005) suggests that in order to reduce enrolment attrition rates it is becoming necessary that engineering schools improve the quality of their teaching and incorporate academic development programmes within their curricula that aim at improving the thinking and problem solving skills of engineering students and by extension engineering graduates. Such a move would require an understanding of the learning needs of today's engineering students and would involve designing curricula related aspects to meet those needs. Felder's (2005) suggestion, mentioned above, requires academic teaching staff and course coordinators to share responsibility for learning with engineering students. Unfortunately, the style of teaching within faculties within the university at the moment is still predominantly lecture-based and supportive of a system where the onus is entirely on students to take full responsibility for their

learning within a system which involves large class instruction and limited individual attention.

2.6 Curriculum

Within South Africa, it is acknowledged that Black students are regarded as the most disadvantaged population group in terms of schooling. It is also perceived that as a population group, Black students consistently under-perform in engineering courses when compared to their White, Coloured and Indian counterparts. As such, ignoring past learning experiences of Black students derived from curricular based schooling experiences has the potential to result in student alienation from science related university study.

There is in general a wide range of definitions pertaining to curriculum that is found in the literature relating to curriculum studies. For the purpose of this review, a definition has been selected that falls into the specific focus of the research, namely: *Curriculum comprises all the opportunities for learning provided by a school. These include the formal programme of lessons in the timetable and the climate of relationships, attitudes and styles of behaviour promoted by the school community as a whole* (Department of Education and Science for England and Wales, 1980).

When viewing the interlocking aspects of the curriculum as described in Education White Paper 6 (2001) it appears that within the current South African curriculum for science education there are a number of constraining factors impacting on science teaching and

learning. For example, the science curriculum currently presented in secondary schools consists of content presented in a rigid manner at either a higher, standard or lower grade level. Only students who maintain a pass mark on the higher grade level are provided with university exemption in a science related discipline. The language of instruction for science education in secondary schools is either English or Afrikaans, with the majority of Black South African students believed to being taught and assessed through the medium of English. The reason for science being taught in these two European based languages is due to the availability of textbooks in these languages and the generalized lack of scientific textbooks in African languages. In general, science teachers teach to equip students to pass examinations and as such, collaborative teaching is not promoted and there tends to be an overemphasis on the transmission of knowledge and rote learning. As such, preparing students to pass the general education examination at the end of the matric year places time constraints on both teachers and students which result in time and pace of curriculum demand impeding opportunities for teachers to explore alternative methods and practices promoting science teaching and learning strategies.

It is apparent from the preceding information that there is an assumption that the types of learning behaviours promoted under the current schooling curriculum are out-of synch with the types of learning behaviours required by higher education systems which value critical thinking, problem solving and independent thought above rote learning. Such an assumption is evident in the National Commission on Higher Education's (1997) recommended Framework for Transformation of Higher Education in South Africa which, as a central feature, focuses on the need for greater curricular responsiveness to

meeting a wider range of social and economic needs found amongst a diverse student population. Such responsiveness has implications for content and processes used in science education (Ekong & Cloete, 1997) as well as for the language of teaching and learning (Evans, 2004) used in institutes of higher education.

The term 'curricular responsiveness' is rare in international literature, but is increasingly becoming a focal point of education transformation and reform in South Africa.

As a South African concept, curriculum responsiveness was initially used in 1997 as a term relating to the need for the curriculum to respond to changing national needs within a global and African context (Ekong & Cloete, 1997). Systemically articulated for the first time in 2003 by Dowling and Seepe it suggested that the African experience be incorporated into the curriculum at the level of further education and training (FET). Gambe (2003) in the same year used the term 'curricular responsiveness' in her work on higher education transformation and around the same time, the terminology was taken up by policy documents relating to debates around the transformation of higher education in South Africa.

Schneider, cited in Cloete et al (1997) strongly advocates that institutes of higher education in South Africa focus deliberately and forcefully on forms of learning that relate to South African societal diversity. How such a suggestion would relate to incorporating traditional African views of science to western 'mechanistic' views (Jegede, 1995) is open to debate. What is apparent, however, is that there is a distinct

need to find out about the types of learning experiences and behaviours that are being encouraged amongst Black students at a school level and how these experiences and behaviours could be incorporated into the development of a curriculum in higher education that is responsive to the needs of a diverse student population. This is of significant importance at a time when the South African Universities Vice Chancellors Association (2004) queries whether the issue of curriculum responsiveness relates to the responsiveness of the students' approach to higher education or higher educations' approach to students.

This is an interesting question with important curricular implications at a time when there is no well developed theory of 'curriculum responsiveness' available to us and when the concept being used has little theoretical depth in regard to what object or objects of study it refers to or what kind of relationship to other concepts it implies.

What is clear is that there can be no curricular responsiveness without an in-depth understanding of the type of learning behaviours a learner has acquired within the schooling sector and the implications of these behaviours for potential learning experiences.

2.7 Feuerstein's Model of Mediated Learning

Vygotsky's, (1978) theory about the concept of mediation is considerable. He introduced the notion of the Zone of Proximal Development (ZPD). The ZPD refers to a space

within a learner's cognitive structure where the learner is unable to fulfill a task on his/her own, but has the potential to do so through the assistance of another more capable person. Through mediation, a learner is assisted to expand their knowledge and capacity as s/he is assisted in constructing a new level of understanding.

Feuerstein's theory of structured modifiability (1979) assumes that an individual's level of functioning is connected to the quantity and quality of mediated learning experiences s/he receives. From such a perspective, first year engineering students' learning behaviours and academic work can be viewed as a reflection of the quality and quantity of mediated learning experiences they have received during their schooling and their induction to the university setting.

The quality and quantity of support that learners receive from educators during their schooling years have a significant impact on the cognitive functions of individuals entering university. Silver (2001) suggests that to function competently at the level of higher education, individuals need sufficient mediation of cognitive processes that will allow them to develop the cognitive tools needed to become autonomous and active learners.

Traditionalists regard student failure as the 'fault' of a student and often query a failing student's level of intelligence when grading them. From a traditionalist paradigm, students arrive at university unprepared for academic working, lacking either the skills or the motivation to succeed (Gamache, 2002). Seabi (2004) claims that Feuerstein rejects

this traditionalist notion of intelligence being tied to academic performance which perceives intelligence as being static, immutable and fixed through life. According to Feuerstein, Rand and Hoffman (1979) individuals are born with the capacity to function at different levels of cognitive processing which, if well maintained, enable the individual to achieve in a variety of tasks, and if not sufficiently developed, result in cognitive deficiencies. According to Feuerstein, cognitive skills can be mediated through mediated learning experiences despite the appearance of cognitive deficiencies.

Mediated Learning Experiences (MLE), which takes into account, not only the experiences the learner has acquired, but also his/her potential to learn, is an approach that has been used successfully with children but which is claimed to be applicable to all individuals of different race and age group (Feuerstein et.al., 1980). MLE refers to human interactions that generate the capacity of individuals to chance, to modify themselves to the direction of greater adaptability and towards the use of higher mental processes (Feuerstein et al, 1979). Falron (2005) claims that MLE can be viewed as an intervention that successfully helps disadvantaged learners to bridge the gap between their past experiences and the academic, creative and practical demands of their current academic courses. Feuerstein and Feuerstein (1991) argue that sufficient exposure to MLE enables a mediatee's schemata to become flexible, thus allowing the mediatee the ability to adapt more easily to the requirements of the environment s/he finds him/herself in.

Vygotsky (1978) emphasized culture as a significant contributing factor to learning and development and suggested that cultural contexts have an impact on the development of learning behaviours and approaches to problem solving that learners develop. Research conducted by Feuerstein and Rynders (1988) using MLE shows that this model is significant in developing thinking skills that relate to problem-solving regardless of the culture from which a learner derives. Thinking, reasoning and problem solving skills are essential to students studying engineering and promote a deep approach to learning.

Prosser and Miller (1989) examined first year Physics students' understanding of the force concept before and after their introductory machines course. They found that eight out of nine students who took a deep approach and only two of twenty-three who used a surface approach showed significant development in their understanding of force concepts. A deep approach to learning involves more than memorization and includes approaching concepts with understanding and critical thought. Meyer (1988) found that engineering students who adapted a deep approach in a course were very likely to pass the course. Students who displayed a deep approach had generally a more positive attitude towards their courses and experienced greater satisfaction with their university experience.

Mediated Learning Experiences has in the past been used as part of an attempt to address underpreparedness amongst first year engineering students at the University of the Witwatersrand. However, this approach, in combination with other more mainstream measures, while having being used with varying degrees of success, have continued to

fail to adequately rectify the issue of underpreparedness amongst first year engineering students in a consistent and substantial manner (Woollacott & Snell, 2004a; Vivier, 2004). Such a finding implies that students may be entering the university environment with learning behaviours ill suited to the scientific and academic demands required of them in their first year of study.

The purpose of this study is to identify and determine possible ill-suited learning behaviours found amongst first year English second language engineering students in the hope that the identification of such learning behaviours would lead to more constructive mediatory provision for these students during their first year of study.

2.8 Learning

The construct of human learning is complex and reflects a diversity of theoretical explanations and orientations. The epistemology of Piaget and his notion of constructivism provide the theoretical framework for the understanding of human development and learning in many studies on teaching and learning (Piaget, 1977). In particular Piaget's argument that during adolescence the human mind is capable of 'logico-mathematical thought" and that thinking becomes abstract and flexible at this time is of huge importance to the understanding of teaching and learning in tertiary contexts. Even more important is an understanding of why it is that at this stage of human learning and development, some students engage successfully with university level tasks and academic activities while others do not. What is it in the learning behaviour of the individual student and in the derivation of the range of individual learning behaviours that negate successful academic participation and the development of the academic discourse?

Hergen (1982) defines learning as a relatively permanent change in behaviour or in behavioural potentiality that results from experience which in the case of first year university students would be their schooling experience. As such, learning cannot be attributed to temporary body states such as those induced by illness, fatigue or drug use. Meyer and Seriwener (2005) claim that learning is a complex multivariate phenomenon derived from a number of sources and variations of sources that lead to learning behaviour many of which are unobserved and uncontrollable but all of which lead to a way of understanding the world.

There are multiple ways of understanding that can be learned. The most obvious explanation of why such variations in understanding exist would be, according to McKeachie (1984), to argue that learning depends on prior knowledge and linguistic skill. All students entering an institute of higher education with the purpose of studying for a degree in engineering each bring with them a certain amount of prior knowledge relating to their understanding of academic tasks; a particular intellectual potential and individual cognitive abilities; values and attitudes which derive inter alia from their background and experiences; and personality characteristics that influence their approaches to learning. Each of these factors has an immediate and direct impact on potential academic performance and each is also likely to affect individual student's motives for understanding learning and the types of strategies they will be likely to adopt in approaching learning (Biggs, 1987).

Traditional explanations of what constitutes learning and learning behaviours have changed dramatically over the past two decades. New approaches to constructivism, theories of active learning , self-regulated learning and the questioning of the nature of learning itself have impacted on the this field of enquiry and directed the focus of research into what is argued by many researches as the most significant issue in the area of learning and that is how to actualize effective learning. (Boyle, 2003)

Effective learning is directly linked to the notion of deep and surface learning as well as that of self-regulation (Marton and Saljo, 1976). These aspects constitute the important features informing current research into student learning in tertiary education. According to Saljo and Marton (1976a) there are two main approaches that impact on learning behaviours. These include a deep approach to learning, which is characterized by the intention to develop an understanding of what is being learnt, and a surface approach to learning, which involves the intention of the individual to memorize what they consider to be important. Saljo and Marton further argue that a deep approach to learning demands an appropriate level of intelligence as a prerequisite. Such an approach presumably also requires sufficient prior knowledge and interpretive skills to make sense of intellectual arguments, abstract thought and scientific evidence. Marton and his colleagues in Sweden examined approaches of students to academic texts and established that student approaches to learning are closely linked to individual student levels of understanding and that a deep approach to learning promotes better understanding of central concepts. In addition, Mwamwenda (1995) asserts that students who learn through insight are better problem solvers than those who learn by rote.

It could be ascertained that students of lower intellectual ability tend to use a surface rather than a deep approach to learning. However, use of a deep approach to learning is not particularly associated with either high or low verbal ability. From such a perspective it appears that a deep approach to learning is not a prerogative of students with above average intellectual ability. This is important to note as it means that approaches to

learning are probably learned (as they are not genetic) and as such it is possible to encourage a deep approach to learning across all people except those with the very lowest ability level. (Biggs, 1987)

Apart from student approaches to learning, the context in which learning takes place also influences the way in which learning occurs. A context-related influence includes the effects which are mediated by the characteristics of individual students. For example, students who rely entirely on a surface approach to learning prefer lecturers who provide pre-digested information that can be rote learned. Conversely, student who learn through a deep approach prefer lecturers who challenge and stimulate them. (Entwistle & Tait, 1990)

Such information, as described in the above paragraph, is interesting as it suggests that in any learning context there will be students who have different approaches to learning that need to be accommodated in order for meaningful learning to take place. It also has implications for assessment as it can be assumed that lecturers who provide pre-digested materials will probably design assessment tasks that surface learners will succeed in and that lecturers who base their teaching style on challenging and stimulating students will tend to set assessment tasks that cater to the problem solving abilities of learners who use a deep approach to learning. Aspects of self-regulation reflect the type of mediation that directs students' learning behaviours which in turn promotes critical self-thinking.

Learning Strategies

Different researchers have indicated that one of the many factors that contribute to the high academic failure rate is poor learning strategies (Pollock & Wilkinson, 1988: Pintrich & Johnson, 1990). Learning strategies is a way of behaving when one is confronted with a problem to solve.

Weinstein and Mayer (1986) investigated the relationship between learning strategies and academic achievement of 193 first year university students and found significant correlation between the scores on the learning strategies and students' academic achievement. In another study, conducted in the same year, Weinstein and Mayer (1986) found significant improved academic achievement between students who participated in a learning strategies course and those who did not participate.

Educational research has shown that students can be characterized by significant differences in learning styles and that they tend to rely on these personalized styles to obtain different types of information and to operate on perceived information (Felder, 1996). Felder (1996) further stated that good instruction should equip all students with a variety of skills associated with different learning style categories, regardless of the students' personal preferences, since they will need all of those skills to function effectively as professionals.

Student Academic Behaviour

Within a classroom situation there are different types of academic behaviours that students may engage in which could either advance or impede their understanding. Asking questions, being actively involvement in experiments and activities, and active engagement with the lecturer and other students could all be behaviours that one would expect to assist in the development of learning. According to Majoribanks (1991) the nature of classroom related behaviour of students has been found to differ according to cultural or ethnic background. In Majoribanks (1991) a study conducted by Gay (1974) found that Black students participated less in academic environments than White students. Such a lack of active participation may be culturally embedded and needs to be explored from this perspective. However, lack of active participation may also be related to the type of schooling received by many Black learners in the South African context where educational experience is dominated by spoon feeding and rote learning and emphasis is placed on productivity at the end of the year and not on participation in classroom settings. In Majoribanks (1991) a study conducted by Hillman and Davenport (1978) found that Black students tended to give more incorrect and irrelevant responses when posed with direct questions than White students. Such a finding may also be linked to either cultural or schooling background within the South African context and leaves one with the question … are techniques for response to questions in classroom settings learned behaviour and if so, how can appropriate ways of responding to questions be taught, learned or mediated within the higher education context?

Laurilland (2002) argues the success of lectures depends on the lecturer knowing very well the capabilities of the students. This is specifically relevant if lecturers expect metacognitive and self regulatory behaviours amongst the students they teach (Bransford, 2002; Brown et.al, 2000). Meyer & Serivener (2005) assert that in the higher education sector, in general, little attention is paid to the learning processes used by students or to the learning activities through which students can improve their learning skills.

According to McKeachie (1984) the prerequisite for attempting to influence how individuals or groups of individuals behave in learning situations is to have a clear grasp of the precise types of learning behaviours they exhibit. For the purposes of this study, this is precisely what the research will attempt to determine.

CHAPTER THREE

CONTEXT OF THE STUDY AND METHODOLOGY

Introduction to the Chapter

This chapter initiates with information relating to the context in which the study took place. It further documents the research design and methodology followed during the fieldwork. It also discusses the instruments that were used in the measurement of key variables of the study and gives a detailed outline of the sample design. Information pertaining to the data collection process as well as procedures used in capturing information is provided. The chapter concludes with an expression of the limitations of the research and the ethical considerations taken into account in the study.

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3.1 Context of the Study

The study was located in the School of Chemical and Metallurgical Engineering at the University of the Witwatersrand, Johannesburg, South Africa. Within the school, as the preceding two chapters have indicated, there has been some concern that amongst undergraduate students registering in the school, Black students in particular experience a relatively high rate of failure, attrition and drop out, (Cohan & Cohen, 1989; Henning, 2005; Rushdon, Skuy & Fridjohn, 2003; Seabi, 2004; Vernon, 1979; Woollacott & Snell, 2004a).

The inequality of schooling for Black South Africans under apartheid has been documented in the preceding chapters, as has the fact that post 1994 a number of transformative educational policies have been put in place at both the level of schooling and higher education. Despite these transformative measures, which have broadened access for Black students within the university, these same students experience a higher rate of failure in science related disciplines than their Coloured, Indian and White counterparts.

The School of Chemical and Metallurgical Engineering has been grappling with these issues since the widening of access in the late 1990's and has undertaken a number of research initiatives in order to try and understand the reason for the relatively high rate of failure, attrition and drop out within the School. All these research initiatives, conducted in collaboration with the Cognitive Research Programme under Professor Mervyn Skuy

(until 2003) or separately, under the project coordination of Laurie Woollacott since 2002 have indicated that the legacy of schooling inequalities found under the apartheid system continue to have repercussions for Black South African students in the 21st century, (Henning, 2005; Rushdon, Skuy & Fridjohn, 2003; Seabi, 2004; Vernon, 1979; Woollacott & Snell, 2004a).

Where the broadening of access to the University of the Witwatersrand has taken place in line with equity targets set out by the South African Council of Higher Education, indicators for access have continued to be based on individual matriculation results that meet both the subject and mark related entry requirements for tertiary study in a science related field such as engineering. To be eligible for a scholarship, Black students require 35 points or more for their matric, this means that they require an average matriculation mark of 70%.

Over the period 2003/2004, Joseph Seabi conducted a research project amongst first year Chemical and Metallurgical Engineering students at Wits. His findings confirm previous studies in the department, indicating that there is generalized poor academic performance amongst first year engineering students in general with the highest incidence of failure being amongst Black students. With a number of studies indicating that Black students proportionately achieve lower marks than other racial groups within their undergraduate studies within the School of Chemical and Metallurgical Engineering, the following questions arise:

a) Are matriculation results significant indicators of potential success within a science based degree? and
b) How do learning behaviours required by schools to achieve a 'successful matriculation pass' relate to the types of learning behaviours required for success in university study?

This study is based on the hypothesis that Black students, particularly Black students who have attended rural schools, enter the university with learning behaviours that have enabled them to pass with a 'good matric' but which are not adequate for success in higher education science based courses. On this assumption, the research aims to identify and classify incoming learning behaviours found amongst a sample of first year, English second language, engineering students in order to determine as closely as possible the exact nature of these incoming learning behaviours. The purpose of finding this information being to provide a framework that may assist in improved selection processes of first year engineering students and which will provide information that could be utilized in supporting, through correct mediation, Black students who gain entry to the university environment.

3.2 Research Design

The goal of this study is exploratory in nature as it seeks to investigate a relatively unknown area of research. As such, it is open to and intends to make use of both quantitative and qualitative analysis techniques. While a basic study, it is hoped that this

study will generate findings that can be applied in the sense that they will make a contribution towards practical decision making for accommodating the learning needs of English second language first year engineering students in the future.

The use of a qualitative research approach is relevant to this study which seeks to explore naturalistic, holistic and inductive aspects of a social phenomenon (Terre Blanche & Durheim, 1999). Further, the study is concerned with understanding human behaviour within a complex system that is more than the sum of its parts while simultaneously identifying relevant categories, dimensions and interrelationships found within the data (Terre Blanche & Durheim, 1999). As the study is a case study it focuses on the collection of data in the form of written and spoken language (written biographies and interviews) and on the analysis of such data (Terre Blanche & Durheim, 1999).

3.2.1 Case Studies

Adelman et.al (1980) describes a case study as the study of an instance of action. Entwistle (1988) asserts that the use of a case study in attempting to understand an educational phenomenon has distinct advantages for educational research. According to Entwistle (1988), use of a case study enables the totality of a phenomenon to be observed as it allows for the observation of the behaviours exhibited by individuals as they operate in an educational setting.

In this study, the behaviours of a sample of students will be observed as they interact within the educational context of their PRME lectures and tutorial groups. While use of a case study approach in this instance provides the opportunity for the obtaining of rich and thick data on each of the sample members, as Entwistle (1988) points out, such descriptive data can only be achieved if sample is be relatively small. As will be discussed later, the sample consisted of 11 first year English second language engineering students, a number that is deemed small enough to allow for the development of rich and valuable information pertaining to the particular sample. The limitations of using a case study approach using a small sample is that the findings from this case study will not easily be transferred to other groups outside of the sample studied.

To minimize the limitations of the use of a case study approach, Cohen & Manion (2000) suggest that a focus within a case study on 'cause and effect' can provide data that is meaningful both to the sample group studied and to other groups facing similar instances of cause and effect within an educational setting. Highlighting the notion of observing cause and effect in case studies, Cohen & Manion (2000) suggest that the use of a case study allows for the observation of effects in real contexts where the context itself is recognized as a powerful determinant of both effect and cause. They further affirm that case studies are a step to action in that they begin in a world of action and by their nature, contribute to it.

From such a perspective, it is believed that the use of a case study approach in this study will be of benefit to staff and students in the future in the sense that it will make a

contribution to 'action' through the provision of information that could be used in practical decision making relating to the accommodation of learning needs found amongst English second language first year engineering students in the future.

In addition, in addition, the use of a case study approach in combination with the interpretation of a full assessment battery that students take part in, has the potential to, as Keats (2000) puts it, put flesh on the bones of statistics and bring together the discrete components of the analysis into an integrated whole.

3.3 Sample

Where initially 12 students were identified to take part in the sample, ultimately 11 volunteered to participate. All students who took part in the study were students enrolled in their first year in the PRME class of 2006 at the University of the Witwatersrand. All students who participated were English second language students. Where at the proposal stage four language groups namely isiZulu, isiXhosa, Ndebeli and siSwati were selected as the researcher is fluent in them, of the total sample 10 students were found to be Zulu home language speakers with 1 students stating siSwati as a home language. The purpose of selecting students from the above mentioned language groups was that belief that more information relating to English second language students could be obtained if students were able to speak in a language they are comfortable with and fluent in.

An additional criteria used in the selection process was based on a comparison between students' matric marks and their academic marks for their first quarter in the PRME

assessments. Students were requested to participate if they had failed their first quarter PRME assessment yet received a matric mark of above 70% in the learning areas of Mathematics and Science.

The sample comprised 7 male and 4 female students.

3.4 Ethical Considerations

Following the principle of full disclosure the researcher clearly defined the purpose of the study, as stated in the aim and rationale for the study, to the student participants.

As the study was based on the need for student volunteers, students who did elect to take part in the study were informed that their participation was not obligatory and that if they did take part, they were free to excuse themselves from participation during the process without prejudice. A rejection and exclusion clause was included in the participation form which allowed students to exclude themselves from the study without prejudice at any time. All students selected for the research signed a consent form agreeing to take part in the study (Appendix 1).

Confidentiality of all students was ensured with student interviews taking place behind closed doors at times when the students were free to make appointments. Every effort was taken to ensure the students' anonymity at all times. Data collected during the

course of the study was used by the researcher only and on finishing the final report, all raw data will be destroyed.

3.5 Data Collection

As the discipline of Process and Materials Engineering conducts a battery of tests on all first year students at the beginning of every year, these tests were analyzed by the researcher in combination with data obtained from the biographical questionnaire and follow up interviews with the students.

3.5.1 Description of Tests used in the Assessment Battery

All first year PRME students took part in an assessment battery during the first months of the year (2006). Tests used as part of this battery included *The Learning and Study Strategies Inventory* (LASSI), the *Coopersmith Self-Esteem Inventory* (CSEI), the *Organizer*, and *Raven's Advanced Progressive Matrices* (RAPM).

To briefly describe these tests:

3.5.1.1 **The Learning and Study Strategies Inventory (LASSI)**

(Weinstein, Palmer & Schutte, 1987)

The LASSI was developed in the late 1980's under the Cognitive Learning Strategies Project at the University of Texas, Austin. The purpose of its development was

identifying individual's study skill abilities, such as time management and note taking, from a correlational approach that focused on an individual's thoughts, behaviours and activities and how these correlate with academic achievement, while probably not having a direct causal effect.

The LASSI is an assessment tool that is designed to assess an individual's thoughts and behaviours in relation to the use of learning and studying processes (Weinstein et al, 1987). It is a self-report questionnaire, comprising ten subscales with 77 items on a five point scale, ranging from 'not at all typical of me' to 'very typical of me'. Each of the ten sub-scales addresses an area of study and learning strategies which include: Attitude, Motivation, Time Management, Freedom from Anxiety, Concentration, Information Processing, Selecting Main Ideas, Study Aids, Self Testing and Test Strategies (Weinstein et al, 1987).

The LASSI is not a timed assessment instrument. It is a self-report tool in which students are requested to darken the letter that corresponds to how well a standard describes them. Students are encouraged to respond to the LASSI according to how well the statement reflects their behaviour and thinking and not how they think they should respond or how they think other people want them to respond.

The LASSI is both diagnostic and prescriptive (Weinstein et al, 1987). It is diagnostic in that it provides students with a diagnosis of their areas of strength and weakness in comparison to other students in the areas covered by the ten scales. It is prescriptive in

that is provides feedback regarding areas where students may be weak and indicates where students may need to improve their knowledge, attitudes, beliefs or skills.

As the LASSI serves as a diagnostic instrument, no total score is computed, instead, each subscale yields an individual score. Scoring of the LASSI yields raw scores and percentile scores. Reliability measures include Coefficient Alphas from 0.68 to 0.86, and test, retest correlations from 0.72 to 0.85. (Weinstein et al, 1987)

A copy of the LASSI instrument, its answer sheet and a feedback sheet are attached to appendices 2, 3 and 4 respectively.

3.5.1.2 The Coopersmith Self-Esteem Inventory (CSEI) (Coopersmith, 1975)

The Coopersmith Self-Esteem Inventory is an assessment instrument used to measure the self-esteem of students. Developed through research that sought to measure evaluative attitudes towards the self in general and specific contexts, the CSEI is a self-administered paper-pencil assessment tool that takes about ten minutes to complete.
There are two forms of the CSEI, a school form and an adult form. Students who took part in the assessment battery completed the adult form as they were above sixteen years of age.

The CSEI comprises twenty-five questions containing seven high esteem items ('I am a lot of fun to be with') and eighteen low esteem items ('I often wish I were someone else'). Individual scores are calculated based on the sum of high self-esteem items marked in a positive direction and low self-esteem items marked in a negative direction.

The raw score of the CSEI is reported as a single score with a maximum of 25, which indicates high self-esteem. The score is then multiplied by 4 (25 x 4) to obtain a percentage score. The higher an individual's score, the higher his/her self-esteem.

The CSEI meets Hudson's (1985) axiom for practical utility as it is 'short, easy to administer, easy to understand, easy to score, and easy to interpret' (Skuy, 2003). A well established instrument, its reliability, stability and construct validity is well supported by research (Anastasi, 1988; Balscovich & Tomaka, 1991).

A copy of the administered CSEI Adult Form is provided in appendix 5.

3.5.1.3 **The Organiser** (Feuerstein, Rand & Hoffman, 1979)

The Organiser is a verbal test with numerical components which may be administered individually or in a group setting that measures hypothetical or inferential thinking strategies, the gathering and application of logical evidence and summative behaviour. It forms part of Feuerstein's (1980) Learning Propensity Assessment Device (LPAD) and comprises both a pre-test and a post-test.

The Organiser comprises twenty-two problems, where each problem consists of a set of items (objects, colours, countries, etc) which have to be organized and placed in positions relative to one another based on a determined attribute or condition (Feuerstein, Rand & Hoffman, 1979).

In responding to the Organiser, the subject is required to extract only part of the information needed to reduce uncertainty and to determine an accurate placement of the items relevant to one another. The items in the Organiser are ordered by their degree of complexity. According to Feuerstein (1979), in order to solve the problems, the subject must process the given information and generate sufficient information, not immediately available, to solve the problem through logical reasoning.

The subject obtains scores based on the number of correctly answered items. The Organiser was selected as part of the assessment battery as an instrument that assesses intellectual functioning based on its previously demonstrated reliability, validity and usefulness amongst South African adolescents (Skuy & Schmukler, 1987; Skuy et al; 1990).

A sample of the Organiser is provided in appendix 6.

3.5.1.4 The Raven's Advanced Progressive Matrices (RAPM)

(Raven, Raven & Court, 1998)

The RAPM was designed to measure an individual's capacity to understand meaningful figures, notice the relations between them, visualize the nature of a figure completing each system of relations within a presentation and as such, determine an individual's systematic method of reasoning. (Raven, Court & Raven, 1977)

As such, the RAPM assesses an individual's ability to form comparisons, reason by analogy and organize spatial perceptions into systemically related wholes (Tzuriel & Feuerstein, 1992). These visuo-spatial type of skills are considered essential for engineering students who wish to pursue a career which requires the perceptual ability to deal with gestalts and which requires the specific spatial ability to conceptualize various types of problems presented in the course of engineering work.

The RAPM is considered to have been predictive with engineering students (Raven, Court & Raven, 1996) and despite criticisms that it is not 'culturally blind' (Owen, 1992) and that it has a less predictive validity that than verbal tests (Anastasi, 1996), several studies have confirmed the significance of the RAPM as a measure of intellectual functioning and positive correlations between high levels of functioning and positive correlations with academic achievement (Grieve & Viljoen, 2000; Rushton et al, 2003; Skuy et al; 2002; Strous, 2003; Zaaiman et al, 2001).

A sample of the RAPM has been provided in appendix 7.

3.5.2 Questionnaires and Guided Interviews

All student selected to take part in the sample were required to complete a biographical questionnaire (Appendix 8). Based on the information obtained in these questionnaires, the researcher conducted a series of guided interviews with the student participants. The questionnaire was divided into three sections under the categories a) home background, b) schooling background and c) tertiary experience.

Questionnaires were used to obtain relevant background information on the student participants as Cohen and Manion (1980) assert that there are distinct advantages to using questionnaires when collecting reliable data as they tend to be more anonymous and as such encourage greater honesty.

While in general it is perceived that the disadvantage of using questionnaires is the low percentage of returns, in the case of this study, where the sample group was small, all the student participants completed and returned their questionnaires.

Further, as the answers the students provided in their responses to the questionnaires guided the individual interview questions, opportunity was provided whereby misunderstandings experienced by the interviewee could be clarified and corrected where necessary.

On completion of the biographical questionnaire, students took part in guided individual interviews in their home language. These interviews were taped (with the students' permission), transcribed and interpreted. All questions pertaining to the guided interviews were drawn from the findings identified in the initial questionnaire and were open ended (bearing in mind the research aims).

According to Keats (2000), an interview is a controlled situation in which one person, the interviewer, asks a series of questions of another person, the interviewee. To maintain the aims of the research, the interviewer is 'in charge' of the direction of the questioning. Thus, during the guided interviews, data is gathered from direct verbal interaction between the individual participants and the interviewer.

Like any other type of data collection, the use of interviews has both advantages and disadvantages. Borg (1963) suggests that one of the advantages of using interviews is that it allows for depth of information to be obtained. Further, Oppenhein (1992) suggests that interviews have a higher response rate than questionnaires as they allow for the respondent to become involved and hence motivated in the question and answer process.

Borg (1963) states that a critical disadvantage of using interviews to obtain data lies in the fact that by their nature interviews are prone to subjectivity and bias on the part of the interviewer. While the threat of subjectivity and bias is a limitation of the research, the

use of multiple forms of data collection attempt to reduce subjectivity and bias as much as possible. An interview schedule is provided in appendix 9.

3.5.3 Observations

Cohen and Manion (1980) state that at the heart of every case study lies a method of observation. They further suggest that observation is one of the best tools to use in a case study as it provides the researcher with first hand information. Cohen et al (2000) affirm that observational data is a highly attractive form of data that provides a researcher with the opportunity to gather information (live data) from live situations.

For the purposes of this study, classroom observations were planned so that student participants in the study could be observed during their PRME lectures and tutorial group sessions. These observations were aimed at finding additional information relating to the sample groups classroom learning behaviours as a means of supplementing and validating the biographical information received from the subjects as well as the information obtained during the interviews. Observations took place in order that the researcher was provided with the opportunity to explore students 'subconscious learning behaviours' and to discover aspects of student participants learning behaviours that might otherwise have been missed.

Classroom based observations, including observations during lectures and tutorial sessions took place during the months of April and May 2006. A detailed observation schedule is provided in appendix 10.

3.6 Data Analysis

Pollard (1986) states that only experimental data can conclusively demonstrate causal relations between variables. As a form of experimental research, the different forms of data collected in this study will involve, in the analyses, a calculation of correlation based on the interpretation of thematic analysis and elements of coding. All attempts were made in the interpretation of the data to interpret it from a position of empathic understanding as a means of providing a thick description (Geertz, 1973) of the characteristics and processes, transactions and contexts that constitute the learning behaviours exhibited by the sample group of students.

In order to achieve this type of analysis, the following stages of data analysis, as suggested by Terre Blanche and Durrheim (1999), were followed:

Step 1: Familiarization and Immersion

Identification of the types of interpretations that the data is suggesting or leading towards.

Step 2: Inducing Themes

Using a bottom up approach to determine organizing principles that occur naturally in the data collected with tentative categorization of emerging themes.

Step 3: Coding

Data was coded to assist in the development of thematic understanding of the identification of incoming learning behaviours found amongst the sample group. Once these behaviours were identified, additional coding was used in an attempt to classify the learning behaviours exhibited by the sample group.

Step 4: Elaboration

During this stage, themes were explored and raw data revisited in order to capture the finer nuances of meaning revealed in the data that the initial, rather linear style, of coding had provided. The coding system was revised and sub-themes identified.

Step 5: Interpretation and Checking

Using thematic categories as subheadings, a written account of the findings with an interpretation was provided and bias was checked.

CHAPTER FOUR
RESULTS

Introduction to the Chapter

This chapter reiterates the aim of the study and then goes on to profile the eleven students who took part in the survey. Information and findings obtained from student interviews and observations is then thematically presented and discussed. The final part of this chapter identifies the sample students' incoming learning behaviours drawn from a variety of research tools including interviews, observations and biographical questionnaires. This section culminates in the presentation of a classification system of the sample group's incoming learning behaviours.

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4.1 Introduction to the Chapter

This study set out to investigate and classify entry learning behaviours found amongst a small sample of first year, English second language speaking engineering students at the University of the Witwatersrand. While the researcher had at her disposal the results of a full assessment battery, as detailed in Chapter 3 of this research, the study relied heavily on the use of biographical questionnaires and in-depth interviews with the sample students. All interviews were conducted in the students' home languages, taped, transcribed and then translated into English.

4.2 A Profile of the Students who took part in the Case Study

Eleven first year engineering students took part in the study. Of the sample, eight had attended township schools, two had attended suburban schools and one had attended a private school. The student who attended the private school had been taught in English as their medium of instruction. However, amongst the students who attended township schools and suburban schools, only two were taught in English as the medium of instruction and while English was the official language of teaching and learning, teachers in these schools made use of code-switching in their teaching. Of the remaining students, one was taught in South Sotho, three were taught in isiZulu, one was taught in siSwati and three were taught using in a dual medium approach that used English and isiZulu as the languages of instruction.

All of the students obtained entrance to the university and the School of Chemical and Metallurgical Engineering based on their matriculation results. (See Table 1 on the following Page). Students selected for the study had all achieved an aggregate of above 65% for their final matriculation result. Although officially English was documented to be the medium of instruction for the purposes of university entry, through the interview process it was revealed that only three of the students who took part in the study were consistently taught in English. This is a significant finding as the literature pertaining to science teaching assumed that the language of teaching and learning in South Africa is either English or Afrikaans.

From Table 1, it is clear that all eleven students obtained good results in their final English examinations, however, it needs to be noted that six of the participants in the study wrote English as a second language.

It is of interest to note that four of the students had taken 7 subjects and one student even took 8 subjects for matric.

From the matriculation marks obtained by the students, it can be inferred that they would have had little difficulty in gaining entrance to university study as their marks suggest competent individuals who had successfully navigated their academic study requirements at the level of schooling.

Table 1: Matriculation Results of the Subjects who took part in the Study

Matric Results											
Subjects	**Case 1**	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**	**Case 8**	**Case 9**	**Case 10**	**Case 11**
English	75%	78%	65%	65%	74%	74%	71%	82%	76%	82%	70%
Maths	55%	66%	85%	69%	63%	100%	94%	89%	68%	87%	65%
Biology	75%	68%	45%	80%	82%		76%	85%	74%	73%	70%
Physical Science	55%	62%	65%	72%	61%	87%	81%	72%	70%	82%	75%
Geography		77%			87%	81%		90%	65%	76%	87%
Computer Science			65%^								
Agricultural Science					65%						
Home Economics						67%					
Technical Drawing									61%		
Biology Studies							79%				
History	90%										
Accounting										92%	
isiZulu	90%	75%			78%	72%	65%	86%		85%	82%
Afrikaans	65%		65%	64%		59%			46%		
seSotho				68%							
siSwati									78%		
Aggregate	**72%**	**71.4%**	**65%**	**69.7%**	**72.9%**	**77.1%**	**77.6%**	**84%**	**67%**	**82%**	**74.84%**

By reviewing the raw scores of the Coopersmith Self-Esteem Inventory instrument, it appears that all the students who took part in the sample, on entry to the university, exhibited a positive self esteem.

Table 2: Coopersmith Self-Esteem Raw Scores

Coopersmith Self-Esteem Scores										
Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**	**Case 8**	**Case 9**	**Case 10**	**Case 11**
21	17	20	16	21	16	20	17	24	16	20

From the biographical questionnaire as well as from interviews conducted with the sample students, it appears that all the students selected for the study had positive school experiences. These positive experiences are highlighted in student responses when discussing their time at school and are well expressed in two of the study participant responses:

> School was very easy for me, we were given notes to help us study and we would work through past examination papers together as a class. I also had a study partner and I liked the teachers at school because they were involved in our lives, not only academically, but also in our well-being.
>
> (Case 5: female, 26 July 2006)

> At school I did well because the teachers did everything they could to make us understand. When we started a new topic, the teachers would write it on the board and discuss it. Then they would write up the main points and explain them too. My teachers guided us in problem solving by giving us examples on the board. The teachers tried their best to make sure that everyone understood by giving clear explanations and using isiZulu when necessary. They would give us short notes and provide us with study guides to help us prepare for the exams.
>
> (Case 7, male, 26 July 2006)

While school appears to have been 'easy' for the students who took part in the study, they were selected due to their poor performance in the PRME course in relation to their high matric marks. Of the eleven students selected for this study, seven failed PRME in the first quarter while the remaining four students received either exactly 50% or just above.

The students appear to have no idea as to why they have performed so badly in a university course, as one student said:

> Sometimes I ask myself how come that from secondary school to high school, not even from there, from as early as primary school, I was excelling. But now in first year, wow, I am failing! I do not understand why. Sometimes I think I have learnt something, I go over it and think I know it - then I write a test and fail.
>
> (Case 3, female, 12 September 2006)

When asked whether they thought school had prepared them for university, five of the participants in the study mentioned that they thought school had prepared them adequately, while six of the participants in the study thought that school had not adequately prepared them for university study, but rather only for the matriculation examinations.

It is interesting to note that of the students who considered school not to have sufficiently prepared them for university one of the students, (Case 9) was in a school where he did not have a maths or science teacher and another (Case 6) was in a school where there were no science laboratories.

Three of the students who claimed that school did not prepare them for university work, (Cases 2, 3 and 11) received extra tuition in maths and science. Two students who believed that school did prepare them for university also received additional tutorage. While there are no significant differences between the students' PRME marks between those who claimed that school either prepared or did not prepare them for university, it is important to note that from the sample selected for this study almost half of the participants had received additional tuition while studying at school.

When asked to comment on the difference between schooling and university study, all the participants who took part in the study indicated that having good retention and recall skills and the ability to memorize facts or theorems assisted them in their schooling success but not in their university study. The student participants in the study further

indicated that they had relied heavily on study notes and past examination papers in preparation for examinations, items that are not available at university. As one student pointed out:

> In high school it is easy to turn to memorization because once you see a past paper you really have an idea of what the exam will look like because they don't really make big changes to the exams from one year to the next. They ask questions like, 'list five characteristics of …. And if you memorize those characteristics for sure you will pass. In past exam papers and tests you always find the same questions.'
>
> (Case 8, male, 14 September 2006)

Two of the subjects had parents who had attended university and the remaining nine participants in the study were first generation university students. Having heard the students discussing working with 'known' elements of schooling, it is significant that for nine of the students who took part in the study, university study was an 'unknown' element of study for which they were not prepared, especially since university study does not rely on memorization for success but rather on interpretation of facts and application of theories. The students appeared to be cognizant of the difference between school and university study through their comments that they think they could improve their marks if they were given more practice in problem solving skills.

The language of teaching and learning at university also appears to be problematic for the majority of students who took part in the study with all students indicating the belief that their understanding of concepts could be enhanced, and their marks improved if they were provided with some form of mother tongue instruction. Such a notion, while foreign in an English medium university environment appears to be carried over from the schooling environment where, as was mentioned earlier, the majority of students received dual medium instruction or mother tongue explanations while in their schooling environments.

From the biographical questionnaires and the interviews conducted with the students who formed the sample for this study, a number of themes emerged. These include issues related to language and understanding, differences in learning practices required for success between school and university study, and students perceived needs for success within the course they are registered for.

Each of these themes will be explored in greater detail over the next three sections of the following chapter.

4.3 Thematic Analysis of Questionnaires and Interviews conducted with First Year, English Second Language Engineering Students

4.3.1 Language and Understanding

As stated at the outset of this research, all the students selected to take part in the study were English second language students. Of the sample, ten of the students named their home language as isiZulu and one claimed siSwati as a home language.

Two students, one who attended an English private school (Case 1) and one who attended a township school (Case 6) received their schooling instruction in English only and this appears significant to the study as these two particular students claim to understand 90-100% of the language used during lectures, prefer an English speaking lecturer and appear to be coping with most of the technical language and vocabulary used at university level. Both these students' work has also steadily improved during the year and while they claim to have difficulty in expressing themselves in written English in a clear manner, they have emerged as the 'best' students of the sample group over the course of the year in relation to the marks they have received for their PRME course.

The remaining nine students who took part in the study have expressed difficulty coping with the presentation style of English lecturers used at university, claiming to understand only 50 – 60% of the language used in lectures. All of these students stated that they have difficulty understanding the technical language and vocabulary used during lectures

and feel that this has impacted negatively on their studies. Further investigation into this matter indicates that of these nine students, six of them (Case 2, Case 3, Case 7, Case 9, Case 10 and Case 11) demonstrate poor levels of English comprehension.

This is an interesting finding when compared to the LASSI skill component scores which suggest that, with the exception of Cases 2, 6 and 8, all the students selected for the sample have satisfactory to good information processing skills (See Table 3). This suggests that it is not the students skills to succeed in higher education that is in question but rather their lack of competence in English language that is creating a barrier to their understanding and their success.

Table 3: LASSI Skills Component

LASSI Skills Component											
	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**	**Case 8**	**Case 9**	**Case 10**	**Case 11**
INP	95%	20%	99%	90%	95%	55%	90%	45%	75%	80%	85%
SMI	90%	85%	95%	95%	65%	65%	90%	13%	75%	85%	10%
TST	99%	45%	90%	85%	90%	60%	60%	27%	90%	90%	5%

Key to above table:

INP – Information Processing; SMI – Selecting Main Ideas; TST – Testing Strategies

The students in the sample, with the exception of Case 9, commented on the pace of teaching at university level, saying that it was fast and that while they tried to listen and take notes, they missed out on critical information during the lecture process. Further, without exception the students who participated in the study claimed that the most common form of difficulty they experienced during lectures was insufficient clarity of explanation by lecturers and lack of written resources that the students could use to 'catch up' on what they had missed out on in spoken lectures. As two students commented:

> We get to class and the lecturers just say this and that and then they say go and study at home. OK, we understand that it is our duty to study, but you get out of there (the lecture theatre) not knowing what is really happening.
>
> (Case 4, male, 25 July 2006)

> At school I used to have a study partner and we used our notes and text books to study. We also had a lot of explanation in our classes. At university our courses demand understanding, but the way it is taught makes it very hard to understand. I am a type of person who needs to understand very well in the class so that I can grasp a concept, but I keep missing out on some points and I end up confused. I have always believed that if you work hard nothing can prevent you from doing well, but with some of my courses I really don't know what to do to pass. I think notes would help because the text books are just too big and I really do not know what is needed to pass even though I am trying very hard.
>
> (Case 5, female, 25 July 2006)

From the information provided by the students it appears that the English second language engineering students experience difficulty in keeping up with the workload they are faced with as well as with understanding new concepts and terms presented to them during the lecture process. It further appears that a combination of weak language competence, lecture style teaching and insufficient written or oral explanation contributes to these students' feelings of disorientation and insecurity within the university environment. Interviews conducted with the students also indicate that the university orientation process in itself is not conducive to inducting students into academic study, as one student clearly articulated:

> Most students who are failing are the black students; I do not know why … when we came to the university the people who orientated us told us that we are going to fail. They built that mentality on the first day and they instilled a negative impact on us. They said that they know we were the best in our schools but here we will be the worst. Things like this are really discouraging. I think they have to encourage us to study hard and tell us that if we work hard we will pass. After hearing that I will fail, I was demotivated.
>
> (Case 4: male, 25 July 2006)

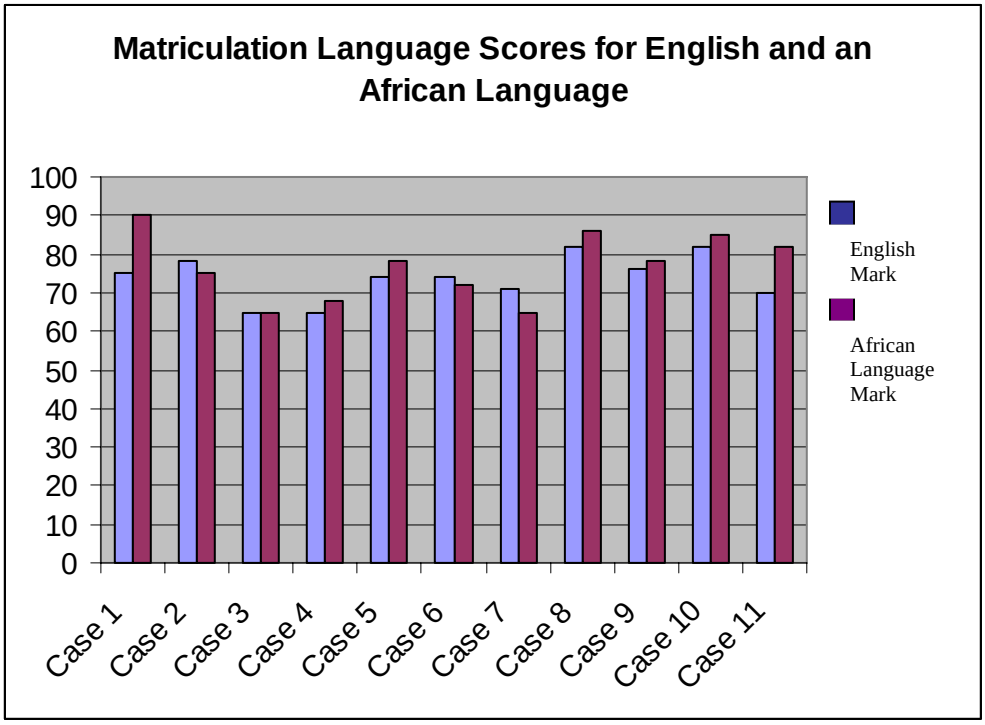
While none of the students who took part in the survey actively stated that they feel under-supported, during the interviews there was a clear sense that the students felt isolated and in need of guidance and encouragement. This is indicative of students' descriptions of wanting their studying time as being 'time on their own' as groups are

'destructive and unhelpful'. Also, all the students put forward the proposition that if they could have better explanations of what was required of them or if they could have more attention paid to them when they seek assistance, they could do better.

The Organizer and RAPM are instruments that were used as part of the entry assessment battery from which the present sample of students was drawn. The results from these two assessment techniques confirmed the intellectual ability of the participating students in the present project.

When examining the sample students' language marks of both English and their marks in an African language (Figure 2), one would not anticipate that the students of the sample group would experience any difficulty with the language used in higher education. However, when one considers the White, male, English first language predominance of lecturers in the field of engineering at the University of the Witwatersrand compared to the Black school teachers who had the ability to code switch and provide students with explanations in an African language (with the exception of Case 1) one begins to get a clearer understanding of some of the language related difficulties English second language students might experience at a tertiary level.

Figure 2: Matriculation Language Scores of the Sample for English and an African Language



When the fact that university courses in engineering differ markedly from school subjects that students performed well in, is taken into consideration, coupled with the fact that engineering has its own disciplinary set of concepts and terminology that students are expected to master, it is not surprising that seven students from the sample group expressed the desire that some explanations be discussed with greater clarity and that they wished that lectures could explain difficult concepts to them in their mother tongue.

Slonimsky and Shalem (2005) have written about the difficulties English second language university students experience when attempting to engage with text at the level of university study. They state that "so much energy in reading a text is spent on

decoding parts of the text rather than working in the structural integrity of the whole text" (Slonimsky & Shalem, 2005: 87). While the students who participated in this study did not specifically mention this type of difficulty when engaging with text, they did indicate a similar difficulty when attempting to listen to what their lecturers were saying. For example one student clearly stated:

> I think the problem is that we are learning in our second language. Our job is to understand what is being taught but when the lecturer says some words in English we have to translate them in our minds to understand them. When we do this, we miss what the lecturer says next and end up confused as to what a lecture was about.
>
> (Case 3, male, 24 July 2006)

Another student from the sample group elaborated further:

> In PRME we depend on lecturer's explanations for understanding. It is not like physics where you can go to the library and find a book that will give you all the information about a topic. In PRME you don't find any material in the library and the notes we get are very shallow so we have to concentrate hard in the lectures.
>
> (Case 9, male, 27 July 2006)

The students who participated in the sample expressed a desire for course notes which they could study on their own as they believed this would be of benefit to their understanding. This 'desire' to be alone when studying was consistent across the sample surveyed and is an interesting finding as Felder et al (2000) points out that engineering is a cooperative enterprise, conducted by a team of people with different skills. While the engineering courses offered at the University of the Witwatersrand provide opportunity for group engagement in the form of tutorial sessions, the English second language students who took part in the study indicated their hesitance to take part in this type of activity, a learning behaviour which was confirmed through observation of the student participants.

Such a finding was interesting to note, especially when taking into account the fact that during their school years all the participants in the study had worked with a study partner or in small groups which they believed enhanced their understanding. With the exception of Case 1, the students participated in these study groups or partnerships in their mother tongue. Lack of opportunity to collaborate with one another due to the long day of studying and the prescriptive allocation of heterogeneous groups during university hours appear to be creating a hindrance to the sample group's ability to work collaboratively with one another in their home language.

Through observations and discussion with students in their mother tongue during the research process, it was also found that students were hesitant to ask questions in large classes such as those found during lecture periods as they do not feel confident enough in their English language ability to ask questions that will reflect what they need from the lecturer. Most of the sample group also expressed fear that they would be thought of as 'stupid' by the lecturer or their fellow classmates for asking basic questions or for explanations of what other English first language students appear to understand. For the sample group of students, this is a new emergence of learning behaviour as at school they appear to have interacted well with their educators and other members of their peer group, and were unafraid to ask questions to enhance their understanding.

While behaviours of language related interaction and participation in a learning setting appear to have lessened for the English second language engineering students who took part in the study, there are a number of other learning behaviours which they engaged in which while conducive in a schooling setting appear not to be working well for the students at a university level. In the next section differences between learning practices required for success at school and those required for success in higher education will be explored.

4.3.2 Differences between Students' Perceptions of Learning Practices required for Success at School and University

All of the students who participated in the study indicated awareness that university study was different to the kind of study required for success in school. However initially most students perceived that the differences they would experience would be with regard to an increased workload compared to what they were used to at school. The students also anticipated some initial difficulty in orientating themselves to studying for subjects that would be new to them. All the students felt that their schools had prepared them for these particular challenges through warnings such as the two related below:

> I remember my principal telling us that we are going to tertiary but that after six months we would be running back to school away from the hard work. I don't think anyone comes here not expecting to have to work hard and I was scared that Wits would kick me out in the first semester even though I was prepared to work hard.
>
> (Case 4, male, 25 July 2006)

> I think my school did try and prepare me for university because they used to say 'go do this' and if I complained that the work was too much for me they would tell me that if I wanted to go to university I must be prepared to work hard because they work they give you is just very difficult compared to school.
>
> (Case 8, female, 27 July 2006)

While all the students who took part in the study entered first year engineering with the desire to work hard and to pass, they soon realized that the differences between school and university were more complicated than what they had initially anticipated. As one student pointed out:

> I am a very persistent and hard working person and I felt that school had prepared me for university. But since I have been here I have realized that this is not true. This place is like a new house and in a new house there are new rules and things are kept in different places and you do not always know what you should do or where you should go for help. But then, as time goes on you begin to learn what is expected of you but it is still a shock. It is like waking up in a new house when you still expect to be living in the old one and all the rules have changed.
>
> (Case 5, female, 25 July 2006)

For the students who had been taught in schools where an African language was used, the 'only English approach' followed by university lecturers created a number of difficulties. Students identified that they had been supported greatly at school regarding the understanding of concepts explained in an African language and found it difficult to follow and understand concepts taught during lectures. Two students expressed this difference between schooling and university quite clearly:

> I am from one of those black schools. We were taught everything in Zulu except when it was time for English … at university it is very different. The lecturers speak differently especially that they are all white. I love the course chemical engineering but I am struggling with the language. Sometimes we also have discussion groups, but they are not really helpful because everything is in English and we move so fast through the topics.
>
> (Case 5, female, 25 July 2006)

> When I was at school I really appreciated the teachers who explained things in Zulu but now I can see that it did not really help me. Everything at the university is in English, the lectures, the text books, everything. If you do not understand English you will have a problem at university. I think that our teachers also took a lot of responsibility for making sure that we understood concepts but here, it is my responsibility to understand concepts. The lecturer's responsibility seems to be to deliver the (subject) matter and then I have to work out what is going on by myself and enhance my own understanding of what has been taught. This is a big difference between school and university and I think it is not a good difference. We should have been forced to work on our own at school.
>
> (Case 8, female, 27 July 2006)

The students who participated in the study also mentioned that a major difference between school and university was in the provision of notes, handouts and summaries. At school they received written support in this format while at university they are

responsible for making their own notes and studying from them. There also appears to be the perception held amongst the students who participated in the study that school focused on individual attention aimed at enhancing the school's pass rate while university appears to create distance between the lecturer and the student by focusing solely on working through the syllabus. One student provided an insightful comment on this perceived phenomenon:

> When you complete school you think you are clever and then the university shows you how foolish you are. My school was very interested in the pass rate and so they spent a lot of time on the students work without really thinking about the type of learning students would need when they attended university. They encouraged us to pass exam papers and we used to study exam papers to help us pass. At university the lecturers are very distant from the students and they do not encourage participation. This is a big difference between school and university but I do not think it is a good difference. I think that we need to be encouraged to be more involved with lecturers because I think that is the only way we can pass. I think lecturers need to be more approachable because the distance of lecturers is a contributing factor to failure.
>
> (Case 9, male, 27 July 2006)

The students who participated in the study further identified the pace of study to be different between school and university with the majority of the students expressing a sense of feeling overwhelmed at the pace of university study. Amongst all the students, with the exception of Case 1, students appear to continue to have difficulty adjusting to the pace of study.

A further difference between school and university that the students who were interviewed described was the difference between the type of approach to learning expected from them at the different levels of education. At school, students were taught to aspire to obtaining the correct answers and there was a sense that only one answer was correct, a surface approach to learning. As a result, students tended to rely on memorization of answers and rote learning to succeed. At university however, the emphasis in teaching and learning is embedded in a more problem-based perspective which requires a deep approach to learning. All the students who took part in the study identified the need for themselves to be more proficient in problem solving activities than what they were on entry to the university and yet they still felt that memorization skills were important to obtaining understanding. Two of the participants who took part in the research expressed the dilemma facing them quite succinctly:

At school we were encouraged in memorization skills but I have realized that memorizing cannot lead to understanding. But I have also realized that there are times when memorizing work is essential. I do not think that you can just understand without some type of memorization at university but at university they seem to emphasize understanding more and don't emphasize memorization. I think both must be important but I don't always know when memorization is important or when it is not.

(Case 5, female, 12 September 2006)

I have discovered that at university they provide you with a lot of problems that you must find solutions for. In some ways this is similar to school but there is also a difference – at school to do well you needed to get the right answer but in PRME there are different answers that depend on what you chose to solve the problem and the way you try and solve the problem is more important than getting the solution. This is sometimes confusing because in this type of situation past papers don't really help you. This is quite difficult because we are used to having problems with solutions at school and here there are just problems and you don't know if a solution is right and then you become confused. I don't understand how people can pass if they don't get the right solution. It's like we learned that every problem has a solution and now we discover that every problem could have many types of solutions and that all of them or none of them could be right. I don't know how to study for tests like this.

(Case 7, male, 12 September 2006)

Students also identified differences in the type of feedback they received for class work related to problem solving activities. It appears that at the level of schooling the students who took part in the sample were provided with 'project type' activities where they were given 'problems' to solve. This type of work, whether of an individual or group nature, was facilitated by an educator and feedback was provided for all the problem-based activities the students were required to complete. At university, the students have found there to be less support for problem-based learning activities. Two students from the sample explain some of the difficulties the students perceive themselves experiencing:

> Sometimes we work in small groups called 'tuts' or tutorial groups and when we do tests the tutors help us but mostly they leave us to do the work without any guidance. In the lectures we also do a type of problem solving work using calculations but we receive very little help. In the last problem solving task there were three problems and we did one in class and the rest we had to do at home on our own and these were not checked. It is difficult because you work hard but you don't know whether you are on the right track.
>
> (Case 8, female, 27 July 2006)

> I find that I am not getting the knowledge that I expected to get at university and there is no one who is helping me understand what is going on. For the classes and the tutorials our lecturers want us to bring problems that are already half done and this is difficult. I even went to a lecturer with some questions but he told me he does not work out problems for students. I didn't want him to work the

> problem out for me, I just wanted a head start. I am finding engineering very difficult because we have tutorials that have no solutions and while I understand that university is about gaining the skills of how to solve problems. We don't really get any guidance and I have searched for books on problem solving, even as far as the Chamber of Mines, but I am not winning.
>
> (Case 7, male, 26 July 2006)

From the information set out in this section of the findings chapter, the English second language engineering students who participated in the research are able to draw clear distinctions between differences they experience between school and university study. While different categories of difference have been highlighted, the overarching difference between student's school experiences and their university experiences appears to be embedded in the level of support and facilitation the students received from their teachers as opposed to the level of support and facilitation they receive from lecturers. In the next section of this chapter, students' perceptions of their academic needs are explored.

4.3.3 Students Perceptions of Needs within the Engineering Course they are Registered For

It is clear from the findings documented in this chapter that language plays a critical role in the sample students' university performance, both in terms of their understanding of new concepts and with regard to their ability to maintain concentration and comprehension during lectures. When questioned as to whether they would prefer a

lecturer who spoke an African language to a lecturer who spoke English only, the students who participated in the study were divided in their responses. Six of the students felt that they would benefit from a lecturer who spoke an African language while five of the students who took part in the sample believed that they would benefit more in an English only environment as long as the person lecturing them was able to provide clear explanations.

All of the students stated that they experienced difficulty with the pace of teaching and claimed that they needed additional notes to enhance their ability to study for exams. The stated need for notes that students could refer to apart from the self-made notes that they made during lecturers was a predominant focus of most of the interviews and discussions held with the students. It appears from the interviews held with the students that they are not confident in their own note taking ability, especially as the majority of students expressed only understanding 50% – 60% of what was being relayed during the lectures. One student who participated in the study was particularly vocal on this subject:

> I really try to study hard. During the lectures I take as many notes as I can but it is difficult sometimes to keep up. In the evenings I read through my notes and try and summarize them but it always seems as though I have gaps from what was being covered in class. From my notes I make questions that I ask during the small group sessions but I still don't understand even if I ask continuously. For some of our subjects we have notes and information that you can download to pick up on the pieces you miss, but not in other courses. These courses cause us

> to become very stressed because we don't know where we are going wrong and it is not like I am the only one complaining or doing badly. Without notes it is difficult to change our logic or our methods, likewise our understanding. Also, without notes different lecturers tell you different things and you end up being more confused than ever because what the one person says contradicts what the other person says. It is not like we are not trying to work hard or looking for a shortcut but we need a reference.
>
> (Case 7, male, 12 September 2006)

It appears that to some extent the students who took part in the study are looking for some type of academic support that is integrated into the courses they take during their first year of study for an engineering degree. They also appear to be requesting a certain level of facilitation in basic conceptual understanding essential to their courses.

Of the students who took part in the research, all commented that the orientation process they took part in at the beginning of the year did not assist them in any real way for the year ahead of them. The students suggested that the orientation programme may have been of greater benefit if the students had been introduced to students in their second or third year of engineering who could share their experiences with them. They also suggested that instead of merely informing the students of how difficult their course was going to be, it would have been of benefit to them to have been provided with library references that they could look up that was both subject specific and study related. One student commented:

> I think there are ways for improving students' 'academicals'. For example, if during orientation they gave us some tips on note taking or pointed us to texts that might help us as references in case we miss out on important things in lectures. I do not think it is enough to say 'you are going to fail'. That does not help at all. I think at orientation they can be more productive in leading us to realize our potential if they shared their experiences and gave us an idea of where to conduct our own research. I think they are trying to show us that they are not going to hold our hand and that is fine we don't want anyone to hold our hands but we would like someone to point us in the right direction.
>
> (Case 1, female, 12 September 2006)

While eight of the students who took part in the study identified a need for 'additional support', when questioned further on this topic, the additional support appeared to be directly related to the provision of clear explanations and notes that could be used as references – factors that have already been discussed in this section. The eight students who felt as though they required additional support all thought that the provision of past examination papers and additional practice in problem solving techniques would be of benefit to them.

All the students who took part in the study identified the need for themselves to become more involved in the lectures however, lack of confidence and fear of appearing 'stupid' appeared great inhibitors to this action. The lecture style and pace also appeared to be an inhibitor to student participation.

From the interviews and surveys the students took part in, it appears that English second language engineering students are struggling to make the transition between school and university due in part to their incoming learning behaviours and in part to the inflexible curriculum that they encounter at a university level that does not take into consideration the needs of students who are learning in a language that is not their mother tongue. While the issue of language appears to be the most striking barrier to learning that the students who took part in the study experienced, differences between what was required of these students for success at school and what is required of them at a university level appear to be contributing factors as well.

In the following section classification of incoming learning behaviours displayed by the students who participated in the study will be described.

4.4 Identification and Classification of Incoming Learning Behaviours Displayed by a Sample of English Second Language First Year Engineering Students

The main aim of this study was to identify and classify incoming learning behaviours of a sample of English second language first year engineering students. As such, the biographical questionnaires, interviews and observations which were conducted as part of the study sought to provide information pertaining to this goal. From an analysis of all the data collected during this study, a number of incoming learning behaviours have been identified, most stemming over from the schooling system, but with some identifiable as being emergent due to the university environment in which the students who formed the sample found themselves.

The classification table (Table 4) has been devised for research and educational purposes as an attempt to provide information regarding identifiable categories of incoming learning behaviours found amongst a sample of English second language first year engineering students. While statistics regarding the number or percentage of the sample group are included in the table, these have been included to indicate areas of consistency found within a specific category during the study and are not aimed at providing statistical information outside of the sample group.

Table 4: Classification of Incoming Learning Behaviours amongst a Sample of English Second Language First Year Engineering Students

Classification of Incoming Learning Behaviours		
Section A: Learning Behaviours derived from the schooling context in which students studied prior to attending university		
Description of Learning Behaviour	Number of Students from the sample displaying this behaviour	Percentage of Students from the sample displaying this behaviour
Teacher dependence – the student enters the university expecting a similar relationship with the lecturer to what they experienced with their teachers at school. They expect their work to be guided and facilitated by a more 'knowledgeable person' who they can consult and question when they feel out of their depth or when they require additional explanation regarding the learning of concepts.	10	90.9%
Mother Tongue reliance – the student enters the university having had key concepts explained to them in their mother tongue, either through being taught in an African language medium of instruction or having had teachers who have been able to use code-switching techniques to provide mother tongue explanations. The student is therefore not used to English being the medium of instruction for the explanation of key concepts and finds it difficult to make or attach meaning to the concepts taught in English at a university level.	8	72.7%
Text dependence – the student has good reading and reading comprehension skills and is used to working with multiple textual sources to obtain information pertinent to their success within the school environment. The student relies on the provision of notes from the teacher and supplements these notes by reading textbooks, study guides and other references related to the topic of study.	11	100%

Section A: Learning Behaviours derived from the schooling context in which students studied prior to attending university		
Description of Learning Behaviour	Number of Students from the sample displaying this behaviour	Percentage of Students from the sample displaying this behaviour
Examination awareness – the student is aware of the importance of examinations in assessing his/her ability and makes use of past exam papers in preparing for written examinations. From this activity the student is able to highlight probable and possible exam questions and studies according to what s/he feels will be required of him/her.	11	100%
Memorization and rote learning abilities – the student has ascertained that for a good pass mark at the level of schooling memorization of key concepts and rote learning of facts are essential aspects of success. For problem solving activities, equations or calculations the student is dependant on learnt theorems or experiments that they have committed to memory and which can be applied when necessary.	11	100%
Cooperative learning experience – the student has had experience of group work and has worked in groups or with a study partner to prepare for examinations, conduct small research projects or complete task based activities.	11	100%
Active learning experience – the student has been actively involved in his/her own learning experience; s/he has participated in class activities, has engaged with the teacher during lessons, and has initiated independent learning/studying strategies for self-learning that exceed what has been covered in school.	11	100%
Familiarity with a laboratory setting – the student has clearly had experience in working within a laboratory setting and has knowledge of how to conduct scientific experiments within a laboratory. The student shows an appropriate understanding of the use and care of equipment found within a laboratory.	10	90.9%

Section A: Learning Behaviours derived from the schooling context in which students studied prior to attending university		
Description of Learning Behaviour	Number of Students from the sample displaying this behaviour	Percentage of Students from the sample displaying this behaviour
Awareness of the importance of punctuality and attendance – the student is aware of the need to attend class on time and to follow the time table to ensure his/her presence in all lectures. The student is aware that homework needs to be completed by the due date and that tests need to be planned and learnt for ahead of time.	11	100%
Section B: Learning Behaviours exhibited by the sample students in their first year engineering course		
Description of Learning Behaviour	Number of Students from the sample displaying this behaviour	Percentage of Students from the sample displaying this behaviour
Displays of passive learning – the student concentrates hard on what is being said during lectures but appears to be using all their energy to understand what is going on and as a result does not engage in effective note taking practices. The student answers direct questions when they are asked of him/her but does not engage with the lecturer by asking questions regarding clarification.	10	90.9%
Displays of isolated learning – the student prefers to study alone and does not actively participate in group discussions or group tasks, remaining largely a passive observer in group activities.	10	90.9%

The classification of incoming learning behaviours exhibited by the sample of English second language engineering students provided here reveals an interesting set of defining features displayed by the majority of the sample group that do not correlate to the hypotheses on which the research was grounded.

Chapter 5 discusses the implications of the results in relation to the literature review, mentions the limitations of the study, and outlines ideas for future research. Following this, the summary and conclusion of the study will be presented.

CHAPTER FIVE
DISCUSSION

Introduction to the Chapter

As a conclusion to the study, this chapter presents a brief discussion regarding the interpretation and implications of the findings. It then goes on to mention the limitations of the study and make recommendations for future/further research. A concluding summary is provided.

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5.1 Interpretation and Implications of the Findings

The aim of this study sought to investigate the extent to which school learning behaviours consolidated reproductive rote learning and surface learning approaches amongst students enrolled in a science orientated, engineering first year university programme. As such, the study sought to investigate and classify the entry learning behaviours amongst a small sample of English second language speaking engineering students at the University of the Witwatersrand. While the research was exploratory in nature, it was based on the hypothesis that Black schools in South Africa, due to the legacy of apartheid, were not adequately equipping learners at the level of the further education and training band for university study.

The results of the study indicate that at the level of teaching and learning within Black schools, Black students are being taught fundamental academic skills, such as reading for meaning and self study techniques that should enable them to cope with university study in the field of engineering. While to some extent the students display a dependence on memorization and rote learning in their approach to learning, they also exhibit research skills and the ability to approach problem solving activities from a scientific perspective. Thus in general terms, the sample students' incoming learning behaviours indicate no real relationship with the high rate of failure found among Black university students in the Engineering Faculty.

However, while no real comment can be made on the proficiency of the student's school teachers, it does appear that at the level of schooling, the sample students were exposed largely to what Perry (1999) terms basic duality – the notion that all problems are solvable and that the student's task in the learning process is to learn the right solutions for the right problems. The sample students' desire for notes and additional practice in problem solving structures indicate that they are working largely at a surface level with regard to the construction of knowledge and searching for 'correct' answers at university level when exposed to disciplinary reasoning together with multiplicity of knowledge (Perry, 1999). As such, it appears that the students have transferred a dependence on received knowledge into their approach to university study. By doing so, the students who formed the sample group indicate a belief in a form of absolute knowledge that can be found in written text or in the words of the lectures teaching them. Heavy reliance on educators, notes and study guides at the level of schooling appear to have entrenched in the sample students this surface perception of what knowledge is and the purpose for which knowledge is acquired.

Throughout the interviews conducted with the students, language emerged as a significant factor regarding the sample students' success in the first year engineering course for which they are registered.

Where the literature used as a review base for this study assumed that students were taught scientific concepts in either English or Afrikaans, information obtained from the students indicated that the majority of students who took part in the study were taught

scientific concepts in their mother tongue or through code switching techniques. This finding is of significance for a number of reasons.

First, it suggests that within Black schools, while students write their examinations in English, they are provided with African language instruction as a means of facilitating or mediating their learning in science related subjects. While such instruction could suggest a form of interlingual mediation, as there are no scientific text books written in an African language at the level of matric or university, the validity and uniformity of such instruction as it relates to critical scientific concepts must be brought into question.

Second, while students appear, from their Matriculation results, to benefit from a dual medium approach to teaching and learning at the level of schooling, mother tongue instruction does not sufficiently prepare students to cope within the English medium approach at a university level. Further, when it is understood that a number of the sample students received the support of mother tongue instruction, one has to question whether or not the students would have achieved the same Matriculation results if they had been taught in English only. Such a view is complicated for many reasons yet needs to be expressed as it has implications for the selection of students into an engineering course that is significantly related to Matriculation scores.

For example, of the students who took part in the study, Case 1, who was taught in English only and Case 6, who relied on English text books rather than on school-based teaching, while struggling initially, towards the end of the year improved in marks

substantially while the other students who formed the sample group did not do as well when considering their matriculation aggregates which gained them entry into the university as can be seen in Table 5 below.

Table 5: Matric Aggregate Scores and Students' First Year PRME Results

	Matriculation Aggregate	**1/4 Marks**	**2/4 Marks**	**July Exam**	**3/4 Exam**
Case 1	**72%**	55%	55%	69%	72%
Case 2	**71.4%**	50%	35%	27%	25%
Case 3	**65%**	48%	60%	29%	44%
Case 4	**69.7%**	47%	63%	53%	38%
Case 5	**72.9%**	43%	61%	31%	42%
Case 6	**77.1%**	48%	76%	42%	62%
Case 7	**77.6%**	47%	56%	37%	42%
Case 8	**84%**	57%	62%	54%	56%
Case 9	**67%**	55%	49%	29%	24%
Case 10	**82%**	53%	65%	72%	48%
Case 11	**74.8%**	50%	50%	36%	22%

Language further appears to be creating a barrier to the sample students' ability to achieve in their first year university engineering course as it appears that the language barrier students experience has led them to become passive rather than active agents in the learning opportunities provided by the university in the form of lectures and small group tutorials. As students claimed to have been actively engaged in school lessons

through asking questions and contributing to group discussions, it appears that a general lack of confidence in the students' English competence, together with the fast pace of work, has resulted in the sample students withdrawing from participation that would assist them in their understanding. Observations of the students in lecture and small group settings suggest that students feel self-conscious about their ability to participate and as a result withdraw from active participation, concentrating more on what is being said than on working on increasing their own understanding through active engagement.

Overall, the students' incoming learning behaviours indicated a strong reliance on text-based resources; this type of learning behaviour is not in and of itself distanced from the academic requirements of an engineering university programme as the notion of reading for a degree has long been propagated. What does appear to be creating a barrier to student success for English second language first year engineering students is the real or perceived lack of reading material that the sample students indicated a need for to supplement lectures delivered in the medium of English. For the majority of students who took part in the study, the lack of provision of such material appears to result in them approaching their studies from a decontextualized and depersonalized position of learning embedded in a persistent belief of the 'object' of knowledge (Gamache, 2002).

These findings suggest that the university environment in which the research took place (The University of the Witwatersrand), through its English medium approach is neither actively empowering English second language learners to develop their individual strengths nor enabling them to participate critically in the process of learning (Education

White Paper 6, 2001: 16). They also suggest a mismatch between student and staff expectations of what is required at the level of first year study for engineering students enrolled at a university level while endorsing McKeachie et al's (1985) view that learning is dependant on prior knowledge and linguistic skill.

5.2 General Implications

While the sample for the research was small, the findings from the research suggest that for English second language students who have been taught in Black township schools where either the medium of instruction was an African language or where code-switching was a common occurrence, the 'English only' medium of instruction at the University of the Witwatersrand is creating a barrier to the students' learning and academic success. While such a view could be viewed as controversial, and where this research could argue that at the level of schooling students should be taught in English only, the focus of this study is directly related to the identification of incoming learning behaviours found amongst English second language engineering students, as such, the views and perceptions of the sample students need be heard, accepted and dealt with in a way that is responsive to the students.

Where curricula responsiveness was discussed in the literature review of this study, Education White Paper 6 (2001: 19) expands on this concept by making the claim that for many learners, the most significant barrier to learning arises from inflexible aspects of the curriculum offered within a learning institution. The interlocking aspects of the

curriculum which are considered to create barriers to learning for English second language learners include the language of instruction, methods and processes used in teaching, the learning materials that are used and the pace of teaching or the time available to complete the curriculum. It would appear from the results of this research that these specific aspects of the first year engineering curriculum are contributing to the creation of unresponsiveness to English second language learners' needs.

According to Education White Paper 6 (2001: 20) the most important way of addressing barriers arising from the curriculum is to ensure that the process of teaching and learning is flexible enough to accommodate different learner needs and styles in a manner that provides accessibility to all learners. While higher education is not known for its 'flexibility' with regard to the teaching process, the results of this research suggest that some degree of flexibility of curriculum may succeed in reducing the high failure rate amongst English second language Black students registered for a degree in engineering. Some suggestions for how curriculum flexibility could be implemented include:

- The creation of language homogenous small group tutorials or activities where students can engage with one another in their mother tongue;
- The availability of lecture notes and textual references that students can easily access to supplement the information covered in English lectures;
- The creation of an orientation programme that allows for school leavers to develop and broaden their understanding of the meaning of knowledge; and

- The creation of an orientation programme for English second language speakers that provides them with an outline of concepts key to the course along with suggestions for note taking during different lecture presentations.

5.3 Limitations of the Study and Suggestions for Future Research

Limitations of the study need to be considered together with suggestions for future research.

The current study explored English second language first year engineering students' learning behaviours as a possible factor in contributing to the high failure rate found amongst Black first year students at the University of the Witwatersrand. Where the results of the research seemed to point in the direction of language and language use being a more significant contributor to the failure rate than general school learning behaviours, the sample obtained was representative only of the Nguni language group, due to the researchers proficiency in those languages. It would be interesting to see if the findings remain the same or whether they change when including speakers of the Sotho language group in a similar study.

The sample, while small, yielded relatively rich data and yet the sample group was only representative of ten students who had attended Black township schools. It is believed that it would be informative and important to explore whether there would have been any

differences in the findings amongst students who entered the university from rural schools.

These limitations allow for the consideration of future research options which could improve on this existing study.

First, a study involving the same aims as the present study but broadening the subject representivity of the different African language groups found within South Africa could be undertaken. Such a study would allow the researcher to determine the extent to which the themes emerging from the current study could be challenged or strengthened.

Second, the current study could be replicated across all branches of first year engineering courses at the University of the Witwatersrand. It could also be replicated as a comparative study across different universities offering engineering degrees in South Africa,

Finally, a research study could be conducted into the feasibility and viability of the implementation of the support strategies suggested in this research as a means of determining the extent to which changes to the current engineering curriculum could enhance the pass rate of English second language first year engineering students.

5.4 Summary and Conclusion

This research identifies and classifies incoming learning behaviours found amongst a sample of English second language first year engineering students. During the research process, it was discovered that students entering university for an engineering/science based degree tend to struggle with the English lecture style and the pace of work at a first year level due to their having been taught in their mother tongue or through the use of code switching in their school years. It was further identified that the students who took part in the sample were highly reliant on notes and lecturers for 'obtaining knowledge' that could be utilized in the answering of problems. The findings indicate that English second language students who had been taught in Black schools had a limited view of knowledge that was dependant on received knowledge. It was further found that with the exception of students who had been taught in English only schools, there appeared little correlation between the matriculation aggregates of the students and their first year engineering marks. Where English second language first year engineering students exhibited some learning behaviours that suggest an aptitude for success in higher education, the findings suggest that the students who took part in the study do not feel supported at university. The findings, while complicated in nature, also suggest that university structures and procedures are not responsive to the specific needs of the sample group. It is the recommendation of this study that further research be undertaken amongst a larger sample group if curricula changes amongst first year engineering courses are to be considered.

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APPENDICES

Appendix 1

Student Letter of Invitation to Participate in the Study

University of the Witwatersrand

School of Education and School of Chemical and Metallurgical Engineering: May 2006

Dear

I am a Wits student currently working on my Masters Degree in Education. In my research I am attempting to identify and categorize the learning behaviours of English second language first year engineering students to determine whether there is a link between the way you were taught to learn at school and the way you are expected to learn at university level. The reason for me conducting this research is to try and understand your academic needs and determine the type of support or academic development strategies that could be of benefit to you in your course. It is also hoped that the findings from this research will be able to influence the future development of PRME in subsequent years.

A range of students are presently being asked whether they would be willing to take part in this study. Each student who is willing to participate will need to agree to be interviewed for short periods of time over the course of the year. You would also need to be willing to be observed during PMRE lectures and practical activities. As a participating student you will be assured of confidentiality at all times – pseudonyms will be used to ensure that your identity is known only to me. While the interviews that will be conducted with you will be recorded and transcribed, the source of the material used in the research will be kept confidential and once the report has been examined, the raw data will be destroyed.

I would be most grateful it you would agree to participate in this research study and look forward to developing a sound ‘working’ relationship with you.

Yours sincerely

Zanele Simalane

Please feel free to contact me at any time on either 011-476-2604 (answering machine) or 073-667-7088.

Student Consent form

I _____ consent to take part in the research into identifying and classifying first year learning behaviours. I also consent/ do not consent to being recorded during the interviews.

Date _____ Signature _____

I _____ do not consent to take part in the research into identifying and classifying first year learning behaviours.

Date _____ Signature _____

I _____ wish to withdraw from participating in the research into identifying and classifying first year learning behaviours.

Date _____ Signature _____

Appendix 2

LASSI Question Sheet: Learning and Study Strategies Inventory

(Weinstein, Schutte & Palmer, 1987)

1. I worry that I will fail and drop out of the university.
2. I am able to distinguish between more important and less important information during a lecture.
3. I find it hard to keep a study routine or timetable.
4. 4.After class I go over my notes to help e understand the information.
5. I don't care if I finish university as long as I find a husband/wife.
6. I find that during lectures I think of other things and don't really listen to what is being said.
7. When reading I use italics and headings that are in my textbook to help me study.
8. I try to identify the main points when I listen to lectures..
9. I get discouraged because of low marks.
10. I am up to date in my assignments.
11. Problems outside of the university- being in love, financial difficulties, conflict with parents etc, cause me to neglect my work.
12. I try to think through a topic and decide what I am supposed to learn from it rather than just read it over when studying.
13. Even when study materials are dull and uninteresting, I manage to keep working until I finish.
14. I feel confused and undecided as to what my educational goals should be
15. I learn new words or ideas by imagining a situation in which they occur.
16. I come to class unprepared
17. When preparing for an exam, I make up questions that II think might be included
18. I would rather not be at the University.
19. My underlining is helpful when I go over written material.
20. I do poorly on tests because I find it hard to plan my work within a short period of time.
21. I try to identify possible test questions when going over my class material
22. I only study when there is the pressure of a test
23. I translate what I am studying into my own words
24. I compare class notes with other students to make sure my notes are complete
25. I am very tense when I study
26. I go over my notes before the next class
27. I am unable to summarize what I have just heard in a lecture or read in a textbook.
28. I work to get a good mark, even when I don't like a course.
29. I often feel like I have little control over what happens to me at the University
30. I stop periodically while reading and mentally go over or review what was said.
31. Even when I am well prepared for a test, I feel very anxious.
32. When I am studying a topic I try to make everything for together logically.

33. I talk myself into believing some excuse for not doing an assignment
34. When I study, I have trouble figuring out just what to do to learn the material.
35. When I begin an examination, I feel pretty confident that I will do well.
36. When it comes to studying, procrastination (i.e. putting things off) is a problem for me.
37. I check to see if I understand what the lecturer is saying during the lecture.
38. I do not care about getting a general education, I just want to get a good job
39. I am unable to concentrate well because of restlessness or moodiness.
40. I try to find relationships between what I am learning and what I already know.
41. I set high standards for myself at the university
42. I end up "cramming" for almost every test
43. I find it hard to pay attention during lectures
44. I focus on the first and/or last sentences of most paragraphs when reading my text
45. I only study the subjects I like.
46. I am distracted from my studies very easily.
47. I try to relate what I am studying to my own experiences.
48. I make good use of daytime study hours between classes.
49. When work is difficult I either give up or study only the easy parts.
50. I make drawings or sketches to help me understand what I am studying.
51. I dislike most of the work in my classes
52. I have trouble understanding just what a test question is asking
53. I make simple charts, diagrams or tables to summarize material in my courses
54. Worrying about doing poorly interferes with my concentration on tests
55. I don't understand some course material because I don't listen carefully
56. I read textbooks assigned for my classes
57. I feel very panicky when I take an important test
58. When I decide to study, I set aside a specific length of time and stick to it
59. When I take a test, I realise I have studied the wrong material.
60. It's hard for me to decide what is important to underline in a text.
61. I concentrate fully when studying.
62. I use the chapter headings as a guide to identify important points in my reading.
63. I get so nervous and confused when taking an examination that I fail to answer questions to the best of my ability.
64. I memorize grammatical rules, technical formulas, etc, without understanding them.
65. I test myself to be sure I know the material I have been studying.
66. I put off studying more than I should.
67. I try to see how studying would apply to my everyday living.
68. My mind wanders a lot when I study.

69. In my opinion, what is taught in the course is not worth learning.
70. I go over assignments when revising class material.
71. I have difficulty adapting my studying to different types of courses.
72. Often when studying I see to get lost in details and don't see the overall picture.
73. When they are available, I attend group revision sessions.
74. I tend to spend so much time with friends that my coursework suffers.
75. In taking tests, writing assignments etc, I find I have misunderstood what is wanted and lose marks because of it.
76. I try to interrelate themes in what I am studying.
77. I have difficulty identifying the important points in my reading.

Appendix 3

LASSI Answer Sheet

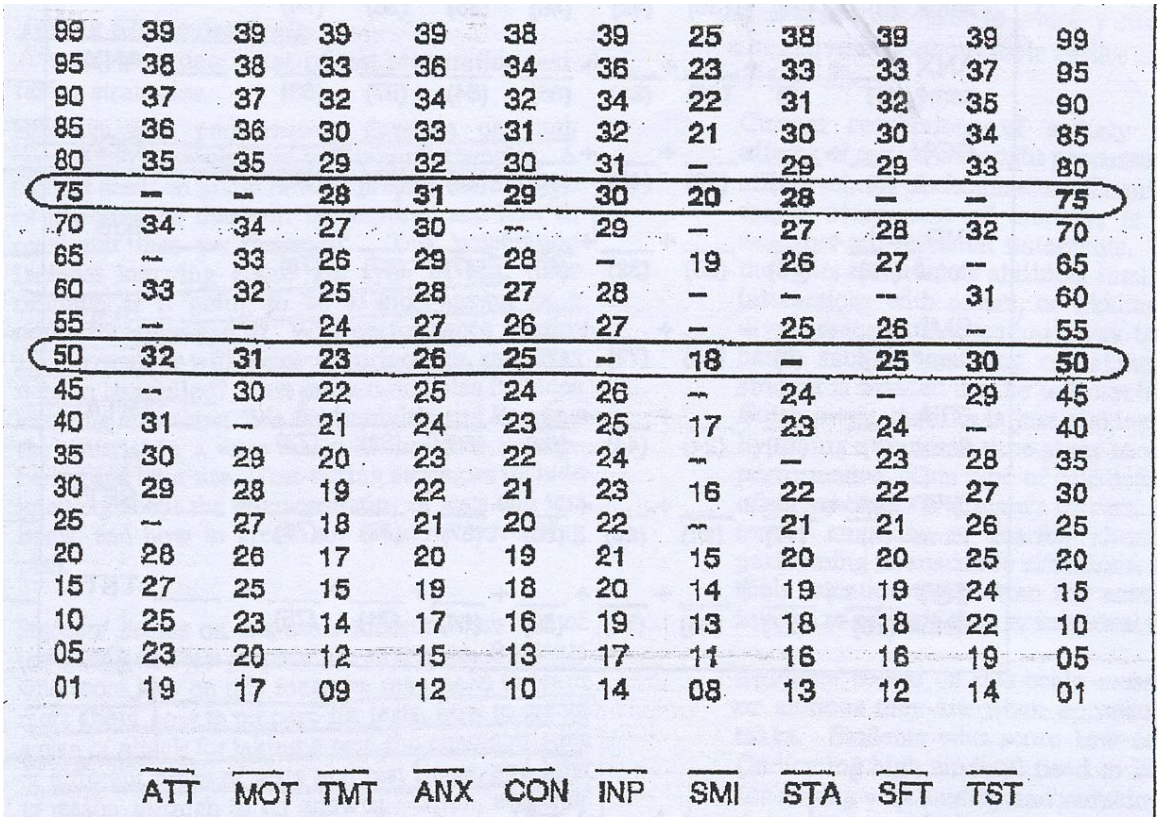
LASSI ANSWER SHEET

Item	Not at all like me	Not very much like me	Fairly much like me	Much like me	Very much like me
E.g.	1	2	3	(4)	5
1	5	4	3	2	1
2	1	2	3	4	5
3	5	4	3	2	1
4	1	2	3	4	5
5	5	4	3	2	1
6	5	4	3	2	1
7	1	2	3	4	5
8	1	2	3	4	5
9	5	4	3	2	1
10	1	2	3	4	5
11	5	4	3	2	1
12	1	2	3	4	5
13	1	2	3	4	5
14	5	4	3	2	1
15	1	2	3	4	5
16	5	4	3	2	1
17	1	2	3	4	5
18	5	4	3	2	1
19	1	2	3	4	5
20	5	4	3	2	1
21	1	2	3	4	5
22	5	4	3	2	1
23	1	2	3	4	5
24	1	2	3	4	5
25	5	4	3	2	1
26	1	2	3	4	5
27	5	4	3	2	1
28	1	2	3	4	5
29	5	4	3	2	1
30	1	2	3	4	5
31	5	4	3	2	1
32	1	2	3	4	5
33	5	4	3	2	1
34	5	4	3	2	1
35	1	2	3	4	5
36	5	4	3	2	1
37	1	2	3	4	5
38	5	4	3	2	1

Item	Not at all like me	Not very much like me	Fairly much like me	Much like me	Very much like me
39	5	4	3	2	1
40	1	2	3	4	5
41	1	2	3	4	5
42	5	4	3	2	1
43	5	4	3	2	1
44	1	2	3	4	5
45	5	4	3	2	1
46	5	4	3	2	1
47	1	2	3	4	5
48	1	2	3	4	5
49	5	4	3	2	1
50	1	2	3	4	5
51	5	4	3	2	1
52	5	4	3	2	1
53	1	2	3	4	5
54	5	4	3	2	1
55	5	4	3	2	1
56	1	2	3	4	5
57	5	4	3	2	1
58	1	2	3	4	5
59	5	4	3	2	1
60	5	4	3	2	1
61	1	2	3	4	5
62	1	2	3	4	5
63	5	4	3	2	1
64	5	4	3	2	1
65	1	2	3	4	5
66	5	4	3	2	1
67	1	2	3	4	5
68	5	4	3	2	1
69	5	4	3	2	1
70	1	2	3	4	5
71	5	4	3	2	1
72	5	4	3	2	1
73	1	2	3	4	5
74	5	4	3	2	1
75	5	4	3	2	1
76	1	2	3	4	5
77	5	4	3	2	1

Appendix 4

LASSI Feedback Sheet



	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST	
99	39	39	39	39	38	39	25	38	39	39	99
95	38	38	33	36	34	36	23	33	33	37	95
90	37	37	32	34	32	34	22	31	32	35	90
85	36	36	30	33	31	32	21	30	30	34	85
80	35	35	29	32	30	31	–	29	29	33	80
75	–	–	28	31	29	30	20	28	–	–	75
70	34	34	27	30	–	29	–	27	28	32	70
65	–	33	26	29	28	–	19	26	27	–	65
60	33	32	25	28	27	28	–	–	–	31	60
55	–	–	24	27	26	27	–	25	26	–	55
50	32	31	23	26	25	–	18	–	25	30	50
45	–	30	22	25	24	26	–	24	–	29	45
40	31	–	21	24	23	25	17	23	24	–	40
35	30	29	20	23	22	24	–	–	23	28	35
30	29	28	19	22	21	23	16	22	22	27	30
25	–	27	18	21	20	22	–	21	21	26	25
20	28	26	17	20	19	21	15	20	20	25	20
15	27	25	15	19	18	20	14	19	19	24	15
10	25	23	14	17	16	19	13	18	18	22	10
05	23	20	12	15	13	17	11	16	16	19	05
01	19	17	09	12	10	14	08	13	12	14	01

Key:

ATT – Attention

MOT – Motivation

TMT – Time Management for Academic Tasks

ANX – Anxiety regarding Performance

CON – Concentration and Attention

INP – Information Processing

SMI – Selecting Main Ideas

STA – Use of Support Techniques and Materials

SFT – Self-testing

TST – Test Strategies and Task Preparation

Appendix 5

A Copy of the CSEI Adult Form: Coopersmith Self-Esteem Inventory

COOPERSMITH INVENTORY

ON THIS PAGE YOU WILL FIND A LIST OF STATEMENTS ABOUT FEELINGS. IF A STATEMENT DESCRIBES HOW YOU USUALLY FEEL, PUT A TICK IN THE COLUMN "LIKE ME" (✓). IF A STATEMENT DOES NOT DESCRIBE HOW YOU USUALLY FEEL, PUT A TICK IN THE COLUMN "UNLIKE ME" (✓)

THERE ARE NO WRONG ANSWERS

	LIKE ME	UNLIKE ME
1. I often wish I were someone else	( )	( )
2. I find it hard to talk in front of a group of people	( )	( )
3. There are lots of things about myself I'd change if I could.	( )	( )
4. I can make up my mind without too much trouble	( )	( )
5. I'm a lot of fun to be with.	( )	( )
6. I get upset easily at home.	( )	( )
7. It takes me a long time to get used to anything new.	( )	( )
8. I'm popular with persons my own age.	( )	( )
9. My family usually considers my feelings.	( )	( )
10. I give in very easily.	( )	( )
11. My family expects too much of me.	( )	( )
12. It's pretty tough being me.	( )	( )
13. Things are all mixed up in my life.	( )	( )
14. People usually follow my ideas.	( )	( )
15. I have a low opinion of myself.	( )	( )
16. There are many times when I would like to leave home.	( )	( )
17. I often feel upset with my work.	( )	( )
18. I'm not as nice looking as most people.	( )	( )
19. If I have something to say, I usually say it.	( )	( )
20. My family understands me.	( )	( )
21. Most people are better liked than I am.	( )	( )
22. I usually feel as if my family is pushing me.	( )	( )
23. I often feel discouraged with what I am doing.	( )	( )
24. Things usually don't bother me.	( )	( )
25. I can't be depended on.	( )	( )

Appendix 6

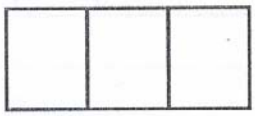
A Sample of The Organizer (Feuerstein, Rand & Hoffman, 1979)

Place the three objects in their appropriate place.

A. The Glass is not beside the Plate.

B. The Glass is to the left of the Fork.

Write the first letter of each object in the appropriate square.



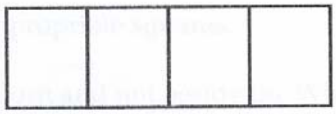
Place the four colours in the appropriate squares.

A. The colours in the outside squares are Black and Red.

B. Green, Red, and Yellow are the three colours in the squares to the right.

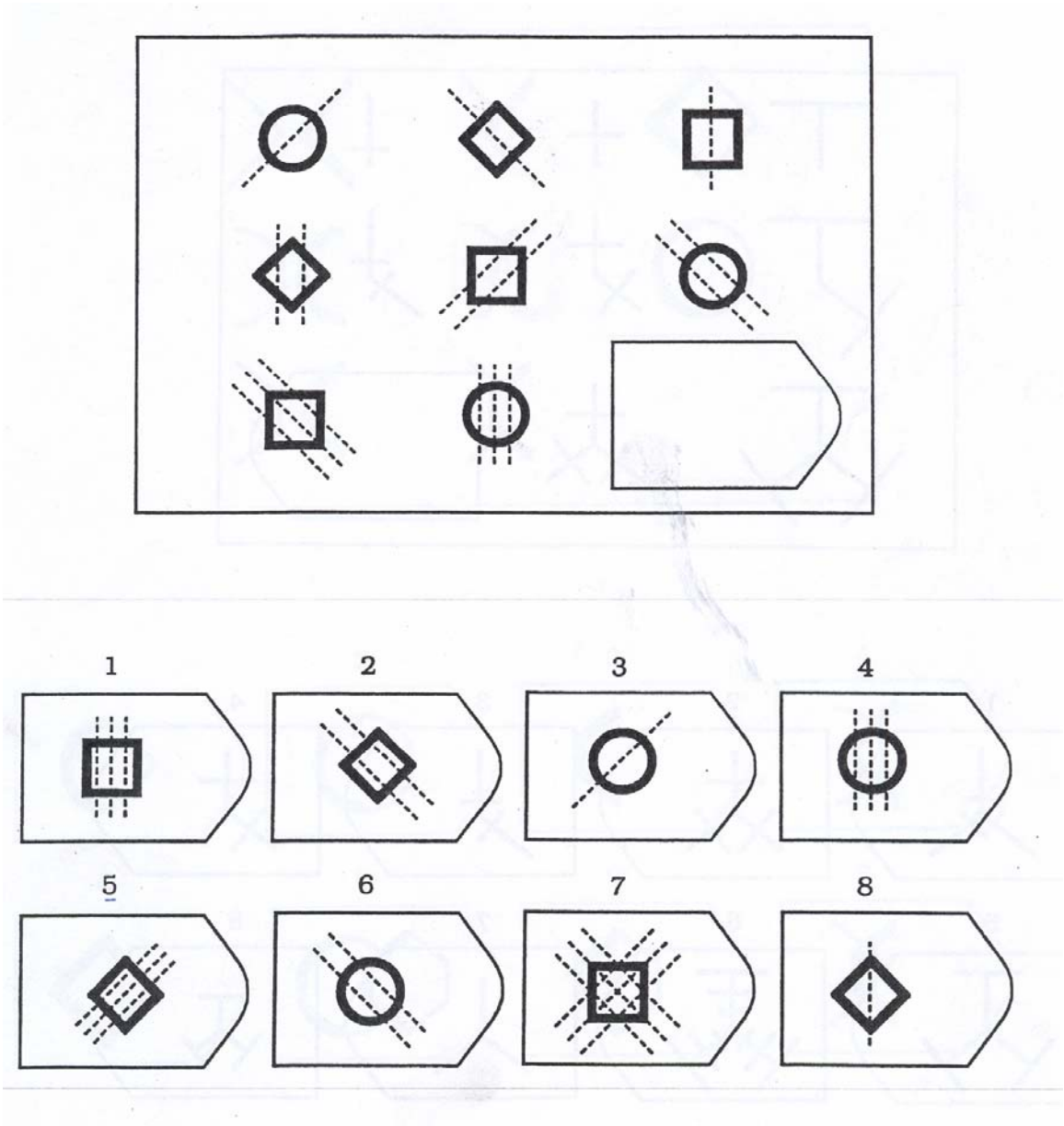
C. The Yellow is beside the Black.

Write the first letter of each colour in the appropriate square.



Appendix 7

A Sample of the RAMP: Ravens Advanced Matrices (Raven, Raven & Court, 1998)



Appendix 8

Outline of Biographical Questionnaire

University of the Witwatersrand: School of Chemical and Metallurgical Engineering

2006 Student Questionnaire

Please complete this questionnaire by filling in the answers where necessary and circling the correct answers clearly in Black pen where appropriate.

Section A: Home Background

1. Home Language	a) English b) Afrikaans c) African Language d) Other	_____
2. Parents	a) Both Living b) Mother Living c) Father Living d) Both Deceased	
3. How many members in your family?	a) 2 b) 2 – 4 c) 4 – 6 d) More	_____
4. Occupation	a) Mother b) Father	_____ _____
5. Maximum Educational Level Achieved	a) Mother b) Father c) Siblings d) Other Family Member	_____ _____ 1_____2_____3_____ _____

6. Location of Family Home	a) Rural b) Urban c) Township d) Other		_____
Please provide your physical address _____ _____			
7. School Fees paid by:	a) Parents/Parent b) Grandparent/s c) Family Members d) Other		_____
8. University Fees paid by:	a) Parents/Parent b) Grandparent/s c) Family Members d) Bursary e) Scholarship f) Other		_____
9. Service Provision at Home	a) Electricity b) Water in the house c) Inside toilet facilities	Yes Yes Yes	No No No
10. Does your family have:	a) Health insurance policy b) Medical Aid c) Access to public Health d) Access to Private Health	Yes Yes Yes Yes	No No No No

11. Who do you admire the most in your family?	a) Mother b) Father c) Sibling d) Other	_____
Explain what it is you admire about this person		
12. What is the most common form of transport used by your family?	a) Foot (walking) b) Own car c) Public transport (e.g. bus) d) Taxi e) Other	_____
13. What is the most common form of transport used by you?	a) Foot (walking) b) Own car c) Public transport (e.g. bus) d) Taxi e) Other	_____
14. Circle each meal you eat per day and give an example of the type of food you eat	a) Breakfast b) Lunch c) Supper d) Snacks e) Other	_____ _____ _____ _____ _____
15. Where do you fit into your family structure?	a) First born b) Last born c) Middle child d) Only child e) Other	_____

16. Do you have enough time for studying at home? How much time do you spend on studying each day? How much time do you spend on studying on weekends? How much time do you spend traveling to and from university and how does this impact on your study time?	
17. Do you have a place to study at home that does not have distractions? (explain your answer)	
18. What do you like most about your family/home	
19. What do you dislike most about your family/home	
20. What circumstances in your family life do you think may impact negatively on your studies?	

University of the Witwatersrand: School of Chemical and Metallurgical Engineering

2006 Student Questionnaire

Please complete this questionnaire by filling in the answers where necessary and circling the correct answers clearly in Black pen where appropriate.

Section B: Schooling Background

1. Medium of Instruction at School	a) English b) Afrikaans c) African Language d) Other	 _____ _____
2. Location of School	a) Rural b) Town/City c) Inner City d) Suburban e) Township f) Other	 _____
3. Type of School attended	a) Government b) Private c) Other	 _____
4. Who influenced your choice of subjects for Matric?	a) Teacher/s b) Family c) Other	 _____
5. What was the most common form of teaching you were exposed to at school?	a) Teacher talking b) Copying of a board or OHP c) Using Textbooks d) Other	 _____

6. Did you receive any extra tuition in any of your subjects at school? If 'yes', identify which subjects and mention who you received assistance from.		
7. What type of learning practices were encouraged at your school?	a) Questions and Answers b) Group Work Activities c) Independent Work d) Class Presentations e) Project Work f) Other	 _____
8. Did you take part in any extra mural activities? If 'yes', give examples of the activities you took part in.		
9. What was it about your schooling experience that encouraged you to apply to study at university?		
10. Why did you select the subjects for Matric that you did?		
11. Did you ever repeat a Grade in School?	a) Grades 1 - 3 b) Grades 4 - 7 c) Grades 9 - 10 d) Grades 11 – 12 e) More than 1 grade repeat	 _____

12. What type of learning styles did you use to prepare for exams and tests at school?	a) Memorizing by heart b) Mind maps c) Note taking d) Group discussion e) Cramming the night before f) Other	 _____
13. What materials did you most frequently use to study from for exams and tests?	a) Class notes b) Textbooks c) Additional Readings d) Your own notes e) Other	 _____
14. Which subjects did you perform your best in, and why? Give full reasons for your answer.	a) English b) Maths c) Science d) Other	
15. What inspired you to reach your highest grade at school? (You may circle more than one reason)	a) Motivation from home b) Motivation from school c) Motivation from one or more teachers d) School discipline e) Home discipline f) Fear of punishment g) Self motivation	

16. What did you like most about school?	
17. What do you like least about school?	
18. How do you think your school experience prepared you for university study?	
19. Did your school provide you with the opportunity for career guidance counselling? (If 'yes', did this help you select your tertiary area of study?)	
20. Which teachers did you like best at school? Why?	

University of the Witwatersrand: School of Chemical and Mtallurgical Engineering

2006 Student Questionnaire

Please complete this questionnaire by filling in the answers where necessary and circling the correct answers clearly in Black pen where appropriate.

Section C: Tertiary Experience

1. Do you find that your experiences of university life to date have met your expectations? Explain your answer.	a) Yes b) No c) In some ways	
2. Are you comfortable with the teaching methods currently used in PRME? Explain your answer.	a) Yes b) No c) In some ways d) Not really	
3. Do you think that you have been provided with adequate study tips to succeed in PRME? Explain your answer.	a) Yes b) No c) In some ways d) Not really	

4. Which situation would you prefer to study under?	a) As a passive learner (Sitting quietly, listening to tutors, and making notes, reading texts and studying for tests on your own) b) As an active learner (Participating in class, asking questions, contributing to discussions, taking part in experiments, reading additional texts related to subject matter, etc) c) Other	_____
5. Do you think that you need additional academic support? Explain your answer.	a) Yes b) No c) Maybe Type of support:	
6. Having been in the university for a semester, what do you think are the learning behaviours and study skills that result in success and passes? Which students seem to have these types of skills?		

7. Who do you think dominates classroom activities such as discussions and asking questions in your classes? (Provide a reason for your answer)	a) Black students b) White students c) Indian students d) Coloured students e) No difference	
8. If you could change the way things were done at the university in relation to teaching and testing techniques, what would you change and why?		
9. How do you think you could study better to perform better in your PRME course?		

Appendix 9

Interview Schedule

Questions used during the Guided Interview Process

University of the Witwatersrand: School of Chemical and Metallurgical Engineering

2006 Student Open Ended Interviews

Demographic Information

Code: _____ Gender: _____

Home Language: _____ Race: _____

Interview Questions

1. Looking at your matriculation results and your results from your first semester tests, what do you think contributed to the difference between your marks at school and your marks at university?

2. It has been suggested that the University has a high failure rate. What, as a student, do you think could contribute to a high failure rate amongst first year PRME students?

3. In what way do you think that your schooling experiences could have better prepared you for university study?

4. How do you think the University itself could better prepare students for how to study effectively at a first year level?

5. If you were in charge of supporting students who have failed the first semester, what type of programme would you offer? What skills would you teach students?

6. Thinking back to how you studied for your tests and exams, how do you think you could have done things differently to achieve increased performance?

Interview Schedule

First Interview

Date	Student Case Number	Interview Period
24/07/2006	Case 1	11:30 – 11:55
	Case 2	12:00 – 12:30
	Case 3	12:30 – 13:00
25/07/2006	Case 4	10:20 – 11:00
	Case 5	11:00 – 11:30
	Case 6	11:30 – 12:00
26/07/2006	Case 7	14:00 – 14:30
27/07/2006	Case 8	14:30 – 15:00
	Case 9	15:00 – 15:30
28/07/2006	Case 10	12:00 – 12:30
	Case 11	12:30 – 13:00

Second Interview

Date	Student Case Number	Interview Period
12/09/2006	Case 1	10:00 – 10:30
	Case 2	10:30 – 11:00
	Case 3	11:00 – 11:20
	Case 4	11:20 – 11:40
	Case 5	11:40 – 12:00
	Case 6	12:00 – 12:30
	Case 7	12:30 – 13:00
14/09/2006	Case 8	10:20 – 10:40
	Case 9	10:50 – 11:20
	Case 10	11:20 – 11:45
	Case 11	11:50 – 12:20

Appendix 10

Observation Schedule

Observations took place every Thursday from the 6th of April to the 18th of May. For the first observation students were observed in large group lecture settings during these dates. For the second and third observation periods students were observed in smaller tutorial groups.

Student Case Number	Observation 2	Observation 3
Case 1	Not observed/No tutorial	Not observed/No tutorial
Case 2	29/04/2006	09/05/2006
Case 3	04/04/2006	09/05/2006
Case 4	04/04/2006	12/05/2006
Case 5	07/04/2006	09/05/2006
Case 6	Not observed/absent	09/05/2006
Case 7	07/04/2006	09/05/2006
Case 8	07/04/2006	09/05/2006
Case 9	04/04/2006	16/05/2006
Case 10	Not observed/No tutorial	Not observed/No tutorial
Case 11	04/04/2006	09/05/2006