

https://dspace.org/

The contribution of intelligence, learning strategies, and personal development to engineering students' academic performance

Skuy, Melissa Ann

2003

http://hdl.handle.net/10539/22769

Skuy, Melissa Ann (2003) The contribution of intelligence, learning strategies, and personal development to engineering students' academic performance, University of the Witwatersrand, Johannesburg,<http://hdl.handle.net/10539/22769>

Downloaded from a DSpace repository. https://dspace.org/

THE CONTRIBUTION OF INTELLIGENCE, LEARNING STRATEGIES, AND PERSONAL DEVELOPMENT TO ENGINEERING STUDENTS' ACADEMIC PERFORMANCE

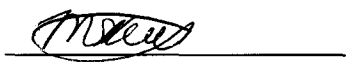
Melissa Ann Skuy

A research report submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Masters of Education (Educational Psychology)

Johannesburg, South Africa **2003**

DECLARATION

I hereby declare that this research report is my own unaided work. It is being submitted for the degree of Master of Education (Educational Psychology) at the University of the Witwatersrand, Johannesburg. It has not been submitted for any degree or examination at any other university.



Melissa Ann Skuy

30/11/03

ACKNOWLEDGEMENTS

I am very grateful to the following people for their assistance and support, and I wish to express my sincere thanks to them:

Kate Cockcroft, my research supervisor, for her wonderful guidance, knowledge and support.

Peter Fridjhon, my co-supervisor, for his helpful supervision on the research design, statistical programme and discussion.

Joseph Seabi, for all his assistance with running the statistical analyses, and for liasing with the Engineering Department.

Mr Woollacott and the Engineering Department, for being helpful with the administration of the measures, and other practicalities of the study.

My husband, Gaby, for his encouragement, love and support. You have been my rock.

My parents – Mervyn and Eileen- who have given me their advice and full support throughout my studies.

I would further like to acknowledge the role of the Cognitive Research Programme, of which this study forms a part.

ABSTRACT

Previous studies have addressed the question whether intellectual ability (as measured by the Raven's Progressive Matrices Tests) is related to academic performance in engineering (Rushton & Skuy, 2000; Rushton, Skuy & Fridjhon, 2002; Rushton, Skuy & Fridjhon, 2003). The question arose of whether non-intellective (personality and attitudinal factors) play a larger role at this level, than intelligence, in determining academic performance in engineering university students. Accordingly, data were yielded for 93 percent (N=100) of the second year Chemical Engineering class in terms of their performance on various measures. These included two measures of intellectual ability, namely the Ravens Advanced Progressive Matrices (RAPM) and the Organiser (of The Learning Propensity Assessment Device), together with a measure of learning strategies and attitudes (Learning and Study Strategies Inventory), locus of control (Locus of Control Inventory) and self-esteem (Coopersmith Self-Esteem Inventory). The students' academic results comprised the December 2002 and June 2003 examination results. The current research results demonstrated that while neither the RAPM nor the Organiser yielded any significant correlations with academic results, certain of the non-intellective measures did, and were able to differentiate between high and low academic performers. Motivation, Autonomy and Freedom from Anxiety were found to be significantly related to academic performance, and contributed 26 percent of the variance. This indicates that these factors play a role in academic achievement, and that exploration of personality and motivational factors constitutes a potentially fruitful avenue of research. However, it also seems that 74 percent of variance was unaccounted for, and therefore future studies should explore other factors, not included in this study, in relation to engineering students' academic performance. Furthermore, it emerged that it is unrealistic to attempt to predict academic performance at midyear (June results).

KEY WORDS: Intelligence, learning strategies, locus of control, self-esteem, engineering students, second year, and academic performance.

TABLE OF CONTENTS

Title Page ..... **I**
Declaration ..... **II**
Acknowledgements ..... **III**
Abstract ..... **IV**
Table of Contents ..... **V**
List of Tables ..... **VII**
List of Figures ..... **VIII**

CHAPTER 1: LITERATURE REVIEW **1**
1.1 Introduction 1
1.2 Predictors of Success in Engineering Students 2
1.3 The South African Context 6
1.4 A Multi-Dimensional Approach 8
1.5 Intelligence 12
1.6 Learning Strategies 16
1.7 Personal Development 19
1.7.1 *Locus of Control* 19
1.7.2 *Self-esteem* 23
1.8 Summary 25

CHAPTER 2: RATIONALE AND METHODOLOGY **27**
2.1 Rationale 27
2.2 Aim of the Study 27
2.3 Research Hypotheses 28
2.4 Research Design 29
2.5 Sample 29
2.6 Measures 30
2.6.1 *The Ravens Advanced Progressive Matrices (RAPM)* 30
2.6.2 *The Organiser* 33

2.6.3 *The Learning and Study Strategies Inventory (LASSI)* 34
2.6.4 *The Locus of Control Scale (LCI)* 36
2.6.5 *The Coopersmith Self-Esteem Inventory (CSEI)* 38
2.6.6 *Measuring Academic Performance* 39
2.7 Procedure 39

CHAPTER 3: RESULTS **41**
3.1 Overview to Data Analysis 41
3.2 Descriptive Statistics 42
3.2.1 *Students' Demographic Information* 42
3.2.2 *Mean Scores on the Measures* 42
3.3 Inter-Correlation Matrices between the Independent Measures 46
3.4 Correlations between the Measures and Academic Performance 48
3.5 Multiple Regression Analyses 50
3.5.1 *Prediction of June Aggregate* 51
3.5.2 *Prediction of December Aggregate* 51
3.6 Performance on Measures in terms of Division of Scores 52
3.7 Conclusion to Results 55

CHAPTER 4: DISCUSSION **56**
4.1 Interpretation and Implications of the Findings 56
4.2 General Implications 61
4.3 Limitations of the Study and Suggestions for Future Research 63
4.4 Summary and Conclusions 67

REFERENCES **68**

APPENDICES **85**
Appendix A: An Item from Ravens Advanced Progressive Matrices 86
Appendix B: Examples of Items from The Organiser 87
Appendix C: The Learning and Study Strategies Inventory (LASSI) 89
Appendix D: The LASSI Answering Sheet 92
Appendix E: Examples of Items from The Locus of Control Scale (LCI) 93
Appendix F: The Coopersmith Self-Esteem Inventory (CSEI) 95

LIST OF TABLES

Table 3.1: Information about the Sample 42

Table 3.2: Mean Scores on the Organiser, CSEI, RAPM & LCI 43

Table 3.3: Mean Scores on the LASSI 44

Table 3.4: Students' Academic Performance 45

Table 3.5: Correlation Matrix between Organiser, CSEI, RAPM and LCI .. 46

Table 3.6: Correlations between the Organiser, CSEI, RAPM and LCI with the LASSI 47

Table 3.7: Correlations between LCI, Organiser, RAPM, CSEI and Academic Performance 49

Table 3.8: Correlations between the Subscales of the LASSI and Academic Performance 49

Table 3.9: Results of the Stepwise Regression Analysis 51

Table 3.10: Performance of Top, Middle and Low students on the RAPM, Organiser, CSEI & LCI, based on December Scores Division 53

Table 3.11: Performance of Top, Middle and Low students on the LASSI, based on December Scores Division 53

LIST OF FIGURES

Figure 3.1: Differences between the Top, Middle and Bottom Scorers on the LASSI 54

CHAPTER 1: LITERATURE REVIEW

1.1 Introduction

According to Rushton, Skuy and Fridjhon (2002), engineering students are among the highest scoring students at universities in South Africa. Despite this, the failure and drop out rate of engineering students at all South African universities continues to be high (Behr, 1982; Rushton, Skuy & Fridjhon, 2003; Woollacott, 2003). Various research studies have investigated predictive factors for success in engineering studies. For example, Behr (1982) looked at the predictive ability of matriculation results and Lohman (1994) investigated how well tests of spatial ability predicted success in engineering studies. More recent studies (ibid, 2003; Rushton et al., 2002; Strous, 2003) have explored the relationship between non-verbal intelligence, as measured by the Ravens Progressive Matrices and academic success in first year engineering. None of these studies found consistent significant correlations between academic performance and intelligence.

This suggests that factors beyond or in addition to intelligence may be responsible for academic success. No study had yet looked at the combination of intelligence, learning strategies and personal-professional development factors (locus of control and self-esteem) as predictive of academic success in engineering students in South Africa. In other words, no study had yet taken a more comprehensive approach of considering the impact of cognitive, learning strategies, and affective factors on academic success in engineering.

More comprehensive studies have been used with the prediction of other courses at university. For example, Skuy, Zolezzi, Mentis, Fridjhon and Cockcroft (1996) examined intelligence, motivation and approaches to study in predicting academic performance of Faculty of Commerce students at the University of the Witwatersrand. Nunns and Ortlepp (1994) explored

empirical predictors of students' performance in the Psychology I course at the University of the Witwatersrand. They used a battery of school results, conceptual reasoning, mental alertness and reading comprehension.

The following literature review firstly places the current study in context by discussing the academic performance of engineering students, and the broader context of the South African tertiary learning situation. Thereafter, a multi-dimensional approach to predicting academic success in engineering students is outlined. Finally, the relevant variables of intelligence, learning strategies and personal-professional development (locus of control and self-esteem) are considered, and studies related to their effectiveness are documented. It must be noted that there are vast amounts of literature on these issues, but due to the constraints of the research report, the most salient points are discussed.

1.2 Predictors of Success in Engineering Students

Research in the United States of America indicates that engineering students are among the highest scoring students on the Scholastic Aptitude Tests (SAT), and on the Graduate Record Examinations (GRE). According to the Educational Testing Service (1998), engineering students generally score a mean GRE of about 1800, which is one standard deviation above that of psychology and education students, whose mean GRE is generally 1500. In both Canada and South Africa, engineering students were found to be a more highly select group of students than psychology students (Jones & Bell, 1980, cited in Strous, 2003; Rushton et al., 2003; Skuy, Gewer, Osrin, Khunou, Fridjhon & Rushton, 2002). Furthermore, engineering students, who are generally required to be proficient in mathematics and science, as an entry requirement for the course, are thought to be the highest achieving students at university (Rushton et al., 2002).

Part of the reason for this, is that engineering students are required to have obtained a reasonably high number of matriculation points as a minimum entry requirement, as well as certain points in mathematics in order to be accepted into the Engineering faculty. Students who don't meet these criteria, write a selection test, which investigates mathematical and scientific ability. If such ability is present, the students may be placed in a foundation course to help further develop these skills (Rushton et al., 2002, cited in Strous, 2003).

Two independent studies (Rushton et al., 2003; Skuy et al., 2002), using the Ravens Progressive Matrices (RPM) were conducted on first year psychology and engineering students at the University of the Witwatersrand. These studies indicated that engineering students scored significantly higher on the RPM than psychology students. Furthermore, the results suggested that the RPM was predictive of academic success for first year engineering students, but not for psychology students.

The drop out and failure rate among engineering students in all South African universities appears to be high. For example, in 1968, only 25 percent of engineering entrants at the University of the Witwatersrand graduated. In 1973, 40 percent of engineering students at Rand Afrikaans University failed first year. Behr (1982) claimed that the high failure and drop out rate among engineering students resulted in wastage and a lack of skilled manpower, which was detrimental to the economic growth of the country. According to Behr (1982), this high drop out rate prevailed between the 1950's and the 1980's. The Engineering Department at the University of the Witwatersrand report that this trend has continued (Woollacott, 2003).

As she was concerned about these failure rates, Behr (1982) decided to look at the available tests and use a combination of tests which would identify those students who have the potential to be successful in a course in engineering. Behr (1982) reported that engineering students required an aptitude in

mathematics and physical science, as well as the ability to perceive spatial relationships and understand mathematical principles. Furthermore, she suggested that they required commitment, motivation and general scholastic ability. She also contended that language abilities are essential in the study of mathematics and other related subjects. It was therefore decided to use matriculation scores in English, Maths and Science, and a battery of tests from the National Institute for Personnel Research (NIPR). The battery included Mental Alertness Test, Reading Comprehension and Vocabulary, the Gottschaldt Figures Test, and the Patterns Relations Test. This battery thus was reflective of the factors that Behr (1982) believed were important in engineering functioning, in other words, intellectual ability, inductive reasoning and verbal and perceptual ability. However, according to the results of Behr's study (1982), the battery did not appear to be effective for predicting success of the engineering students. Thus, Behr (1982) concluded that a specific battery of tests for use in predicting success in engineering students was yet to be found.

Potter, Van der Merwe and Kemp (1987) attempted to identify students with spatial perceptual difficulties, as well as predictive measures of performance in engineering. They conducted research over a period of seven years at the University of the Witwatersrand, and they reported that spatial perceptual ability was best linked with success in engineering at first year university levels. Their research resulted in different teaching approaches with a greater emphasis on problem solving, and remedial programmes for low achieving students. Furthermore, after implementation of these programmes, the student failure and drop out rates decreased, indicating their relevance for engineering students (Potter et al., 1987).

Lohman (1994) also claimed that engineering students have high levels of spatial ability, and that this level has frequently been linked to creativity in both science and mathematics. He further suggests that tests of spatial ability are moderately good predictors of grades in engineering. This links to Potter et al's. (1987) work.

The aim of a more recent study (Van Eeden, De Beer & Coetzee, 2001) was to evaluate a battery of tests to be used as part of the process of selecting students for engineering and other science and technology courses at a tertiary institution. The predictor variables included Grade 12 results for Science, English and Mathematics, the General Scholastic Aptitude Test Senior (GSAT), the Senior Aptitude Test (SAT) and the Sixteen Personality Factor Questionnaire (16 PF). The average performance for first-year subjects at Technikon was used as the criterion variable. Results indicated that school achievement was the best predictor while the GSAT Verbal Scale contributed more than the other psychometric tests to the explanation of variance in academic achievement. In addition, English proficiency seemed to influence performance on both predictor and criterion variables (Van Eeden et al., 2001).

All of the studies discussed above reaffirm the findings of Behr (1982) - that a good battery of tests for predicting success in engineering has yet to be found. Some studies (ibid, 2003; Rushton et al., 2002; Strouss, 2003) have examined reasoning ability (as measured by the Ravens Advanced Matrices) and spatial perception (Potter et al., 1987) in relation to success in engineering. Other studies have looked at Matriculation results as predictors of academic performance. However, none of these measures emerged as significant predictors of success, as students come from different backgrounds and different standards of education partly due to the Apartheid system, and to differences between to private and government schooling. Although all of the above mentioned studies have taken intellectual factors and perceptual

factors into account, none have taken personal factors, such as self-esteem and locus of control, into account. Furthermore, no study has investigated the three variables of intelligence, learning strategies and personal-professional development in combination in relation to success in engineering. The current study employed a battery of this nature, in an attempt to address this issue.

Having discussed studies which explore the predictors of success in engineering students, Section 1.3 places the present study into context. The study was conducted on second year engineering students in South Africa, at the University of Witwatersrand.

1.3 The South African Context

In order to provide a comprehensive literature review, it is essential to locate the current study within the broader South African context. South Africa's current population is 44 million. It is comprised of 34.1 million Africans (77.5 percent), 5.1 million whites (11.6 percent), 3.7 million coloureds (8.4 percent) and 1.1 million Indians (2.5 percent). Statistics reveal that 37 percent of the population is unemployed, of whom 42.9 percent are African, 30.3 percent are Coloured, 22.5 percent are Indian, and 10.1 percent are White (South African Institute of Race Relations, 2001/2). This imbalance is directly related to inequalities in educational access during the Apartheid era. Therefore, at the centre of political discussions in South Africa, there has been a consistent demand for educational reform. The Apartheid system legally separated South Africa's inhabitants into four racial groups: Africans, Whites, Coloureds and Indians. Political power and privilege were invested in the White minority, while Africans were socio-politically disadvantaged. The system of education strikingly reflected this division and class inequality (Nkabinde, 1993).

Under the Apartheid system, education services were provided on a racially segregated basis, so that White, African, Indian and Coloured children were taught in separate schools (Burden, 1995). Furthermore, the four race groups fell under different governmental departments. For example, white education fell under the House of Assembly, and the Department of Education and Training was responsible for African education. In general, schools that accommodated white learners were well resourced, while schools for learners of the other three races were under resourced (Burden, 1995). Education policies traditionally favoured the White population, while the education of African, Coloured and Indian people was not considered to be as important. The Apartheid government was invested in White education, as it wanted to provide a skilled White population who could command high incomes. This was in contrast to the plans for the African population – where Grade Seven was considered a sufficient education for labourers, and therefore an appropriate exit point for these learners. (Rushton et al., 2003).

These separate educational systems resulted in deprivation for many African learners. In South Africa, even as recently as 2000, 22 percent of teachers lacked the necessary qualifications, 45 percent of schools were without electricity, and over 67000 classrooms were needed (South African Institute of Race Relations, 2001/2002). Although the percentage of under resourced schools is very much higher in the rural areas, there are also urban schools with these difficulties. These educational inequalities continue into the tertiary level, as it has been noted that almost double the number of White individuals (four hundred and ninety thousand) as opposed to African individuals (two hundred and seventy six thousand) hold a university degree (South African Institute of Race Relations, 2001/2002).

The history outlined above indicates the vast differences that African and White people experienced in relation to educational opportunities and basic living conditions (among others). Although the current study's focus is not on

the differences between African and White students, it is still important to take these background factors into account, as these differences still have repercussions today. This is especially relevant when considering matriculation results as predictors of success at the tertiary level. According to Potter and Jamotte (1985), African South Africans have been subject to significant educational disadvantage, and so their matriculation results cannot be taken as a true reflection of their academic potential. This again points to the necessity of including a range of variables beyond matriculation results when examining success at tertiary level.

In this regard, studies have investigated intelligence (ibid, 2002; Rushton et al., 2003;) and some external factors, such as race and socio-economic status (Strous, 2003) when considering academic performance in engineering. Although those factors are important, it appears that to only focus on these variables may be limited. Therefore, the current study employed a multi-dimensional, comprehensive approach, and focused on both cognitive factors and intrinsic factors (such as locus of control and self-esteem). The next section outlines what a multi-dimensional approach entails, and thereafter details each of the variables under investigation in the current study.

1.4 A Multi-Dimensional Approach

Over the past few years, there has been increasing pressure from employers and funding authorities in higher education institutions to promote the development of students' self-regulatory learning skills (McMahon & Luca, 2001). It is often difficult to obtain a consistent set of required academic skills across different institutions. There is, however, a consistent demand for graduating students to have life long learning skills that enable them to continually upgrade their skills and knowledge through their own self-motivation, learning skills and knowledge (McMahon & Luca, 2001). In response to these demands, there is now a move towards multi-dimensional

assessment of student's performance. Such an assessment takes both the cognitive and the affective factors that influence learning into account. According to Garcia and Pintrich (1994, p.127), "Neither motivational nor cognitive models alone fully describe the various aspects of student academic learning, yet the two types of models are complementary due to the respective strengths and weaknesses of motivational and cognitive models."

There are two researchers whose work has brought cognitive and affective variables together, namely Boekaerts (1997) and Feuerstein (1980). Boekaerts (1997) provided the Self-Regulation Model, which examined both cognitive and affective (motivational) components of learning. Self-regulation has been described as "the process whereby students activate and sustain cognitive behaviours and affects, which are systematically orientated towards attainment of their goals" (Boekaerts, 1997, p.162). This definition is reinforced by Brooks (1997), who argues that learning is active and goal directed, resulting from self-control of behaviour, motivation and cognition. This emphasis on the impact of multiple constructs on learning placed self-regulated learning at the junction of several fields of research (Boekaerts, 1997).

The notion of self-regulation is prone to multiple interpretations based upon educational philosophy. Behaviourist approaches emphasize self-monitoring, self-instruction and self-reinforcements, while a phenomenological approach defines it according to dimensions such as self-worth, planning and goal setting. Common to both of these approaches is the acknowledgement of the interaction of affective and cognitive processes (McMahon & Luca, 2001).

Boekaerts' (1997) six-component model of self-regulated learning includes content domain, cognitive strategies, cognitive regulatory strategies, metacognition, and motivation. Included in the cognitive domain are meta-cognition (awareness of one's own mental processes), self-monitoring and

strategy formation. Under the affective domain, there are self-concept, motivation, volition and control strategies. The model accommodates the role of both affective and cognitive aspects of self-regulation, but also acknowledges the effects of external environmental factors upon an individual's ability to regulate his/her learning. Thus, according to this model, self-regulation is viewed as the intersection of self-awareness at both a rational and emotional level (Boekaerts, 1997).

This model is in line with the Humanist approach, which has long emphasized the need for education to take a holistic view of the individual, and have rejected the emphasis on purely academic or intellectual learning. For example, Rogers (1969) used the phrase "learning from the neck up" to refer to learning that was not connected to the emotional or experiential dimensions of human functioning. It is said that Feuerstein's theory (1980) is one of the most affective (emotional) cognitive theories there is, since the concept of mediation reflects the inextricability of communication and cognition, of understanding and interpersonal relationships, of motivation and learning (Skuy, 1996).

The technique introduced by Feuerstein, Rand and Hoffman (1979), to mediate cognitive skills, is called Instrumental enrichment (I.E). It has been used in numerous studies (Haywood, 1988; Skuy, Archer & Roth, 1987; Skuy & Shmukler, 1987) and the evidence suggests its value for improving the intellectual functioning of disadvantaged students (Skuy, Mentis, Nkwe, Arnott & Hickson, 1994). However, prior to this study, no tested effects of I.E. on self-concept or creative thinking had been demonstrated. Therefore, a programme of socio-emotional development and creativity (named the Creativity and Socioemotional Development Programme), to complement the I.E programme was designed and implemented by Skuy et al. (1994). This was used with grade seven and eight students in Soweto.

The Creativity and Socioemotional Development (CASE) programme complemented and extended the I.E programme by applying principles compatible with mediated learning experience (MLE) to the emotional development and creativity enhancement of the students. Generally CASE aimed at facilitating self-awareness, self-mastery, positive self-concept, and awareness of the environment. The philosophical approach of the programme was based on the ideas of Rogers (1961, 1969), and Gordon (1974), which included self-awareness, awareness of others and the environment, self-mastery, a positive self-concept, individuality, and improved interpersonal communication. This combination was considered to be particularly important for South African children who suffered from a widespread loss of self-esteem, as a result of racism, the undermining of their cultural mores, and the dominant culture (Skuy et al., 1994).

The findings of the Skuy et al. (1994) study suggest that the I.E was well implemented when combined with the CASE programme. This indicates that an emphasis on greater awareness of feelings and meta-emotion is important for successful learning. The validity of the I.E programme and of the dimension of socio-emotional development for disadvantaged South African adolescents was demonstrated. The CASE programme highlights the importance and relevance of taking both intellectual and emotional factors into account.

As discussed, a multidimensional approach to predicting success in engineering students is needed. The factors that should be included in such an approach are intelligence, learning strategies, and personal-professional factors (locus of control and self-esteem inter alia). All these factors have been used in various separate studies (For example, Baumeister, 1997; Daniels & Stevens, 1976; Ismail & Kong, 1985; Mwamwenda, 1995) as predictors of academic success, but no study has examined them in combination. Sections

1.5, 1.6 and 1.7 discuss the factors of intelligence, learning strategies, and personal factors respectively.

1.5 Intelligence

The concept of psychometric intelligence and the factors affecting measured intelligence have been a controversial issue from the inception of psychometric testing. According to the literature, the concept of intelligence is either debatable, or defined without a scientifically acceptable degree of consensus (Carroll, 1997; Gustafsson, 1994; Jensen, 1998). One of the ways to understand intelligence is provided by Gottfredson (1997, p. 13). She defines intelligence as "among other things.... the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience". She claims that intelligence can be measured well with the use of various intelligence tests. Furthermore, she argues that all intelligence tests – whether they make use of words, numbers, shapes or designs – measure the same intelligence.

For the purpose of this study, the concept of intelligence is understood from a psychometric approach, as a measurable entity. In the late 19th Century, Sir Francis Galton introduced the idea that human capacities could be objectively measured using statistical methods (Jensen, 1998). Galton preferred the concept of mental ability to intelligence, and assumed that human mental ability comprised a general *(g)* and specific *(s)* component, of which the general component was predominantly a product of biological evolution, and was the largest source of difference. *g* is the general component of mental ability, and has traditionally been thought of as innate. Spearman believed that *g* is "mental energy" that is used in the application of all kinds of mental tasks (Jensen, 1998). He asserted that *g* is most strongly reflected in tests that call for the "education of relations and correlates". This refers to the ability to reason both inductively and deductively, to grasp rules, to generalise, to solve

problems, and to see similarities and differences between entities (Jensen, 1998).

The psychometric approach to intelligence originated with the work of Binet and Simon (1905), who developed the first practical test of intelligence. The concept of an intelligent quotient or IQ (referring to the ratio between mental and chronological age) was developed by Louis W Stern in 1908. The term IQ now refers to standardized test scores, and is scaled to a mean of 100 and a standard deviation of 15, while its distribution closely approximates the normal curve (Gustafsson, 1994; Jensen, 1998).

The appropriateness of Euro-American developed tests for use among the diverse South African population has been much questioned (Skuy, Schutte, Fridjhon & O'Carroll, 2000). According to Shuttleworth- Jordan (1996), South Africa is characterised by a multiplicity of racial, ethnic and linguistic groups who occupy shifting positions along a continuum of lesser or greater levels of urbanization, westernization and literacy. Furthermore, the history of Apartheid has resulted in discrimination, lack of mediation, and a paucity of opportunity for the majority of the population. Since research indicates that performance on IQ tests is correlated with academic level, it follows that individuals who have been academically disadvantaged (received inferior primary and/or secondary education) would fare less well than those who have received a superior education (Skuy et al., 2000).

Based on an assumption that non-verbal tests would measure the same intellectual ability as verbal tests, and that non-verbal tests were less likely to be influenced by cultural factors, supposedly culture fair, non-verbal instruments were developed (Owen, 1998). This was an attempt to lessen the inequality between educationally disadvantaged and advantaged individuals. Although some people claim that non-verbal tests are futile, research suggests that there are non-verbal measures that operate in the same way for diverse

racial, cultural and linguistic groups (Chan, 1989; Rushton et al., 2001; Stone, Wong & Lo, 2000; Zindi, 1994). Among these tests is the Ravens Standard Progressive Matrices (RSPM).

Raven (1983) originally constructed the Standard Progressive Matrices (RSPM) under the supervision of Spearman. The underlying purpose was to develop a non-verbal, figural test comprised of homogeneous items thought to be highly loaded on *g* in order to provide a culture fair, relatively pure measure of *g* (Jensen, 1998).

Besides attempting to be culture fair, the Standard Progressive Matrices (RSPM) were also designed to be useful with individuals of all ages - irrespective of their education. However, the test proved unable to discriminate between those at either the upper or lower levels. Thereafter, the Advanced Progressive Matrices (RAPM) were designed to identify people of "superior intellectual ability, such as students for advanced scientific or technical studies", while the Coloured Progressive Matrices were designed for use with children, as well as to identify those at the lower end of intellectual functioning (Raven, Raven & Court, 1988b).

According to Raven, Court and Raven (1996), the Ravens Progressive Matrices measure the ability to make meaning out of confusion, and the ability to generate high level, non-verbal schemata which make it easier to handle complexity. The Matrices also require the perceptual ability to deal with gestalts and relationships, as well as a conceptualization of the nature of the problems presented. Some researchers also suggest that the Matrices measure visuo-spatial ability (Cattell, 1963; Raven et al, 1996). These are all skills essential for engineering students, which is the reason for its selection as a measure in the current study. The RAPM is discussed in more detail in the Rationale and Methodology Chapter.

The RAPM are considered to be a non-verbal measure of intelligence, which has been used in many recent studies (Magangane, 2003; Rushton & Skuy, 2000; Rushton et al., 2002; Rushton et al., 2003; Strous, 2003). However, it would also be interesting to consider a verbal measure of reasoning. The Organiser (Feuerstein, 1980) is a verbal test with a numerical component, which assesses hypothetical or inferential thinking, the use of strategies for hypothesis testing, the gathering and application of logical evidence, and summative behaviour. The Organiser was chosen as a test of cognitive functioning on the basis of its previously demonstrated reliability, validity and usefulness with South African adolescents (Skuy, Hoffenberg, Visser & Fridjhon, 1990; Skuy & Shmukler, 1987). Rand and Kaniel (1987) report reliability coefficients of .8 and .9 for the Learning Potential Assessment Device, of which the Organiser is part. The Organiser is discussed in more detail in Chapter 3.

The problem of success or failure at tertiary level is significant to this study. This is evident from the increased interest in and research undertaken into the factors and determinants involved (Behr, 1982; Entwistle & Wilson, 1970, Hendrich, 2002; Nunns & Ortlepp, 1994; Rademeyer & Schepers, 1998). Intelligence (as measured by the RAPM) is one variable that has been examined frequently recently (Magangane, 2003; Rushton & Skuy, 2000; Rushton et al., 2002; Rushton et al., 2003; Strous, 2003). Three other variables that have received considerable attention in recent studies are learning strategies, locus of control, and self-esteem. These variables have been investigated as independent factors, and also as part of a cluster of factors (Van Overwalle, 1989; Watkins, 1987). Sections 1.6 and 1.7 provide an overview of these variables.

1.6 Learning Strategies

There are many definitions of the concept of learning strategies, but all arise from the basic premises that there are individual differences in the ways that people approach learning. According to Weinstein (1998, p.291), learning strategies are considered to be "any behaviours or thoughts that facilitate encoding in such a way that knowledge integration and retrieval are enhanced." Learning strategies are also conceptualized as general techniques for more effective learning, and as practices and attitudes which impact on how information is perceived and learned by a student (Weinstein & Mayer, 1986, p.325). The aim of a particular learning strategy may be to enhance a learner's emotional or motivational state (Weinstein & Mayer, 1986). It may also influence the way in which new knowledge is acquired, organized and integrated by the learner. Measures of learning strategies have as their aim, the prediction of academic success, the screening of students, and the provision of relevant data for counselling students regarding their strengths and weaknesses (Weinstein, 1988). This makes the inclusion of learning strategies in this study very valuable.

The learning and study strategies of high school and college students have received a great deal of attention over the past few decades (Schmeck, 1988). Furthermore, numerous local and international researchers have made reference to the positive correlations between the use of learning strategies and academic success. For example, Weinstein and Mayer (1986) state that students participating in a learning strategies course were found to have improved their academic performance. Culverwell (1989) claimed that his study of undergraduate Humanities students established a relationship between learning strategies and academic performance. Similarly, Van Aardt and Van Wyk (1994) concur that learning strategies are an important factor to consider in determining academic achievement at both the secondary and tertiary level.

One way of measuring learning strategies and attitudes is by administering the Learning and Study Strategies Inventory (LASSI). This inventory was developed in the late 1980's (Weinstein, Schulte & Palmer, 1987), and is presently being used by over 1,100 academic institutions throughout the United States alone. According to the user manual, this instrument is designed to measure college students' use of learning and study strategies and methods. The focus of the LASSI is on both covert and overt thoughts and behaviours that relate to successful learning, and that can be altered through educational intervention (Weinstein, 1987, p.2).

The LASSI consists of ten scales: five of these deal with motivation (namely, the Attitude, Motivation and Anxiety Scales) and self-management (namely, the Time Management and Concentration Scales); while the other five deal with cognitive strategies (namely, the Information-Processing, Selecting Main Ideas, Study Aids, Self-Testing and Test Strategies Scales) (Albaili, 1997).

The **Attitude** subscale examines student attitude and interest in university, while the **Motivation** subscale focuses on level of diligence, self-discipline, and willingness to work hard in university. The **Time Management** subscale assesses use of time management principles for academic tasks, and the **Anxiety** subscale examines the degree to which a student is concerned about university and university performance. The **Concentration** subscale evaluates ability to pay attention to academic tasks. The **Information Processing** subscale addresses use of elaboration, monitoring and reasoning, while the **Selecting Main Ideas** subscale focuses on the ability to pick out important information for further study. The **Study Aids** subscale concentrates on use of materials to help learn new information, and the **Self Testing** subscale examines effort to review and prepare for classes and tests. Finally, the **Test Strategies** subscale addresses preparation and test taking strategies (Haught,

Hill, Walls & Nordi, 1998). The LASSI will be discussed in more detail in the Methodology Section.

There is considerable research documenting that certain learning strategies (assessed by the LASSI) of high school and college students are associated with various measures of academic achievement. For example, McKeachie, Pintrich and Lin (1985) examined the relationship between learning strategies and the academic achievement of 193 first-year university students. They found a significant correlation (r=0.38) between the scores on the LASSI and first-year students' academic scores in subsequent semesters. Sinkavich (1991) investigated the relationship between study strategies and grades achieved in one course of 45 college students, and reported a significant correlation between the Motivation scale and students' course performances (r=0.42). Nist, Mealey, Simpson and Kroc (1990), used a sample of 71 college students reported that the LASSI was significantly predictive of first-year students' academic performance scores. Furthermore, Prus, Hatcher, Hope and Grabiel's study (1995) used the LASSI in predicting first-year success at university provided some support for the link between learning strategies and subsequent academic success.

Although it appears that learning strategies are related to academic success, most researchers still stress that learning strategies are not the only factor when considering academic performance. For example, metacognitive strategies and students' management and control of their effort are also two important components (Pintrich & De Groot, 1990).

Intelligence and learning strategies are two variables of the present study that have been explored. Section 1.7 discusses personal development, which comprises locus of control and self-esteem.

1.7 Personal Development

1.7.1 Locus of Control

According to Findley and Cooper (1983, p.419), "Locus of control refers to a person's beliefs about control over life events." In other words, locus of control deals with the issue of whether a person perceives himself or herself to be at the mercy of luck or fate, or if one is in control of one's destiny, life and rewards (Rufus, 1984). The construct has its origin in social learning theory, and was conceptualized by J.B Rotter (1966). He claimed that locus of control can play an important role in understanding the learning processes of human beings and that an individual's locus of control affects his/her behaviour in a variety of ways.

Locus of control has two main dimensions, namely internal and external locus of control, which exist on a continuum. Internal control refers to a generalised expectation that reinforcements occur as a consequence of one's own actions, and are thereby under personal control. Individuals who exhibit an internal locus of control feel personally responsible for things that happen to them (Flippo & Caverly, 1991). Conversely, external control refers to the belief that reinforcements are unrelated to one's own behaviours, and are therefore beyond personal control (Lefcourt & Ladwig, 1965). Individuals with an external locus of control believe that factors beyond their control are responsible for what happens to them.

Rotter (1966) is the developer of the first Locus of Control assessment tool, namely the Internal-External Locus of Control Scale (1966). Since then, many other versions of this scale have been developed. These include the Multidimensional Health Locus of Control Scale (MHCL) by Wallston, Wallston and DeVelllis (1978), and the Internal Control-Index by Duttweiler (1984).

In his research, Schepers (1995) came to the conclusion that there was room for the construction of a new assessment tool for measuring locus of control. The main aim of his development of the Locus of Control Inventory (LCI) was to provide a valid and reliable assessment tool for students and adults. One main difference between Scheper's scale (1995) and the other's scales, is that he provided three scales (based on factor analyses), namely the Internal Control Scale, the External Control Scale, and the Autonomy Scale. The last scale refers to the degree of self-confidence a person exhibits in personally initiating and executing a complex task. This inventory was selected for use in this study, and is discussed in more depth in the Rationale and Methodology chapter.

Locus of control, or whether an individual's motivation for behaviour is centered internally or externally has been a focus of study by researchers for a long time. Several studies (Crump, Hickson & Laman, 1985; Joe, 1971; Lefcourt, 1982; Throop & MacDonald, 1971) indicate that various measures of control beliefs are correlated with a wide variety of social and academic behaviours. For example, a study by Krantz and Friedberg (1986) focused on the relationships between locus of control, positive persuasion, prosocial and popularity of children in Grades Three, Four and Five. The study was based on Rotter's (1966) hypothesis which claimed that a child with an internal locus of control in the social domain would be expected to exert influence in interaction with peers in the form of prosocial leadership skills. The results confirmed the relationship between locus of control and leadership.

Other studies include determining the relationship between locus of control and leadership (Van Staden, Schepers & Rieger, 2000); investigating the relationship of locus of control and marketing (Coetzer & Schepers, 1997), and locus of control as a predictor of work performance (Bothma & Schepers, 1997).

Locus of control has also been found to be related to students' achievement (Murray & Staebler, 1972). According to Milgram (1971, cited in Hendrich, 2002), the extent to which someone comes to view his own personal efforts rather than events in the external environment (chance, fate, and so on), as responsible for his successes and failures, the more likely he is to exert the effort to maximize his abilities to achieve success. Similarly the degree to which a child believes that his own behaviour is responsible for his academic successes and failures will affect his efforts to attain these goals. Schepers (1995) concluded that students who perform highly on the Autonomy and Internal Control Scales and poorly on the External Scale are well adapted to the educational context.

Allen, Giat and Cherney (1974) and Daniels and Stevens (1976) discovered that students with a high internal locus of control performed better than those with a high external locus of control. Ismail and Wai Kong (1985) cite research literature that shows a positive relationship between internal beliefs of locus of control and academic achievement. A study by Schedk and Rhodes in 1980 (cited in Burkhalter, 1995) found a strong relationship between an internal locus of control and ratings of competence. Conversely, external locus of control is often associated with a history of failed experiences.

The notion that a high internal locus of control will correlate with high academic achievement is based on the assumption that a person who believes that successes and failures are due to the results of his own behaviour, will be more likely to exhibit initiative and persistence in meeting achievement goals (Rotter, 1966).

One study (Ismail & Wai Kong, 1985) examined the relationship between locus of control, cognitive style, anxiety and academic achievement –while partialling out general intellectual ability, in 375 primary school children. The

authors claimed that while each of the variables, that is locus of control, cognitive style and anxiety had been shown to account for variation in academic achievement, to date no study had included all three variables in an attempt to determine the relative contribution of each to academic performance. The results indicated that locus of control, cognitive style and anxiety were correlated significantly ($r=0.40$, $p<0.05$) with academic achievement. It was discovered that locus of control was a significant predictor of academic achievement, followed by state-anxiety, cognitive style and trait anxiety (Ismail & Wai Kong, 1985).

The results of regression analyses indicated that even with the presence of general intellectual ability, locus of control was a significant predictor of academic achievement -followed by state anxiety, cognitive style and trait anxiety. The results have important educational implications. Traditionally academic achievement had often been explained in terms of individual difference in intellectual ability. However based on the results of the study, it appears that it may be useful to take personality variables (particularly locus of control) into account when examining academic performance.

According to Skuy (1975, p.113), an external locus of control is "a style of problem solving which reflects a lack of faith by the individual in his own thought processes and the solutions they provide in dealing with problems. It can be described as a lack of ability an/or inclination to resume responsibility for one's own actions". This may therefore explain its contribution to academic achievement. Adelman and Taylor (1983) make a distinction between intrinsic and extrinsic motivation. According to them, extrinsic motivation comes from external influences, such as physical and social reinforcers. It corresponds with an external locus of control. On the other hand, intrinsic motivation refers to that motivation that comes from within the individual, and corresponds to a more internal locus of control. Intrinsic motivation involves a striving for competence, self-determination and the

ability to make choices. According to Feuerstein and Feuerstein (1991), if an individual has had the mediation of competence, individuation, challenge and goal setting, a more internal locus of control may be fostered.

It therefore appears that locus of control may be an important factor to take into consideration when investigating factors contributing to academic success. More specifically, it seems that an internal locus of control is related to success. Having discussed locus of control, another important individual factor to consider is self-esteem.

1.7.2 Self-Esteem

"By self-esteem we refer to the evaluation which the individual makes and customarily maintains with regard to himself; it expresses an attitude of approval or disapproval, and indicates the extent to which the individual believes himself to be capable, significant, successful and worthy" (Coopersmith, 1990, p.31).

Research on self-esteem has had a long, prolific history in psychology. This may be due to the impact of self-esteem on human cognition, motivation, emotion and behaviour. Research has demonstrated the effects of self-esteem in achievement, competition and coping with stressful life events (Campbell & Lavalee, 1993). Self-esteem is the result of many experiences throughout life. It appears that those individuals with high self-esteem tend to function better in general, and have more positive interactions than those with poor self-esteem (Nolan, Dai & Smith, 2003). Furthermore, individuals with high self-esteem are generally more effective in their functioning in a number of different areas. They also tend to perceive themselves as satisfied and happy (Coopersmith, 1967).

Some researchers (Durbin 1982; Keat, 1974) believe that self-esteem is "the single most important variable in an individual's life" (Keat, 1974, p.47). According to Reisman (1985), self-esteem is the bridge between one's identity and what's important in life. Mruk (1995) claims that self-esteem has been found to be linked with high ego functioning, personal adjustment, internal control, autonomy, and the likelihood of a favourable outcome for therapy.

Numerous studies have illustrated that a pupil's self esteem is related to performance at school. According to Mwamwenda (1995), a pupil with a positive self-concept stands a higher chance of performing better than a pupil with a negative self-concept. Baumeister (1993) claims that people with high self-esteem are likely to bounce back after a failure, and try again. However, many students who fail academically might not bounce back due to lower self-esteem, and they might subsequently develop a "failure identity." Due to this, Reck (1980) claims that educators have become increasingly interested in the ability of schools to enhance student self-concept.

However, it seems that the relationship between self-esteem and academic performance is a controversial topic (Singg & Farquhar, 2003). According to Filozof, Albertin, Jones, Steme, Myers and McDermott (1998), self-esteem does not cause academic achievement, but rather academic performance influences subsequent self-esteem. Furthermore, the correlation between self-esteem and academic performance has been reported to range from low to moderate (Baumeister, 1993; Moeller, 1994). Purkey (1970) on the other hand, claims that self-esteem and scholastic achievement are dynamically interrelated. According to him, negative self-perceptions lead an individual to see him/herself as incapable of mastering academic work, and also as seeing such work as irrelevant to their experiences of their world. The subsequent and repeated experiences of failure then serve to reinforce such negative self-perceptions (Skuy, 1975).

Spencer (1985) notes that feelings of competence are related to self-concept, and that minority status children are at risk in this regard. According to him, minority children in particular are at risk given the fact of racial discrimination and it's institutionalization. Furthermore, Feuerstein (1980) argues that in disempowered communities, transmission of values, norms and cultural identity are often disrupted -leading to a break in the continuity of past with present. This links to the situation in South Africa, where African people were disempowered and disadvantaged during the Apartheid era.

Individuals tend to seek positive judgments about their competencies from themselves and from others, but students with positively framed self-schemata seem more able to persist in problem-solving activities even after having received negative evaluative feedback (Burkhalter, 1995). Thus, a coherent self-schema can be seen to be related to the notion of intrinsic motivation, and therefore, self-directed behaviour.

There have been a number of measures of self-esteem drawn up. Since its publication in 1981, the Coopersmith Self-Esteem Inventory (CSEI) has proven to be a reliable and valid instrument, and it has been used in thousands of studies (Coopersmith, 1990). This instrument is discussed in further detail in the Rationale and Methodology Chapter.

1.8 Summary

While engineering students seem to be amongst the highest scoring students at university, high failure and drop out rates have prevailed. Various studies have attempted to find the factors associated with success in engineering. (Behr, 1982; Strous, 2003; Van Eeden et al, 2001). Some have looked at spatial abilities, and others have investigated mathematical and scientific aptitude (Lohman, 1994; Potter et al, 1987) Further research has investigated intelligence as a predictor of first year university achievement (ibid, 2003;

Rushton & Skuy, 2002; Rushton et al., 2002). However, it seems that the factor of innate intelligence as a predictor of academic success in this population is limited, and that it is important to look at several different dimensions of academic achievement. As discussed, many studies indicate that there has been a focus on either cognitive or affective factors in relation to students' performance, but few which combine both.

The current study attempted to bridge this gap by examining three different areas, namely intelligence, learning and study strategies, and personal-professional development (locus of control and self-esteem). No study had previously looked at these factors in combination. Also, whereas most studies have investigated first year engineering students (Behr, 1987; Strous, 2003; Magangane, 2003; Van Eeden et al, 2001), this study comprised second year engineering students. The current study had the advantage of having access to two consecutive years of results for the same group of engineering students.

CHAPTER 2: RATIONALE AND METHODOLOGY

2.1 Rationale

As mentioned in the Literature Review, various studies in South Africa have investigated psychometric intelligence as a predictor of academic functioning in engineering (Rushton & Skuy, 2000; Rushton et al., 2002, ibid 2003; Strous, 2003). These studies have yielded modest correlations, which have not been consistently significant. Furthermore, the studies have neglected to explore dimensions of human functioning other than intelligence, despite the fact that various other dimensions of personality have been postulated and found to be related to academic functioning (Krantz & Friedberg, 1986; Schmeck, 1988; Van Eeden et al., 2001). There was a need to employ an holistic approach to the investigation of academic performance of engineering students, which took various dimensions of a person's functioning into account. A broad-based approach was thus indicated, which included, in addition to intelligence, a consideration of locus of control, self-esteem and learning strategies. Numerous studies and theorists have demonstrated the relevance and importance of each of these factors to academic performance (McKeachie et al., 1985; Nist et al., 1995; Prus et al., 1995). In an attempt to address the concerning occurrence of a high failure rate among engineering students at tertiary level, the current study examined the relationship of each of these dimensions of functioning - both individually and in combination - to the academic performance of a group of engineering students at the University of the Witwatersrand.

2.2 Aim of the Study

As an extension of the literature reviewed in Chapter 1, the current study aimed to examine the relative contribution of intelligence, learning strategies and personal development to engineering students' academic performance.

2.3 Research Hypotheses

The aims of the current research (outlined above) were operationalised in a series of related hypotheses:

1a) Intelligence (as measured by the RAPM and the Organiser) is significantly related to academic performance in second year engineering.
1b) Individuals who have higher levels of intelligence perform better academically than those with lower levels.

2a) Learning Strategies (as measured by the LASSI) are significantly related to academic performance in second year engineering.
2b) Students who have more efficient learning strategies and motivation perform better than those with less efficient learning strategies and lower motivation.

3) Students who score highly on the Internal Scale and the Autonomy Scale of the Locus of Control Inventory perform better academically than those who have lower scores on these scales.

4a) Self-esteem (as measured by the Coopersmith Self-Esteem Inventory) is significantly related to academic performance in second year engineering.
4b) Individuals with high self-esteem perform better academically than those with lower self-esteem.

5) All of the variables in combination (in other words, intelligence, learning strategies, locus of control, and self-esteem) are more highly correlated with academic performance in second year engineering than each of these variables individually.

2.4 Research Design

The study constituted both a correlational and ex-post facto design. Correlations were conducted in order to determine the association between the five measures; as well as between the measures and academic performance. The study also consisted of ex-post facto design, in terms of which, the effect of intellectual and personal factors, and study strategies (independent variables) upon academic performance (dependent variable) was determined. A stepwise regression analysis was used to establish the contribution of the independent variables to the dependant variable. The dependent variable is academic achievement (measured by December 2002 and June 2003 results, and the independent variables are intelligence, self-esteem, study strategies, and locus of control.

2. 5 Sample

This research was part of a larger project of the Cognitive Research Unit at the University of the Witwatersrand. The larger project (which is still continuing) is concerned with examining performance on the Ravens Standard Progressive Matrices (RSPM) and Advanced Progressive Matrices (RAPM), and other dimensions of test performance of university students.

The present study comprised of 100 second year Chemical engineering students at the University of the Witwatersrand. The average age of the students was 19.7 years, and there were 64 males (64 percent) and 36 females (36 percent). There were 66 African (66 percent), 15 White (15 percent) and 19 Indian (19 percent) students. With the exception of eight students who were absent on that particular day, all of the second year students participated in the study. This accounted for 93 percent of second year Chemical engineering students. It was noted that 25 students (25 percent) were repeating second year.

2.6 Measures

The five main instruments employed in the current study were: The Ravens Advanced Progressive Matrices (RAPM), The Organiser, The Learning and Studies Strategies Inventory (LASSI), The Locus of Control Inventory (LCI), and the Coopersmith Self-Esteem Inventory (CSEI). The RAPM and Organiser were used as measurements of **intelligence**, the LASSI of **learning strategies**, and the LCI and CSEI of **personal development**. Two further measurements pertained to the students' academic performance, which involved the students' results in the December 2002 and June 2003 examinations. These examination results consisted of the students' core aggregate (comprised of Physics, Maths and Mechanics). The instruments employed in this study are discussed in detail below.

2.6.1 The Ravens Advanced Progressive Matrices (RAPM) (Raven, Raven & Court, 1998)

The Ravens Progressive Matrices (RPM) are among the most well known, most researched, and most widely used of all culture- reduced tests (Ravens, 2000). The RPM were designed to measure Spearman's "*g*" - the general factor of intelligence, or at least the non-verbal component thereof. The RPM is also described as a measure of the "ability to identify relationships", "analogical thinking", and the ability to "think clearly" (Raven et al., 1996). The test has different forms of varying complexity, such as the Coloured Progressive Matrices (RCPM), Standard Progressive Matrices (RSPM), and the Advanced Progressive Matrices (RAPM). The CPM are mainly used for children, and the RSPM and RAPM are used for adolescents over the age of eleven and a half, as well as for adults (Strous, 2003).

According to Raven et al (1996), the RPM measure the ability to generate high-level schemata and make meaning out of confusion. The RPM also

require the perceptual ability to deal with gestalts and relationships, as well as conceptualisation of the nature of the problem presented. Some studies also suggest that the RPM measures visuo-spatial ability (Carpenter, Just & Shell, 1990; Chan, 1989; Raven et al., 1996).

Due to the ceiling effect experienced on the RSPM Matrices in the 2001 study of first year engineering students, the RAPM were used in this study. The RAPM are the most difficult of the Ravens Matrices tasks. They were designed to differentiate between "people of superior intellectual ability" such as students for "advanced scientific or technical studies" (Raven, Raven & Court, 1998a, pp.1-2).

The RAPM (originally drafted in 1943) consists of two components, published in separate booklets. Set I comprises a short set of 12 diagrammatic puzzles, each with a missing part that the test taker attempts to identify from several options. Set I is normally used for practice - to familiarize individuals with the test, and to alleviate anxiety. According to Raven et al.(1988), administering Set II without Set I, reduces the validity of the data obtained. Set I is also able to discriminate between high, average and low scoring adults, and is therefore used when deciding which form of the Ravens (RSPM or RAPM) would be most appropriate to administer (Raven et al., 1998b).

Set II consists of 36 diagrammatic puzzles that are identical in presentation to those in Set I. However, the former increase in difficulty more steadily, and become considerably more complex. In both sets, the subject is shown a series of designs, and has to supply a missing part selected from a number of alternatives. Each item is boldly presented, accurately drawn, and pleasing to look at. According to Feuerstein, Rand and Hoffman (1979) the test's increasingly complex operations include analogies and permutations.

All three versions of the RPM are thought to be cost effective measures. They are quickly administered, easily scored by psychologists, and may be used in groups or individually (Raven et al, 1998). The RPM has been used in well-over 1000 studies - both internationally and locally. For example, it has been administered at the University of Venda as part of a battery of tests (Grieve & Viljoen, 2000), the University of the North (Zaaiman, Van der Flier & Thijs, 2001), and at the University of the Witwatersrand (ibid, 2002; Rushton et al., 2003). These latter studies have investigated performance on the RPM by African, Indian and White students (2002 and 2003).

The results of these studies demonstrated reliability and validity across a wide range of populations. Retest reliabilities of between 0.83 and 0.93 were found with an interval of approximately one year between administrations. Internal consistency coefficients of 0.80 were found across many cultural groups, including African South Africans (Owen, 1992). More specifically, the RAPM shows reliability and validity across a range of populations, including African- Americans and other non-whites. The total score on the RPM provides a good measure of "*g*" - at least within the U.S (Jensen, 1980; Raven et al., 1998). The RAPM has high internal consistency, and has been standardised in the United Kingdom (1992), United States of America (1993) and Germany (1997).

In the current study, the RAPM was chosen as one of the reasoning ability measures due to its validity as an index of intellectual capacity and reliability; wide spread use both internationally and locally, and its complexity for engineering students. **Appendix A** provides an example from the RAPM.

2.6.2 The Organiser (Feuerstein, Rand & Hoffman, 1979)

The Organiser consists of 22 problems, where each problem has a set of items (for example, colours, objects, countries), which must be organized and placed in positions relative to one another based on a determined attribute or condition (Feuerstein, Rand & Hoffman, 1979). A series of statements or premises are presented in each task. Each premise permits the extraction of only a part of the needed information required to reduce uncertainty and determine a full and precise placement of the items relative to one another in the series - consistent with the given information. The tasks vary in their level of complexity, the number of units of information involved in the task, and the level of inference required to solve them. In order to solve the tasks, the individual is required to process the given information and to generate information that is not immediately available in the given propositions by using logical reasoning (Feuerstein et al., 1979). The Organiser can be administered as an individual or group test. There are two forms - A and B, which are parallel forms.

This test has been successfully used as part of Feuerstein's (1980) Learning Propensity Assessment Device (LPAD), which uses Form A as a pre-test, and Form B as a post-test after mediation has taken place. In the current study, due to its availability, only Form B was used. Furthermore, no mediation took place, so there was only a need to use one form.

Since the Organiser is used mainly as an individual comparative measure of learning potential, no norms or reliability data are available for this test. However, each student does obtain a score based on the number of correct items. The Organiser has been used in a study concerning the prediction of the performance of gifted children, in both South Africa and Israel (Skuy, Gaydon, Hoffenberg & Fridjhon, 1990; Skuy, Kaniel & Tzuriel, 1988).

This instrument was chosen as the second measure of reasoning. It is a measure of both verbal and non-verbal reasoning, and it specifically assesses hypothetical thinking, problem solving and reasoning ability. It can further provide a full picture of intelligence together with the RAPM. **Appendix B** provides some examples from the Organiser.

2.6.3 The Learning And Study Strategies Inventory (LASSI) (Weinstein, Schutte & Palmer, 1987)

According to Weinstein (1988, p.291), learning strategies can be defined as "any behaviours or thoughts that can facilitate encoding in such a way that knowledge integration and retrieval are enhanced". Learning strategies are also conceptualised as "general techniques for more effective learning; and as practices and attitudes which impact on how information is perceived and learnt by the student (Weinstein & Mayer, 1986).

Weinstein et al. (1987) reviewed the available inventories for assessing learning strategies. They found that many instruments focused on behaviours or activities that are correlated with successful studying, but did not reveal how students learn. They concluded that they needed to develop a more valid tool for assessing learning strategies, and therefore they developed the Learning and Study Strategies Inventory (LASSI) (Weinstein et al., 1987). This inventory comprises 77 self-report items related to study strategies. It is a diagnostic instrument which identifies the strengths and weaknesses of individual students in ten areas. Educational research has shown these ten areas to be important for success at university. The ten sub-scales are Attitude, Motivation, Time-Management, Anxiety, Concentration, Information-Processing, Selecting Main Ideas, Study Aids, Self-Testing, and Test Anxiety (Weinstein, Zimmerman & Palmer, 1988).

The developmental work that led to the creation of the LASSI began in 1978 as part of the Cognitive Learning Strategies Project at the University of Texas in Austin. In response to the increasing numbers of academically unprepared students entering post-secondary educational and training settings, many institutions were creating programs to assess students' deficiencies. This required a reliable and valid means for measuring students' deficits and progress, and therefore the LASSI was created. Data from approximately 800 first-year students from the University of Texas was used to develop norms for the scales. Regarding the reliability of the ten scales, the data indicate favourable alpha coefficients ranging from 0.68 to 0.86. The test-retest coefficients ranged from 0.72 to 0.85 (Rademeyer & Schepers, 1998; Van den Berg & Burke, 1998). This demonstrates a high degree of stability for the scale scores (Weinstein, 1987). More specifically, for each of the ten scales, the Coefficient Alphas, and the Test-Retest Correlations respectively are as follows: Attitude (.72, .75), Motivation (.81, .84), Time-Management (.86, .85), Anxiety (.81, .83), Concentration (.84, .85), Information-Processing (.83, .72), Selecting Main Ideas (.74, .78), Study Aids (.68, .75), Self-Testing (.75, .78), and Test Anxiety (.83, .81). According to Van den Berg and Burke (1998), the instrument yielded favourable results for use with developing Black populations in South Africa, and "both the reliability and the validity of the instrument were found to be satisfactory" (p.159).

The LASSI takes approximately twenty minutes to complete. It uses a self-report format, and does not require any special administrative procedure. Each sub-scale has five to eight statements to which the respondents indicate how well the statement describes them. Students are required to respond to each of the 77 items on a five point Likert-type scale, ranging from "not at all typical of me" to "very typical of me." The LASSI yields ten individual scale scores- one for each of the ten scales. No total score is computed, since this is a diagnostic instrument. These scale scores can then be compared to the norms

provided (Weinstein, 1987). Various researchers classify the ten scales of the LASSI into different categories. For example, Pintrich and Johnson (1990) divide the ten scales into five related to motivation and self-management, and five related to cognitive factors. Rademeyer and Schepers (1998) distinguish between Factor I (Information Processing, Study Aids, Self-Testing and Motivation), Factor II (Test Strategies, Selecting Main Ideas and Anxiety), and Factor III (Time Management, Concentration and Attitude).

There have been numerous positive correlations between the use of learning strategies and academic success at both the secondary and tertiary level. For example, Culverwell (1989) claims that his study established a relationship between learning strategies and academic performance at the tertiary academic level. Furthermore, Van Aardt and Van Wyk (1994) report that learning strategies are an important factor to consider in determining academic achievement at both school and university level.

The LASSI is widely used as an instrument to assess learning strategies, and it was therefore considered to be a good measure of learning strategies in the current study. Furthermore, it is reported to have a high correlation with academic success. For the full version of the LASSI Inventory and a copy of the LASSI answer sheet, please refer to **Appendices** C and D respectively.

2.6.4 The Locus of Control Inventory (LCI) (Schepers, 1995)

The Locus of Control Inventory (LCI) consists of a seven-point Likert type scale -where the individual is required to circle the number most appropriate to him/her. The inventory was designed by Schepers in 1995, and the original form consisted of 65 items, and had a reliability of 0.80. In 1995, the number of items was increased to 80, and the reliability yielded ranged from 0.83 to 0.866 (Rademeyer & Schepers, 1998). This version was administered to

1662 students at the Rand Afrikaans University in 1995, as part of a study investigating the relationship of locus of control and academic performance at tertiary level (Rademeyer & Schepers, 1998).

There are three distinct factors, namely Autonomy, Internal Control and External Control. The Autonomy Scale provides insight into the self-confidence, personal initiative and independence of an individual. The Internal Control Scale refers to the degree of personal responsibility that a person exhibits. Thirdly, the External Control Scale refers to the extent that an individual sees luck or fate as the determining factors of life. The three scales have high internal consistency. The Autonomy Scale comprises 26 items, and it has an alpha coefficient of 0.86, while the External Control Scale has 25 items, and it has an alpha coefficient of 0.84. The Internal Control Scale is made up of 26 items, and has an alpha coefficient of 0.83.

Locus of control could help with insight into understanding learning processes. For example, Paterson (1993) found locus of control to be involved in improved academic performance of senior pupils. Walters (1994) also reported that students who make good scholastic progress, exhibit a stronger internal locus of control than 'at-risk' pupils.

This instrument is seen as appropriate to the current study as it has been widely used within the South African context, and is shown to be correlated with academic success. Various items from the Locus of Control Inventory can be viewed in **Appendix E**.

2.6.5 The Coopersmith Self-Esteem Inventory (CSI) (Coopersmith, 1975)

The Coopersmith Self-Esteem Inventory (CSEI) is a brief paper and pencil self-report instrument. The inventory was designed to measure the attitudes that people hold in social, academic, family and personal areas of experience (Coopersmith, 1975). The CSEI was originally developed for use with children up to the age of 15. However, three separate forms (A, B and C) were subsequently developed, and the inventory has been used with age ranges from 8 through to adult.

Form C of the CSEI is for individuals aged 16 years and over, and the reading level is suitable for persons 8 years and older. It comprises 25 short statements which are answered either "like me" or "unlike me". Raw scores are calculated according to a scoring key, and multiplied by 4 to give a score out of 100. The 1986 test manual states that by employing position in the group as an index of relative self appraisal, the upper quartile can generally be regarded as indicative of high self-esteem, the lower quartile of low self-esteem, and the interquartile range as indicative of moderate self-esteem. The mean for this scale has been noted as 76.1 (Coopersmith, 1975).

The CSEI meets Hudson's (1985, p.186) axiom for practical utility, as it is "short, easy to administer, easy to understand, easy to score, and easy to interpret." Research has demonstrated fairly high degrees of predictive and construct validity, as well as test-retest and alternate form reliability. A negative point of the measure is the social desirability aspect.

On the basis of studies, Coopersmith (1975) reports that scores on this scale are significantly related to academic achievement, creativity, perceptual constancy, anxiety, and resistance to group pressure. Furthermore, since its publication in 1981, the CSEI has proven to be a reliable and valid instrument

of self-esteem (Coopersmith 1990). The CSEI was used in the present study, as it has been used in countless studies of self-esteem. It can be viewed in **Appendix F.**

2.6.6 Measuring Academic Performance

The students' December 2002 and June 2003 engineering results were obtained from the Engineering Department's administrative records. For both sets of results, students received an overall core aggregate, which is made up of Physics, Maths and Mechanics marks. These subjects are the most important for second year Chemistry, and students are required to pass them in order to pass the academic year. The academic marks were obtained in order to be correlated with the students' results obtained on the five psychological measures (RAPM, Organiser, LASSI, LCI and CSEI).

2.7 Procedure

The RAPM was administered to this group of students in 2002, for the purpose of another longer study (Rushton et al., 2002). Therefore, re-examination was not necessary, and data for this measurement was obtained from the initial study. In one sitting (February 2003) of three hours, the Organiser, LASSI, LCI, and CSEI were administered to all the students. Most students finished within two hours, and all of the students had finished in two and quarter hours. The Organiser was the only instrument with a time limit of an hour.

The four instruments were administered to the students in a large hall, with many rows of seats. Prior to the testing, the administrators ensured that all of the seats were adequately spread out. Furthermore, the instructions, order of the tests, and time limit were written up on the large blackboard in front.

There were six administrators present (post-graduate students), in order to facilitate the handing out and collecting of the papers. These administrators were all Psychology Masters students, and had been thoroughly briefed on the testing procedure.

As a formality, the head of department firstly addressed the students. Thereafter, the researcher gave explanations and instructions concerning the time, procedure, and instruments. Prior to each measure, the students completed biographical information, which included ethnicity, gender, date of birth and year of study. The students all started off with the Organiser. Thereafter, they were given The LASSI, LCI, and CSEI in that order. Whenever a student finished one of the measures, he/she was required to put up his/her hand in order to receive the next measure. Although, due to the large group of students, there was not any official break given, every individual could take his/her own break in-between the measures. It was noted that most students did not take a break. Upon leaving, each student was asked whether he/she had completed all four tasks. It was noted that the students appeared motivated throughout the testing.

The researcher marked all of the measures herself, and had an external individual check the scores. The students' June and December academic results were obtained from the engineering department. In order to provide for correlations in an anonymous way, each student obtained the same number on all four of his/her papers. A person unconnected to the research or to the Faculty of Engineering was given each student's student number for the purpose of obtaining and correlating their December 2002 and June 2003 examination results. This ensured that the research was conducted in an anonymous and confidential manner.

CHAPTER 3: RESULTS

3.1 Overview to Data Analysis

Scores were obtained for each of the five measures (namely RAPM, Organiser, CSEI, LASSI and LCI), as well as December 2002 and June 2003 results. In order to investigate the contribution of intelligence, study strategies, self-esteem and locus of control to academic performance, several analyses were executed. Firstly, descriptive analyses were obtained for the sample, in order to provide a summary of the ages, races and gender of the participants. The descriptive data includes the means and standard deviations of the five measures, as well as of the students' academic performance. Secondly, Pearson's Product-Moment Correlations were run between the RAPM, Organiser, CSEI, LASSI and LCI in order to determine relationships among the variables themselves. Thirdly, correlations between the five measures and the June and December results were run in order to determine relationships between the measures and the students' academic performance results. Furthermore, in order to view the percentage of variance accounted for in the academic results by each of the measures, a stepwise multiple regression analysis was executed. This investigated the separate and combined influence of the variables on academic performance, and tested the hypothesis that all the variables in combination are more highly correlated together than individually. Finally, Analyses of Variance (ANOVAS) were run between the levels of variables, to determine whether there were any significant differences between the top, middle and low scoring students on each of the variables - both for the December and June results. In all analyses, the students' raw scores on each of the measures were used. The exception was the RAPM, where scaled scores (IQ scores) were used because, unlike the

other four measures, the raw scores could be converted into these scaled scores.

3.2 Descriptive Statistics

3.2.1 Students' Demographic Information

Table 3.1 provides a breakdown of the races, gender and mean age of the sample.

Table 3.1: Information about the Sample

Race			*Gender*			*Age (in Years and Months)*			
	n.	%		**n.**	%	**Range**	**Mean**	**SD**	**n.**
African	66	66	*Male*	64	64	17-25	19.7	1.54	100
White	15	15	*Female*	36	36				
Indian	19	19							

From Table 3.1, it can be observed that the majority of students in the second year Chemical Engineering group (2003) were African (66%). This was followed by Indians (19%), and Whites (15%). There were 64 (64%) males and 36 (36%) females in the class, and the mean age of the students was 19.7 years.

3.2.2 Mean Scores on the Measures

In Table 3.2, the students' mean scores on four of the measures, namely the Organiser, CSEI, RAPM, and LCI are provided. The LCI does not yield one overall score, but instead provides three separate scores for the Internal, External and Autonomy Control Scales, as indicated in Table 3.2.

Table 3.2: Mean Scores on the Organiser, CSEI, RAPM & LCI

Variable	*n.*	*Min Score*	*Max Score*	*Mean*	*SD*
Organiser	100	8	22	17.0	3.7
CSEI	100	16	100	70.3	18.3
RAPM (IQ)	100	79	135	108.5	9.0
(LCI) External	100	35	137	79.5	20.1
(LCI) Internal	100	105	178	150.9	13.9
(LCI) Autonomy	100	67	172	133.3	17.0

Table 3.2 shows the minimum and maximum scores obtained by the students, as well as the mean and standard deviation on each of the measures. The mean on the Organiser was 17 out of a possible 22. As previously mentioned, there are no available norms for this measure. On the Coopersmith Self-Esteem Inventory (CSEI), the mean was 70.3. This indicates that the students' self-esteem was in the average range, and it corresponds to the research data that indicates 70 percent (70 out of a possible 100) is the mean (Coopersmith, 1975). The students' average on the RAPM was 25 out of a possible 36. This yielded a converted I.Q score of 108, which falls well in the Average IQ Range (85-115). On the Locus of Control (LCI), the students' average on the External Control Scale was 79.5, out of a possible 175. This indicates a low external locus of control (Schepers, 1995). The average score on the Internal Control Scale was 150.9, out of a possible 182, which indicates a high internal locus of control. Finally, the mean score for the Autonomy Control Scale was 133.3, out of a possible 182, which indicates a fairly high autonomic locus of control (Schepers, 1995). According to Schepers' (1995) research, the mean scores on the External, Internal and Autonomy Control Scales of the LCI are 97 (SD=17), 148 (SD=13) and 135 (SD=15) respectively. The sample's scores fell within the Average range on each of the three LCI scales. It was noted that on the CSEI and all three scales of the LCI, the variability among the scores was high. This is indicated by the high standard deviations and the large range between the

minimum and maximum scores obtained on these measures. This may be because these scales allow for much greater variation in scores than the others (LASSI and RAPM).

As discussed in Chapter 2, the LASSI does not yield one overall score, but instead provides ten separate scores for each of the ten subscales. Therefore, for ease of reading, a separate table (Table 3.3) provides the means, standard deviations and percentiles obtained by the sample on these scales.

Table 3.3: Mean Scores on the LASSI

LASSI Variable	*n.*	*Min*	*Max*	*Mean*	*SD*	*Percentile*
Attention	100	23	40	34.1	3.71	71.2
Motivation	100	20	40	30.0	4.18	45.0
Time Management	100	10	36	25.8	5.52	62.0
Freedom from Anxiety	100	12	39	25.6	5.52	43.9
Concentration	100	10	37	28.1	5.80	67.8
Information Processing	100	17	38	28.0	4.40	61.1
Selecting Main Ideas	100	12	24	18.4	2.90	52.5
Study Aids	100	12	37	24.7	4.75	46.5
Self Testing	100	11	43	26.4	5.88	57.8
Test Strategies	100	18	40	30.4	5.13	51.5

According to Weinstein's LASSI manual (1987), when a score on a LASSI subscale falls between the 50th and 70th percentiles, the student should consider working on that particular skill. Furthermore, when a subscale falls below the 50th percentile, the student really needs to work on improving the skill in question, as this indicates a Below Average rating on that skill. Therefore, according to Table 3.3, the research sample's motivation, freedom

from anxiety and study aids really need to be worked on, and all the other subscales also could also be improved. This is with the exception of attention, which falls just beyond the 70th percentile. Attention fell into the highest percentile, while Freedom from Anxiety was in the lowest. This indicates that the sample's attention is very good, but their freedom from anxiety is low (in other words, their anxiety is high), and needs to be reduced.

Having illustrated the students' mean scores on the Organiser, CSEI, RAPM and LCI (Table 3.2) and on the LASSI (Table 3.3), Table 3.4 presents the students' mean academic performance scores for both June 2003 and December 2002.

Table 3.4: Student's Academic Performance

Variable	*n.*	*Min %*	*Max %*	*Mean %*	*SD*
June 2003	100	7	79	50.23	11.53
December 2002	100	23.6	81.5	64.19	10.01

Table 3.4 indicates that the sample's mean average in the June 2003 examinations was 50.23 percent. There was considerable variability in the scores, as the minimum percentage obtained was 7 percent, as compared to the maximum score of 79 percent. The sample's December average was much higher (64.19%) than the June average. The variability among the December scores was also high, as the minimum score obtained was 23.6 percent compared to the maximum of 81.5 percent. The difference between the December 2002 and June 2003 results can be seen in terms of the June results being intermediate and reflecting progress, and the December results carrying the main weight. In other words, whereas June exam results reflect only a portion of the total curriculum (summative and cumulative), December is a more comprehensive assessment of what was learnt in the year, and is only cumulative.

Section 3.2 described the students' personal information, their mean scores on each of the independent variables (Organiser, CSEI, RAPM, LCI and LASSI), and their mean sores on the dependent variables (June 2003 and December 2002 results). Section 3.3 discusses the correlation analyses that were run between the independent variables (Organiser, RAPM, CSEI, LCI and LASSI).

3.3 Inter-correlation Matrices between the Independent Measures

These analyses were executed in order to determine how the independent variables are related to each other, and whether there would be a basis for running further multiple regression analyses. For example, the RAPM and Organiser were expected to be correlated, as they are both measures of reasoning ability. Similarly, the External and Internal Control Scales of the LCI were expected to be negatively correlated, as they measure opposite traits.

Table 3.5: Correlation Matrix between Organiser, CSEI, RAPM, and LCI,

	Organiser	*CSEI*	*RAPM IQ*	*LCI External*	*LCI Internal*	*LCI Autonomy*
Organiser	1.00					
CSEI	0.11	1.00				
RAPM (IQ)	0.41**	0.09	1.00			
External LCI	-0.17	-0.47**	-0.18	1.00		
Internal LCI	-0.05	0.10	-0.18	-0.20*	1.00	
Autonomy LCI	-0.08	0.39**	0.07	-0.32**	0.41**	1.00

* $p < 0.05$ ** $p < 0.01$ (N = 100)

Table 3.5 illustrates that the reasoning measures, namely the Organiser and the Ravens are significantly correlated ($p < 0.01$). This indicates that both measures are tapping into an overlapping ability. Self-esteem and

autonomous locus of control were significantly correlated ($p < 0.01$). This indicates that having high self-esteem and being autonomous are related. Conversely, self-esteem and the External Control scale of the LCI were negatively correlated ($p< 0.01$). The External scale of the LCI was also negatively correlated with the Internal scale of the LCI ($p< 0.05$). This was expected, because as internal locus of control increases, so the external locus of control decreases. Finally, the Autonomy Scale of the LCI was positively correlated with the Internal scale of the LCI ($p< 0.01$), and negatively correlated with the External scale of the LCI ($p< 0.01$).

Table 3.6 indicates the inter-correlations between the four measures (Organiser, CSEI, Ravens, and LCI) and the ten subscales of the LASSI.

Table 3.6: Correlations between the Organiser, CSEI, RAPM, and LCI With the LASSI

	ATT	*MOT*	*TMT*	*ANX*	*CON*	*INP*	*SMI*	*STA*	*SFT*	*TST*
Orga-niser	-0.05	0.04	-0.14	0.17	0.06	-0.09	0.04	-0.10	-0.17	0.18
CSEI	0.26**	0.20*	0.36**	0.41**	0.35**	0.13	0.45**	0.02	0.21*	0.43*
RAPM (IQ)	-0.01	-0.04	-0.16	0.13	-0.03	-0.17	-0.14	-0.24*	-0.28**	0.16
External	-0.23*	-0.19	-0.20*	-0.35**	-0.33**	0.10	-0.44**	0.12	-0.06	-0.39**
Internal	0.12*	0.31**	0.10	0.13	0.03	0.42**	0.21*	0.18	0.22*	0.08
Auto-nomy	0.22*	0.34**	0.27**	0.37**	0.21*	0.38**	0.41**	0.12	0.23*	0.32**

* $p< 0.05$ ** $p< 0.01$ (N=100)

KEY:
ATT – Attention **MOT** – Motivation **TMT** – Time Management
ANX – Freedom from Anxiety **CON** – Concentration **INP** – Information Processing
SMI – Selecting Main Ideas **STA** – Study Aids **SFT** – Self-Testing
TST – Test Strategies

According to Table 3.6, the Organiser was not significantly correlated with any of the LASSI Subscales. This was not unexpected, because whereas the Organiser taps into reasoning ability, the LASSI measures learning strategies. The RAPM is negatively correlated with the Study Aids and Self Testing subscales. Perhaps this is because the higher one's reasoning skills are, the lower your use of self-testing and learning strategies may be. The CSEI was significantly correlated with the Attention, Time Management, Freedom from Anxiety, Concentration, Selecting Main Ideas and Test Strategies subscales all at the $p < 0.01$ level, and with the Motivation and Self Testing subscales at the $p < 0.05$ level. It thus appears that self-esteem and learning strategies are related. This makes sense, as the use of effective learning strategies is likely to lead to academic success, and thereafter boost self-esteem. Furthermore, similarly to the CSEI, the Autonomy Control Scale of the LCI was correlated with many subscales of the LASSI. This was expected, as the CSEI and Autonomy were found to be significantly related in Table 3.5. The Internal Scale of the LCI was significantly correlated with Motivation, and Information Processing at the $p < 0.01$ level, and with Attention, Selecting Main Ideas, and with Self Testing at the $p < 0.05$ level. Finally, the External Scale of the LCI was negatively correlated at the $p < 0.01$ level with Freedom from Anxiety, Concentration, Selecting Main Ideas and Test Strategies, and with Attention and Time Management at the $p < 0.05$ level.

3.4 Correlations between the Measures and Academic Performance

Having executed analyses between the independent variables, the next step was to investigate the correlations between the independent variables and academic performance (dependent variable). The June 2003 results and December 2002 results represented the samples' academic performance. The results of these correlations are shown in Table 3.7.

Table 3.7: Correlations between the LCI, Organiser, RAPM , CSEI and Academic Performance

	Organiser	*CSEI*	*RAPM (IQ)*	*LCI External*	*LCI Internal*	*LCI Autonomy*
June 2003 Aggregate	0.04	0.10	-0.12	-0.10	0.14	0.01
December 2002 Aggregate	0.11	0.16	-0.05	-0.14	0.01	0.20*

* p< 0.05 **p< 0.01 (N=100)

As can be viewed in Table 3.7, none of the five measures were significantly correlated with the June 2003 results. Furthermore, the only measure that correlated with the December 2002 results was the Autonomy Control Scale of the LCI.

Table 3.8: Correlations Between the Subscales of the LASSI and Academic Performance

	ATT	*MOT*	*TMT*	*ANX*	*CON*	*INP*	*SMI*	*STA*	*SFT*	*TST*
June 2003 Aggregate	0.06	0.13	0.06	0.30**	0.14	-0.06	0.06	-0.01	0.05	0.06
December 2002 Aggregate	0.20*	0.39**	0.25*	0.36**	0.33**	0.14	0.19	0.30	0.11	0.27**

*p<.05 level ** p< .01 level (N=100)

According to Table 3.8 above, the only subscale of the LASSI which was significantly correlated ($p < 0.01$) with the students' June performance is the Freedom from Anxiety Scale. With regard to the students' December performance, the significantly correlated LASSI subscales were Motivation, Freedom from Anxiety, Concentration, and Testing Strategies, all at the

$p < 0.01$ level. The Attention and Task Management subscales were correlated with December performance at the $p < 0.05$ level. As previously mentioned, the June results are more temporary and therefore the December results seem to be more significantly correlated with the measures.

3.5 Multiple Regression Analyses

Stepwise multiple regression analyses were used to establish the contribution of the independent variables to the variance in the dependent variable. Stepwise multiple regression analysis was decided upon as a suitable method for understanding the manner in which all the variables are interrelated. Furthermore, it is useful in determining the relative power of the five measures in predicting academic performance of the Chemical Engineering students. Stepwise multiple regression analysis starts by taking all the available predictor variables and then first selects the variables with the largest significant R-Square value. After this variable has been accounted for, the significance of the remaining variables are recalculated and then the next largest variable is selected, until there are no more variables that are able to make a significant contribution. Through this process, forward stepwise multiple regression analysis results in the isolation of only those variables that make a significant contribution to the explanation of variance, while those that don't make a significant contribution are excluded from the regression equation (Rosenthal & Rosnow, 1996). Stepwise multiple regression was chosen as opposed to hierarchical regression, because there was no hierarchical model which the researcher used to fit the data, and it was exploratory.

3.5.1 *Prediction of June Aggregate from the CSEI, LCI, RAPM, Organiser and the LASSI subscales*

Since significant correlations emerged between some of the measures and academic performance (refer to Tables 3.7 and 3.8), as a further step, all of these variables were analysed with stepwise regression analysis to investigate which could predict the June and December aggregate. In terms of the *June aggregate,* only the Freedom from Anxiety subscale was a significant predictor ($F = 9.78$; df: 1; $p < 0.05$) and accounted for an 8 percent explanation of the variance in the scores.

3.5.2 *Prediction of December Aggregate from the CSEI, LCI, RAPM, Organiser and the LASSI subscales*

The stepwise regression was run in order to investigate the relationship between the variables, Organiser, LASSI, RAPM, LCI, and CSEI with the *December aggregate.* Table 3.9 illustrates this.

Table 3.9: Results of the Stepwise Regression Analysis

Predictor(s)	*Partial R^2*	*Model R^2*	*F*
Motivation subscale predicting the December Aggregate	.15	.15	17.34**
Freedom from Anxiety subscale predicting the December Aggregate	.07	.22	8.89**
Autonomy predicting the December Aggregate	.04	.26	4.36*

* $p < 0.05$ ** $p < 0.01$

As seen in Table 3.8 (p.49), the Motivation, Anxiety, Concentration and Testing Strategies from the LASSI and the Autonomy Control subscale from the LCI significantly correlated with the *December aggregate,* (.r = 0.39; 0.36;

0.33; 0.27; 0.20). The stepwise regression analysis yielded significant prediction of the *December aggregate* by the Motivation scale of the LASSI ($F = 17.34$; $df = 1$; $p < 0.01$, which accounted for 15 percent of the variance), Freedom from Anxiety scale of the LASSI ($F = 8.89$; $df = 1$; $p < 0.05$, which accounted for a further 7 percent of explained variance), and the Autonomy scale of the LCI ($F = 4.36$; $df = 1$; $p < 0.05$ and accounted for a further explained 4 percent of the variance). In total, 26 percent of variance in the December 2002 marks was accounted for by these three measures altogether. Although this represents a material contribution, it indicates that 74 percent of the variance is accounted for by other factors, not included in the present study. This is discussed in more detail in Chapter 4.

3.6 Performance on Measures in Terms of Division of Scores

The class was divided into three groups of Top, Middle and Bottom scorers, according to their December academic performance. This division was done to enable the prediction of high, average and low achievers. Thus, the top third (n=33) constituted the High performing group, the middle 33 performers of the class -the Middle group, and the 34 lowest scorers-the Low group. Differences between these groups on each of the variables (RAPM, Organiser, CSEI, LCI and LASSI) were investigated using Analysis of Variance (ANOVA). Furthermore, where significant differences were found, Fischer's Least Statistical Difference (LSD) technique was used to determine which levels differed significantly from one another. As only one significant correlation was found between the June 2003 results and the independent variables, only the December 2002 results are included in these analyses.

Table 3.10: Performance of Top, Middle and Low students on the RAPM, Organiser, CSEI & LCI, Based on December Scores Division

DF=2	Top (n.=33)		Middle (n.=33)		Bottom (n.=34)		F
	Mean	SD	Mean	SD	Mean	SD	
RAPM	108.90	7.90	107.60	10.30	109.10	9.10	0.26
Organizer	17.70	2.90	16.10	4.10	17.30	3.60	1.96
CSEI	74. 18	17.09	70.78	17.67	66.82	19.41	1.38
Internal	151.8	13.80	149.40	12.04	151.30	16.10	0.25
External	73.78	18.9	81.84	22.20	83.23	19.04	2.14
Autonomy	138.54	14.93	133.09	16.07	128.88	19.45	2.73

* p < .05 **p<0.01 (N=100)

Table 3.10 illustrates that no significant differences were found among the variables shown in the table.

Table 3.11: Performance of Top, Middle and Low Students on the LASSI Based on December Scores Division

DF=2	Top (n.=33)		Middle (n.=33)		Bottom (n.=34)		F
	Mean	SD	Mean	SD	Mean	SD	
MOT	32.80	3.6	29.10	3.9	28.40	3.7	13.11*
ANX	28.70	5.0	25.00	5.3	23.40	4.9	9.09*
ATT	35.20	3.5	34.60	3.1	32.50	4.0	5.25*
TMT	28.06	4.6	25.45	4.8	23.83	6.1	5.43*
CON	30.60	4.4	27.70	5.2	25.80	6.6	6.56*
INP	28.60	4.8	27.70	4.7	27.70	3.7	0.46
SMI	19.27	2.7	18.42	2.6	17.82	3.1	2.17
STA	24.60	4.0	25.30	5.4	24.20	4.8	0.51
STF	28.03	6.1	25.69	6.5	25.60	4.9	1.80
TST	32.12	5.1	29.93	5.5	29.13	4.4	3.15*

* p < .05 **p<<0.01 (N=100)

Table 3.11 indicates that significant statistical differences were found as a function of level of academic performance on Motivation, Anxiety, Attitude, Task Management, Concentration and Testing Strategies. Specifically, the Fisher's Least Significant Difference (LSD) Technique differentiated the following group in each:

- *Motivation:* The High achieving group was significantly better than both the Middle and the Low achieving groups.
- *Anxiety:* The Fisher's LSD yielded significant differences between the High and Low groups.
- *Attitude:* The Fisher's LSD yielded significant differences between the High and Low groups, and between the Middle and Low groups.
- *Concentration:* The Fisher's LSD yielded significant differences between the High and Middle groups, and the High and Low groups.
- *Testing Strategies:* The Fisher's LSD differentiated the High from the Low groups.
- Task Management: The Fisher's LSD differentiated the High from Middle groups and High from the Low groups.

Figure 3.1 illustrates the differences described above.

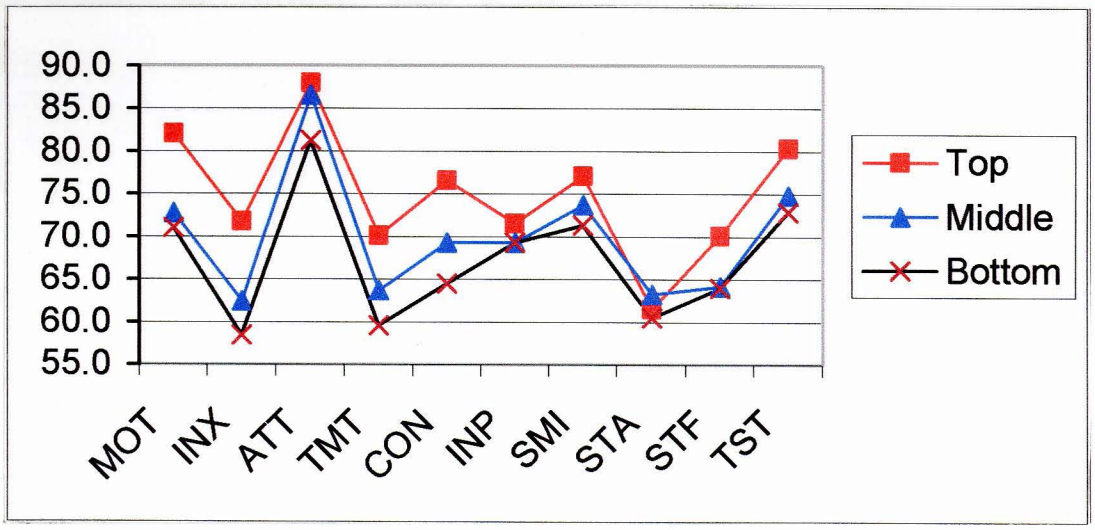


Figure 3.1: Differences between the Top, Middle and Bottom Scorers on the LASSI

As can be seen in Figure 3.1, in all instances, where there were significant differences on the LASSI, the top group scored higher than the middle group, and the middle group higher than the low group. The only exception was Study Aids, where the middle group scored slightly higher than the top group.

3.7 Conclusion to Results

In conclusion, a number of significant results were yielded. Firstly, correlation matrices between the independent variables (Organiser, CSEI, RAPM, LCI & LASSI) yielded some significant correlations. Secondly, the Freedom from Anxiety subscale of the LASSI was the only measure that correlated with the June 2003 results. Furthermore, the Motivation, Freedom from Anxiety, Concentration, Testing Strategies, Attention and Time Management subscales of the LASSI, and the Autonomy Control subscale of the LCI were significantly correlated with December 2002 results. Thirdly, a stepwise regression analysis revealed that anxiety accounted for only 8 percent of the variance in the June 2002 scores. Motivation (15%), Freedom from Anxiety (7%) and Autonomy (4%) accounted for 26 percent of the variability in the final December 2003 scores. Finally, significant statistical differences between the Top, Middle and Bottom scoring students were found on the LASSI scales of Motivation, Anxiety, Task Management, Concentration and Testing Strategies.

Chapter 4 discusses the implications of the results in relation to the literature review, gives limitations of the study, and outlines ideas for future research. Finally, the summary and conclusions of the study are presented.

CHAPTER 4: DISCUSSION

4.1 Interpretation and Implications of the Findings

The current study examined the relative contribution of intelligence, learning strategies, locus of control, and self-esteem to engineering students' academic performance. The research was guided by a specific set of hypotheses, which pertained to each of the five variables described above, and all the variables in combination. The results are firstly discussed with reference to these hypotheses. Thereafter, the general implications of the study are considered, and the limitations and suggestions for future research are outlined. Finally, the summary and conclusions of the study are presented.

The first hypothesis suggested that intelligence (as measured by the RAPM and the Organiser) is significantly related to academic performance in second year Chemical engineering. However, the results of the correlational analyses demonstrate that intelligence was not significantly related to academic performance in this group. Furthermore, students who had higher levels of intelligence did not perform significantly better academically in the examinations than those with lower levels. This could be understood by seeing the RAPM and the Organiser as having ceiling effects with these engineering students. Indeed, this was a highly attenuated sample, with little variance between the scores on the RAPM, and the Organiser. The students had gone through a strict selection process to be accepted into engineering in the first place, and now had further passed first year. In other words, above a certain intellectual level, the RAPM and Organiser may not be significantly predictive of academic success. The present study therefore did not replicate the findings of the Rushton et al. (2002) study, which found the RAPM to have high predictive validity in relation to academic performance. However, considering that the current sample is second year (and thus more advanced than the first-year sample), more homogeneous in terms of RAPM and IQ

scores, and smaller, than the sample in the Rushton et al. study (2002), it is not surprising that the correlates were low in the present study. Furthermore, in another very recent study (Magangane, 2003), results indicated no significant relationship between the RAPM and end of the year academic results for first year engineering students. Due to the nature of the attenuated sample and the results yielded on the RAPM, no further conclusions regarding the prediction of intelligence *(g)* can be made.

The second hypothesis proposed that learning strategies and study attitudes (as measured by the LASSI) would be related to academic performance. Indeed, the results indicated that certain learning strategies were related to academic performance. Those learning strategies that were significantly related to December academic achievement included freedom from anxiety, motivation, concentration, testing strategies, attention and time management. More specifically, the Motivation and Freedom from Anxiety subscales were found to be particularly significant in predicting the December 2002 results. In addition, significant differences were found between the top scoring students and bottom scoring students in terms of the latter two LASSI subscales. This could be because students with high motivation prepare for exams better, and are diligent, while those with less anxiety have a calmer approach towards the exams, and are better able to focus during the exams. It was interesting to note that the broad category of **Motivation** included the three subscales of Motivation, Freedom from Anxiety and Attitude. Further, the broad category of **Self-Management** included the subscales of Time Management and Concentration Therefore, two of the three scales of the motivation category; and both categories of the self-management category seem important for academic success.

The Motivation subscale in particular was found to be the best predictor of student achievement in three studies (Oxford, Park-Oh, Ito & Sumrall, 1993a; ibid, 1993b; Sinkavich, 1991) that investigated factors influencing achievement.

The Motivation subscale of the LASSI focuses on the student's level of diligence, self-discipline and willingness to work hard at university. Moreover, in a study on predicting student's academic success with the LASSI, Hendrickson (1997) found that motivation and attitude were the two best predictors of student grade point average. In a further study (Shih & Gamon, 1995) motivation was the only significant variable for the explanation of variance in achievement scores at the tertiary level. In yet another study, motivation was the only LASSI scale to be correlated with high academic performance (Lipsky, 1995). Several researchers (Garcia, 1995; Pintrich 1995) believe that students should monitor their learning motivation, and use motivational strategies for active involvement in learning. Indeed, the present study confirms that motivation is possibly the most important factor to consider. Furthermore, motivation appears to be more important than intelligence for academic success in second year for engineering students.

Freedom from anxiety seems to be another important factor influencing academic success in the current study. It was the only factor found to be significantly correlated with both June 2003 and December 2002 exam performance. The Freedom from Anxiety subscale examines the degree to which a student worries about university and university performance (Haught et al., 1998). However, no other studies involving the LASSI, have found it to be significantly correlated with academic performance. It is logical that while a certain amount of anxiety may be good, the greater freedom from anxiety a student has, the better his/her results are likely to be.

According to the third hypothesis, the Internal Control and Autonomy Control Scales of the LCI were expected to be significantly related to academic performance. This is supported by the findings of previous studies (Allen et al., 1974; Schedk & Rhodes, 1980 cited in Burkhalter, 1995; Schepers, 1995). However, the results of the current study revealed that only the Autonomy Control Scale is significantly related to academic performance among second

year engineering students. The Autonomy Control Scale adds a third dimension to the understanding of locus of control, and provides insight into the self-confidence, personal initiative and independence of an individual, whereas the Internal Control Scale refers to the degree of personal responsibility that a person exhibits (Schepers, 1995). The findings could suggest that good performance in the exams is related to the ability to work independently, show initiative and be confident in one's responses, and reflect understanding of the material studied, as opposed to the performance being related to the students' feelings of personal responsibility for success in exams. In other words, the Autonomy Control scale could be reflective of a more practical approach to studying, as opposed to a state of mind (Internal Control scale). It is interesting to note that the Autonomy scale is not usually part of a locus of control inventory, rather that it was a component added by Schepers (1995) to Rotter's original (1966) Locus of Control Inventory. Schepers (1995) designed a new measure of locus of control, after claiming that factor analyses of his inventories revealed three factors; namely, autonomy, internal control and external control. Corresponding to these factors, three scales were constructed for the LCI, namely Autonomy Control Scale, Internal Control Scale and External Control Scale. It thus seems that it is more important to be autonomous than have an internal locus of control. In support of this addition, Feuerstein (1980) reflects on the importance of the "Autonomous Thinker", who is a person capable of independent thought, and therefore capable of cognitive modifiability.

Self-Esteem (assessed by the CSEI) was not found to be significantly correlated with academic performance. This is inconsistent with some previous research findings (Mruk, 1995; Mwamwenda, 1995; Purkey, 1970), which have illustrated a relationship between self-esteem and academic performance. Furthermore, in the present study, the Autonomy Control Scale (of the LCI) and Self-Esteem Scales were significantly correlated, and since the Autonomy Scale was also found to be significantly related to academic

performance, it was expected that Self-esteem would also have a significant correlation with academic success. However, it must be noted that many other studies (Filozof et al., 1998; Moeller, 1994; Singg & Farquhar, 2003) have not found a relationship between self-esteem and academic performance, and so the findings are conflictual in this regard. Self-esteem is a complex concept, for example, some individuals with lower self-esteem may strive harder if they have a hardy temperament. Self-esteem may also be assessed by vastly differing measures, which may account for the different results. The CSEI itself also has weaknesses, including the uncontrolled variable of social desirability, which may limit its validity.

In terms of the last hypothesis which proposed that all of the variables together would contribute more than each variable individually to academic performance, Motivation (LASSI), Freedom from Anxiety (LASSI), and Autonomy (LCI) were found to account for 26 percent of the variance in academic performance. This indicates that two variables from the LASSI and one variable from the LCI made a significant contribution to the variance. However, it also demonstrates that the other variables (RAPM, Organiser, CSEI, and other LASSI variables) did not make a significant contribution to the variance in academic performance. Furthermore, it indicates that 74 percent of the variance is not accounted for by the measures used in this study. It thus seems that other factors may account for the unexplained variance in predicting academic performance. This could involve factors such as demographic factors, including home language and/or other aptitudes, such as technical ability. In addition, school performance could be another important factor influencing performance. As was discussed in the literature review, a study by Van Eeden et al. (2001) found that Grade 12 (Matriculation) results were the best predictor of academic achievement in first year engineering and technology students. Magangane (2003) also found a high, significant correlation between the first year subjects' matriculation results and their first year final academic results. However, as discussed in

the Literature Review (Chapter 1), mixed results have been obtained on this front, probably as a result of the discrepancies experienced in education due to unequal opportunities during Apartheid (Burden, 1995; Nkabinde, 1993). Also, whereas the two above mentioned studies pertained to first year engineering students, the present study examined second year engineering students.

4.2 General Implications

There is consensus in the literature that the RAPM has the ability to measure *g* (Jensen, 1998; Raven et al., 1996). In addition, it has been asserted that the RAPM measures visuo-spatial ability to some extent (Carpenter et al., 1990; Raven et al., 1996), which presumably is an important skill for success in an engineering course. However, studies seem to be inconclusive regarding the predictive validity of the RAPM with regard to academic performance. While certain previous studies (Raven et al., 1996; Rushton et al., 2003) suggest that the RAPM has predictive validity (particularly with the engineering students), it is also suggested that the predictive validity of the RAPM is low (Skuy et al., 2002; Strouss, 2003), and that other factors are likely to be stronger predictors of success for these students. The current study indicated that the RAPM was also not predictive of engineering students' academic performance. The lack of predictive ability found within this sample could be attributable (as mentioned previously) to the idea, that above a certain level of intelligence, there is not much discrimination in performance on the RAPM. In other words, this is a highly selected group of students, who achieved very high matriculation results, and that intellectually, there is not a great difference between them. It seems that the Organiser presents a similar situation. The RAPM and the Organiser are two unidimensional measures of intellectual functioning, and possibly a different, more positive relationship would have emerged using other intellectual tests that measure broader aspects of intelligence.

In the present study, intelligence did not contribute to academic success in any meaningful way. Furthermore, the Internal Control and External Control scales of the LCI, and self-esteem also did not appear to be significant predictors of academic performance. This contradicts several studies (Allen et al., 1974; Schedk & Rhodes, 1980, cited in Burkhalter, 1995; Schepers, 1995), where these factors did play important roles. Motivation (LASSI subscale) accounted for the greatest amount of explained variance (15 percent) in the prediction of academic performance. This was followed by the LASSI subscale of Freedom from Anxiety (accounting for 7 percent of the explained variance) and the LCI scale of Autonomy (which accounted for 4 percent of the explained variance).

In conclusion, in the current study, cognitive processes (for example, motivation) seem to have contributed more than intelligence, self-esteem or locus of control to academic success for engineering students. Haywood and Switzky (1992) conceptualize intelligence and cognitive processes as different but complementary constructs. According to these authors, the assessment of intelligence measures achievement and products of learning. Intelligence is seen to comprise intellectual aptitudes, such as verbal and spatial ability. On the other hand, cognitive processes are seen as needing to be taught and learnt. These processes have high modifiability potential- with teaching and mediation being involved. Cognitive abilities are a mixture of work habits, motivation, attitudes and strategies. In the present study, cognitive processes were found to be very important for second year engineering students, and thus need to be considered in relation to academic success at this level.

4.3 Limitations of the Study and Suggestions for Future Research

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

The focus of the present study was on examining second year students' mid-year (June) academic results. However, whereas December examination results are cumulative, the June results are both summative and cumulative. Students need the time to both absorb the material and study for the end of the year examinations, and the prediction of mid-year results is therefore very tenuous. Furthermore, the measures were found to be more highly correlated with the December 2002 results than the June 2003 results. This introduces the possibility that students' performance on the December 2002 examinations played a role in determining how they performed in the June 2003 examinations. For example, those who did better in December 2002 examinations may have been more motivated and confident in the June 2003 examinations. Therefore, the December 2002 results could also have been used as an independent variable.

The current study examined second year Chemical Engineering students, and the sample obtained was very representative of this particular branch of engineering (93 percent). However, as previously mentioned, this was a highly attenuated sample with small variance. It would also have been interesting to look at other branches of engineering (for example, Electrical and Information Engineering, Mining Engineering, Civil Engineering), as these other branches require different skills and abilities, and there would have therefore been greater variance.

A third limitation may pertain to the demographic variables of the sample. Although the study included a comprehensive approach to the prediction of academic success, background variables were not included as covariates in the analyses. For example, educational background, language and socio-economic status were not taken into account in the analyses for the current study, and may have influenced the findings. However, the intention of the study was to focus on pure mental and cognitive measures, independent of the students' background.

Related to the third limitation is the issue of race. As discussed in the literature review, South Africa is comprised of a diverse population, and people of different races have been exposed to very different educational experiences due to the Apartheid System. The current study examined the predictive value of the variables on the sample as a whole. However, it would be informative and important to explore whether the effects were different for each race group. For example, due to the oppressive and disempowering nature of Apartheid, African students may have lower self-esteem than White students. Similarly, the effect of gender could also have been investigated,, although the sample was skewed in this respect - with 36 percent females and 64 percent male students.

English as a medium of instruction is important to consider. The RAPM was administered without administering an English vocabulary test alongside it. However, although the English instructions may have been ambiguous for a few students, it must be considered that the second year engineering students have to have a reasonable level of English. This is due to matriculation examinations, the medium of instruction in engineering, and university examinations being in English.

A further limitation pertains to the non-intellectual measures, namely the LASSI, CSEI, and LCI. These are all self-report measures, and the students

may have felt pressure to give socially acceptable responses. This may especially have been the case, since the research was carried out at the university, and the students may have been concerned about being assessed.

Although five measures were used in the study, other measures could have been included. For example, Matric results, a measure of technical ability, other measures of reasoning ability (e.g. the *Similarities* subtest of the *WAIS III*), aptitude tests, and career questionnaires.

These limitations allow for the consideration of various suggestions for future research, which could improve on the existing study.

Firstly, a longitudinal study involving the same aims as the present study could be undertaken. In other words, the predictive value of the measures used in the current study, could be explored over a number of years. This would enable the researcher to see whether there are trends. A longitudinal study, tracking the same subjects, could determine the effects of various personality factors on academic performance, and the effects of academic performance's affects on personality variables such as self esteem. Longitudinal studies allow for the identification of the causes and effects of academic success.

Since one of the features of cognitive processes is that they can be modified (Haywood & Switzky, 1992), this suggests the value of mounting a study which improves these cognitive processes and assesses the effects of this on personality factors and academic performance, in other words, having an intervention with control and experimental groups.

If the current study were to be replicated, it should include a more representative sample of engineering students in South Africa. For example, the study could be replicated with all the branches of engineering at the

University of the Witwatersrand. Furthermore, it could also be replicated in other South African universities, as well as overseas universities. This would serve to identify the significance of non-intellective factors as predictors of academic performance universally, and allow for greater generalisability of the results.

Finally, a comparison could be made between the role of intellectual factors, personality factors, matriculation results and background factors in engineering, and in other fields of study.

4.4 Summary and Conclusions

This study afforded a more comprehensive approach to the prediction of academic success in the field of engineering than has previously been undertaken. A clean set of psychological measures, regardless of demographic variables or previous academic performance at tertiary level, was used. More specifically, a multifaceted battery- including the RAPM and Organiser and measures of personality (LCI and CSEI) and study strategies (LASSI) was administered. The results indicated that in an attenuated sample of second year students, non-verbal intelligence, IQ and reasoning ability were not significant factors in predicting academic performance. Rather, motivation, freedom from anxiety, and autonomy appeared to be significant factors impacting on academic performance. This implies that the less anxious, more motivated, and more independent an engineering student is, the better he/she may perform academically. The study also indicates that it is unrealistic to attempt to predict academic performance at midyear (June), based solely on the five psychological measures used in the study, due to the nature of the assessment taking place at this time of the academic year (summative and cumulative).

REFERENCES

Adelman, H.S & Taylor, L. (1983). *Learning Difficulties in Perspective.* Illinois: Freeman and Co.

Albaili, M.A. (1997). Differences among low-average and high achieving college students on learning and study strategies. *Educational Psychology,* 17 (1), 1-16.

Allen, G.J., Giat, L. & Chemey, R.J. (1974). Locus of control, test anxiety, and student performance in a personalized instruction course. *Psychology Reports,* 29, 723-729.

Baumeister, R.F. (1993). *Self-Esteem: The Puzzle of Low Self-Regard.* New York: Plenum Press.

Behr, D. (1982). The prediction of academic performance of first year engineering students. *South African Journal of Education,* 2, 89-95.

Binet, A. & Simon, T. (1905). Methodes nouvelles pour le diagnostic du niveau intellectual des anormaux. *L'Annee Psychologique,* 11, 191-244.

Boekaerts, M. (1997). Self-regulated learning: A new concept by researchers, policy makers, educators, teachers and students. *Learning and Instruction,* 7 (2), 161-186.

Bothma. A.C. & Schepers, J.M. (1997). The role of locus of control and achievement motivation in the work performance of black managers. *Journal of Industrial Psychology,* 23(3), 44-52.

Brooks, D.W. (1997). *Web Teaching: A Guide to Designing Interactive Teaching for the Worldwide Web.* New York: Plenum Press.

Burden, A. (1995). Inclusion as an educational approach in assisting people with disabilities in South Africa. *Educare,* 24, 44-56.

Burkhalter, T. (1995). *An evaluation of a youth counselling programme incorporating Feuerstein's concept of Mediated Learning Experience.* Unpublished Master's Research Report University of Witwatersrand, Johannesburg.

Campbell, J. D., & Lavallee, L.F. (1993). Who am I: The role of self-concept confusion in understanding the behavior of people with low self-esteem. In R. Baumeister (Ed.). *Self-Esteem: The Puzzle of Low Self-Regard* (pp.3-19). New York: Plenum Press.

Carpenter, P.A., Just, M.A. & Shell, P. (1990). What one intelligence test measures: A theoretical account of the processing in the Raven Progressive Matrices Test. *Psychological Review,* 97 (3), 404-431.

Carroll, J.B. (1997). Psychometrics, intelligence and public perception. *Intelligence,* 24, 1, 25-52.

Cattell, R.B. (1963). Theory of fluid and crystallized intelligence: A critical experiment. *Journal of Educational Psychology,* 54, 1-22.

Chan, J. (1989). The use of Ravens Progressive Matrices in Hong Kong. A critical review. *Psychological Test Bulletin,* 2 (2) 40-45.

Coetzer, E.L., & Schepers, J.M. (1997). Die verband tussen lokus van beheer en die werksprestasie van swart bemarkers in die lewensversekeringsbedryf. *Industrial Psychology,* 23, 34-41.

Coopersmith, S. (1967). *The Antecedents of Self-Esteem.* San Francisco: W.H Freeman.

Coopersmith, S. (1975). *Self Esteem Inventory Manual.* Lafayette, C.A: Self Esteem Institute.

Coopersmith, S. (1990). *Self-Esteem Inventories.* Palo Alto, C.A: Consulting Psychologists Press.

Crump, B.R., Hickson, J.H & Laman, A. (1985). Relationship of locus of control to achievement and self-concept in education majors. *Psychological Reports,* 57, 1055- 1060.

Culverwell, D. (1989). *Learning strategies and academic Success of Undergraduate Art Students.* Unpublished Master's Research Report. University of the Witwatersrand, Johannesburg

Daniels, R.L., & Stevens, J.P. (1976). The interaction between the internal-external locus of control and two methods of college instruction. *American Educational Research Journal,* 13(2), 103-113.

Durbin, D. M. (1982). Multimodal group sessions to enhance self-concept. *Elementary School Guidance and Counseling,* 16, 288-295.

Duttweiler, P. (1984). The internal control index: A newly developed measure of locus of control. *Educational and Psychological Measurements,* 44, 209-221.

Educational Testing Service. (1998). *Graduate Record Examinations: Guide to the Use of Scores.* Princeton, N.J: Educational Testing Service.

Entwistle, N.J & Wilson, J.D. (1970). Personality, study methods and academic performance. *University Quarterly,* 24(1), 147- 156.

Feuerstein, R. (1980). *Instrumental Enrichment.* Glenview, Illinois: Scott Foresman.

Feuerstein, R & Feuerstein, S. (1991). Mediated Learning Experience: A theoretical review. In R. Feuerstein, P. Klein, A Tannenbaum (Eds.). *Mediated Learning Experience: Theoretical, Psychosocial and Learning Implications* (pp.3-52). London: Freud Publishing House, Ltd.

Feuerstein, R., Rand, Y & Hoffman, M.B (1979). *The Dynamic Assessment of Retarded Performers: The Learning Potential Assessment Device, theory, instruments and techniques.* USA: Scott, Freeman & Co.

Filozof, E.M., Albertin, H.K., Jones, C.R., Steme, S.S., Myers, L & McDermott, P.J. (1998). Relationship of adolescent self-esteem to selected academic variables. *Journal of School Health,* 68(2), 68-72.

Findley, M.J. & Cooper, H.M. (1983). Locus of control and academic achievement: A literature review. *Journal of Personality and Social Psychology,* 44 (2), 419-427.

Flippo, R.F & Caverly, D.C. (1991). *Teaching Reading and Study Strategies.* USA: International Reading Association, Inc.

Garcia, T. (1995). The role of motivational strategies in self-regulated learning. In R.J Menges & M.D Svinicki (Eds.). *Understanding Self-Regulated Learning. New Directions for Teaching and Learning* (pp.29-42). San Francisco: Jossey-Bass Publishers.

Garcia, T. & Pintrich, P.R. (1994). Regulating motivation and cognition in the classroom: The role of self-schemas and self-regulating strategies. In D.H Schunk and B.J Zimmerman (Eds.). *Self-Regulation of Learning and Performance: Issues and Educational applications* (pp 127- 153). Hillsdale, N.J: Erlbaum.

Gordon, T. (1974). *Teacher Effectiveness Training*. New York: Peter H Wyden.

Gottfredson, L.S. (1997). Mainstream science on intelligence. An editorial with 52 signatories, history and bibliography. *Intelligence*, 24 (1), 13-23.

Grieve, K.W & Viljoen, S. (2000). An exploratory study of the use of the Austin maze in South Africa. *South African Journal of Psychology*, 30(3), 14-18.

Gustafsson, J.E. (1994). General Intelligence. In Sternberg, R.J. (Ed). *Encyclopedia of Human Intelligence*, Vol 1 & 2 (pp469-477). New York: MacMillan Publishing Company.

Haught, P.A., Hill, L., Walls, R.T & Nardi, A.H. (1998). Improved Learning and Study Strategies Inventory (LASSI) and academic performance: The impact of feedback on freshman. *Journal of the First-Year Experience*, 10(2), 25-40.

Haywood, H.C. (1988). Dynamic Assessment: The Learning Potential Assessment Device. In R.L. Jones (Ed.). *Psychoeducational Assessment of Minority Children: A Casebook* (pp.39-63). New York: Cobb & Henry.

Haywood, H.C & Switzky, H.N. (1992). Ability and modifiability? What, how and how much? In Carlson, J. (Ed.). *Advances in cognition and educational practice* (pp. 45-52) . Connecticut: J.A.I Press.

Hendrich, U.G. (2002). *Learning Strategies and locus of control as predictors of academic success.* Unpublished Master's Research Report. University of the Witwatersrand, Johannesburg.

Hendrickson, A.B. (1997). *Predicting student success with the Learning and Study Strategies Inventory (LASSI).* Unpublished Master's Thesis. Iowa State University, Ames, IA.

Ismail, M & Wai Kong, N.G. (1985). Relationship of locus of control, cognitive style, anxiety and academic achievement of a group of Malaysian primary school children. *Psychological Reports,* 57, 1127- 1134.

Jensen, A.R. (1980). *Bias in Mental Testing.* New York: Free Press.

Jensen, A.R. (1998). *The g Factor. The Science of Mental Ability.* London: Praeger.

Joe, V. C. (1971). External-internal control construct as a personality variable. *Psychology Reports,* 28, 19-640.

Jones, B & Bell, J. (1980). Handedness in engineering and psychology students, *Cortex,* 16, 521-625.

Keat, D. (1974). *Fundamentals of Child Counseling.* Boston: Houghton Mifflin.

Krantz, M & Friedberg, J. (1986). Locus of control and leadership in children. *Psychological Reports*, 59, 871- 874.

Lefcourt, H.M. (1982). *Locus of Control: Current Trends in Theory and Research.* Hillsdale, N.J: Erlbaum.

Lefcourt, H. M. & G. W. Ladwig. (1965). The American Negro: A Problem in Expectancies. *Journal of Personality and Social Psychology*, 1, 377–80.

Lipsky, D. (1995). National study on inclusion: Overview and Summary Report. *Bulletin of the NCERI.* 2(2), 6-7.

Lohman, D.F. (1994). Spatial Ability. In Sternberg, R.J. (Ed.). *Encyclopedia of Human Intelligence,* Vol 1 & 2 (pp.1000-1007). New York: Macmillan Publishing Company.

Magangane, D.P. (2003). *Relationship among school background, intellectual functioning and academic performance of engineering students at university.* Unpublished Master's Research Report. Johannesburg, South Africa.

McKeachie, W.J., Pintrich, P.R & Lin, Y. (1985). Teaching learning strategies. *Educational Psychologist*, 20, 153-160.

McMahon, M & Luca, J. (2001). Assessing students' self-regulatory skills. In M McMahon and J. Luca (Eds.). *Meeting at the Crossroads* (pp.427-434). Canberra: Australian Publishing Service.

Moeller, T.G. (1994). What research says about self-esteem and academic performance. *Education Digest*, 59(5), 34-39.

Mruk, CC. (1995). *Self-esteem: Research, Theory and Practice.* USA: Springer Publishing Company, Inc.

Murray, H.B. & Staebler, B.K. (1972). Effects of locus of control and pattern performance on teacher's evaluation. *Proceedings of the American Psychological Association,* 7, 569-570.

Mwamwenda, T.S (1995). *Educational Psychology: A South African Perspective* (2nd Ed). Johannesburg: Butterworth Publishers LTD.

Nist, S.L., Mealey, D.L., Simpson, M.L. & Kroc, R. (1990). Measuring the affective and cognitive growth of regularly admitted and developmental studies students using the Learning and Studies Strategies Inventory. *Reading Research and Instruction,* 30, 44-49.

Nkabinde, Z.P. (1993). The role of special education in a changing South Africa. *The Journal of Special Education,* 27, 107-114.

Nolan, R.F; Dai, Y & Smith, J.N. (2003). *Self-esteem reported by African-American students enrolled in North Louisiana middle schools.* Paper given at Louisiana State University.

Nunns, C. & Ortlepp, K (1994). Exploring predictors of academic success in Psychology I at Wits University as an important component of fair student selection. *South African Journal of Psychology,* 24(4), 201-207.

Owen, K. (1992). The suitability of Ravens Progressive Matrices for various groups in South Africa. *Personality and Individual Differences,* 13 (2) 149-159.

Owen, K. (1998). *The Role of Psychological Tests in Education in South Africa: Issues, Controversies and Benefits.* Pretoria: Human Sciences Research Council.

Oxford, R., Park-Oh, Y., Ito, S., & Sumrall, M. (1993a). Factors affecting achievement in a satellite-delivered Japanese language program. *American Journal of Distance Education,* 7 (1), 1-6.

Oxford, R., Park-Oh, Y., Ito, S., & Sumrall, M. (1993b). Learning a language by satellite television: What influences student achievement? *System,* 21 (1), 31-48.

Paterson, C.C. (1993). *An experimental study of self-regulated learning in Biology with special reference to instructional control, locus of control, and academic performance.* Unpublished Master's Research Report. University of Cape Town, Cape Town.

Pintrich, P. R. (1995). *Understanding Self-Regulated Learning. New Directions for Teaching and Learning* . San Francisco: Jossey – Bass Publishers.

Pintrich P.R & De Groot, E.V. (1990). Motivational and Self-regulated learning components of classroom performance. *Journal of Educational Psychology,* 82 (1), 33-40.

Potter, C.S. & Jamotte, A.W. (1985). African matric results. *Indicator S.A,* 13, 135-142.

Potter, C.S., Van der Merwe & Kemp, A.R (1987). Increasing Pass Rates. *South African Journal of Higher Education,* 1 (1), 91-98.

Prus, J., Hatcher, L., Hope, M & Grabiel, C. (1995). The Learning and Study Strategies Inventory (LASSI) as a predictor of fist year college academic success. *Journal of the Freshman Year Experience,* 7(2), 7-26.

Purkey, W.W. (1970). *Self Concept and School Achievement.* New Jersey: Prentice-Hall, Inc.

Rademeyer, M.M & Schepers, J.M. (1998). Voorspelling van die akademiese sukses van eerstejaardstudente. *Tydskrif vir Bedryfsielkunde,* 24 (1): 33-40.

Rand, Y & Kaniel, S. (1987). Group administration of the LPAD. In C.S Lidz (Ed.). *Dynamic Assessment: An Interactional Approach to Evaluating Learning Potential.* New York: The Guilford Press.

Raven, J. (2000). The Ravens Progressive Matrices: change and stability over culture and time. *Cognitive Psychology,* 41, 1-48.

Raven, J.C., Court, J.H & Raven, J. (1996). *Raven Manual: Section 3. Standard Progressive Matrices: 1996 Edition.* Oxford: Oxford Psychologists Press Ltd.

Raven, J., Raven, J.C & Court, J.H. (1998a). *Manual for Raven's Progressive Matrices and Vocabulary Scales: Section I, General Overview.* Oxford: Oxford Psychologists Press Ltd.

Raven, J., Raven, J.C & Court, J.H. (1998b). *Raven Manual: Section 3. Advanced Progressive Matrices: 1998 Edition.* Oxford: Oxford Psychologists Press Ltd.

Reck, U.L. (1980). Self-concept, school and social setting: A comparison of rural Appalachian and urban non-Appalachian sixth graders. *Journal of Educational Research,* 74, 49-54.

Reisman, J. (1985). Friendship and its implications for mental health or social competence. *Journal of Early Adolescence,* 5, 383-391.

Rogers, C.R. (1961). *On Becoming a Person.* Boston: Houghton Mifflin.

Rogers, C.R. (1969). *Freedom to Learn.* Columbus, O.H: Merrill.

Rosenthal, R & Rosnow, R.L. (1996). *Essentials of Behavioural Research: Methods and Data Analysis* (3rd Ed). USA: McGraw-Hill, Inc.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied,* 80 (1), 609-700.

Rufus, K. (1984). *Locus of control among coloured, Indian and White Student teachers.* Unpublished Master's Research Report. Johannesburg: South Africa.

Rushton, J.P. (1998). The "Jensen Effect" and the Spearman-Jensen Hypothesis of Black-White IQ Differences. *Intelligence,* 26(3), 217-225.

Rushton, J.P & Skuy, M. (2000). Performance on Raven's Matrices by African and White University students in South Africa. *Intelligence,* 28(4), 251-265.

Rushton, J.P., Skuy, M. & Fridjhon, P. (2002). Jensen effects among African, Indian and White engineering students in South Africa on Ravens Standard Progressive Matrices. *Intelligence*, 30, 409- 423.

Rushton, J.P., Skuy, M. & Fridjhon, P. (2003). Performance on Raven's Advanced Progressive Matrices by African, East Indian and White Engineering students in South Africa. *Intelligence*, 31, 123- 137.

Schepers, J.M. (1995). *Die Lokus van Beheer Vraelys: Konstruksie en Evaluering van n Nuwe Meetinstrument.* Departement van Meenslike Huulpbronbestuur, Raandse Afrikaanse Universiteit.

Schmeck, R.R. (1988). *Learning Strategies and Styles.* New York: Plenum.

Shih, C. & Gamon, J. (2001). Web-based learning: relationships among student motivation, attitude, learning styles ad achievement. *Journal of Agricultural Education*, 42 (4), 12-20.

Shuttleworth-Jordan, A.B. (1996). On not reinventing the wheel: a clinical perspective on culturally relevant test usage in South Africa. *South African Journal of Psychology*, 26, (2), 96- 102.

Singg, S. & Farquhar, K.C. (2003). Evaluation of a self-enhancement program for alternative school students. *Journal of School Health*, 73, 1-7.

Sinkavich, F.G. (1991). *Metamemory, Study Strategies and Attributional Style: Cognitive Processes in Classroom Learning.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago IL.

Skuy, M.S. (1975). *Definition and measurement of adaptive behaviour in a psychoeducational setting.* D. Litt et Phil. Unpublished Doctoral Thesis. University of South Africa, Pretoria.

Skuy, M. (1996). Cross-cultural and inter-dimensional implications of Feuerstein's construct of Mediated Learning Experience. In P Engelbrecht; S.M Kriegler & M. Booysen (Eds.). *Perspectives on Learning Difficulties* (pp.185-198). Pretoria: J.L. Van Schaik.

Skuy, M., Archer, M. & Roth, I. (1987). Use of the Learning Potential Assessment Device in Assessment and Remediation of a Learning Problem. *South African Journal of Education,* 7 (1), 53-57.

Skuy, M., Gaydon, V, Hoffenberg, S & Fridjhon, P. (1990). Predictors of Performance of Disadvantaged Adolescents in a Gifted Program. *Gifted Child Quarterly,* 34(3), 97-101.

Skuy, M., Gewer, A., Osrin, Y., Khunou, D., Fridjhon, P. & Rushton, J.P. (2002). Effects of mediated learning experience on Raven's matrices scores of African and non-African university students in South Africa. *Intelligence,* 30, 221-232.

Skuy, M., Hoffenberg, S., Visser, L & Fridjhon, P. (1990). Temperament and the cognitive modifiability of academically superior Black adolescents in South Africa. *International Journal of Disability, Development and Education,* 37(1), 29-43.

Skuy, M., Kaniel, & Tzuriel, D. (1988). Dynamic assessment of intellectually superior Israeli children in a lower socio-economic community. *Gifted Education International,* 5, 90-96.

Skuy, M., Mentis, M, Nkwe, I, Arnott, A and Hickson, J. (1994). Combining Instrumental Enrichment and Creativity/ Socioemotional Development for Disadvantaged Gifted Adolescents in Soweto: Parts I & II. *International Journal of Cognitive Education and Mediated Learning,* 1, 93-102.

Skuy, M., Schutte, E., Fridjhon, P. & O' Carroll, S. (2000). Suitability of published neuropsychological test norms for urban African secondary schools in South Africa. *Personality and Individual Differences,* 30, 1-13.

Skuy, M. & Shmukler D. (1987). Effectiveness of the Learning Potential Assessment Device with Indian and Coloured Adolescents in South Africa. *International Journal of Special Education,* 2(2), 131-149.

Skuy, M, Zolezzi, S., Mentis, M., Fridjhon, P. & Cockroft, K. (1996). Selection of advantaged and disadvantaged South African students for university admission. *South African Journal of Higher Education,* 10(1), 110-117.

South African Institute of Race Relations. South Africa Survey, 2001/2002. Johannesburg, 2001.

Spencer, M.B. (1985). Racial Variation and Achievement prediction. In H.P McAdoo and J.C McAdoo (Eds.). *Black Children: Social, Educational and Parental Environments* (pp.85-111). London: Sage Publications.

Stone, R., Wong, G. & Lo, S. (2000). English in Hong Kong: a preliminary study of the ACER Word Knowledge Test- Form F, and the Raven's Standard Progressive Matrices as indicators of verbal reasoning ability and abstract reasoning ability among Hong Kong University students. *Educational Research,* 42(2), 330-336.

Strous, L.S. (2003). *Background variables related to the intelligence and academic functioning of African, White and Indian engineering students.* Unpublished Master's Research Report. University of the Witwatersrand, Johannesburg.

Throop, W.E., & Macdonald, A.P. (1971), Internal-external locus of control - a bibliography, Monograph Supplement I-V28, *Psychological Reports,* 175-190,

Van Aardt, A & Van Wyk, C.K. (1994). Student Achievement in Mathematics. *South African Journal of Higher Education,* 8(1), 233-238.

Van den Berg, P.J & Burke, A. (1988). The examination of the reliability and validity of the LASSI for the assessment of developing students' learning and study strategies in the RSA. *South African Journal of Higher Education,* 12(3), 159-166.

Van Eeden, R., De Beer, M & Coetzee, C.H. (2001). Cognitive ability, learning potential and personality traits as predictors of academic achievement by engineering and other science and technology students. *South African Journal of Higher Education* 15(1), 171-179.

Van Overwalle, F. (1989). Structure of freshmen's causal attribution for exam performance. *Journal of Educational Psychology,* 81, 400-407.

Van Staden, J.F., Schepers, J.M., & Rieger, H.S. (2000). Locus of Control and Transformational Leadership. *Journal of Industrial Psychology,* 26(3), 8-14.

Wallston, K. A., Wallston, B. S. & DeVellis, R. (1978). Development of the multidimensional health locus of control (MHLC) scales. *Health Education Monographs,* 6, 160-170.

Walters, C.T. (1994). *Locus of control as a cause of school dropout.* Unpublished M. Phil. Thesis, Rand Afrikaans University, Johannesburg.

Watkins, D. (1987). Academic locus of control: a relevant variable at tertiary level? *Higher Education,* 16, 221-238.

Weinstein, C.E. (1987). *LASSI User's Manual.* Clearwater, F.L: H & H Publishing.

Weinstein, C.E (1988). Assessment and training of student learning strategies. In Schmeck, R.R (Ed). *Learning Strategies and Learning Styles.* New York: Plenum Press.

Weinstein, C.E & Mayer, R.E. (1986). The teaching of learning styles. In Wittrock, M.C. (Ed). *Handbook of Research on Teaching* (pp. 315-327). New York: McMillan Publishing.

Weinstein, C.E., Schutte, A.C., & Palmer, D.R. (1987). *Learning and Studies Strategies Inventory (LASSI).* Clearwater, F.L: H& H publishing.

Weinstein, C.E., Zimmerman, S.A & Palmer, D.R. (1988). Assessing learning strategies: the design and development of the LASSI. In Weinstein, C.E; Goetz, E.T & Alexander, P.A. (Eds.). *Learning and Study Strategies: Issues in Assessment, Instruction and Evaluation* (pp. 25-40). San Diego: Academic Press, Inc.

Woollacott, L. (2003). University of the Witwatersrand, Faculty of Engineering and the Built Environment. Personal Communication.

Zaaiman, H., Van der Flier, H & Thijs, G.D. (2001). Dynamic testing in selection for an educational programme: Assessing South African Performance on the Ravens Progressive Matrices. *International Journal of Selection and Assessment*, 9 (3), 258-269.

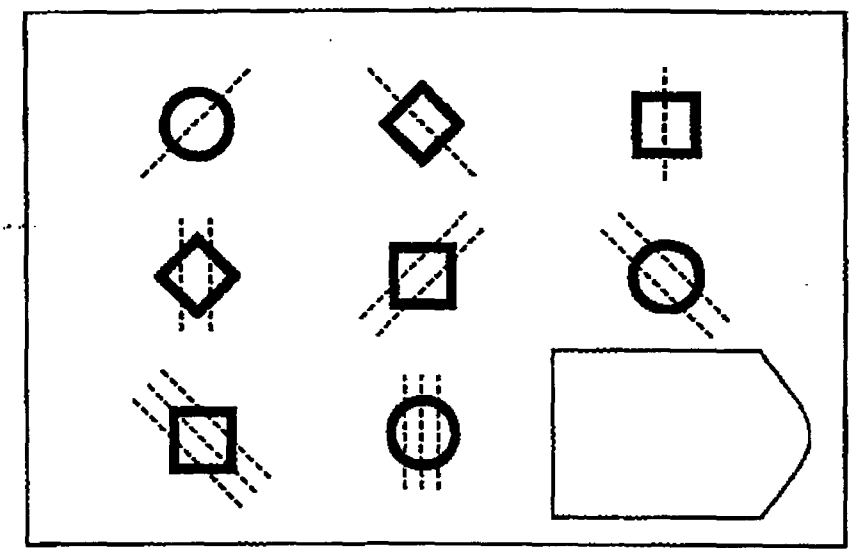
Zindi, F. (1994). Differences in psychometric performance. *The Psychologist*, 7, 549-552.

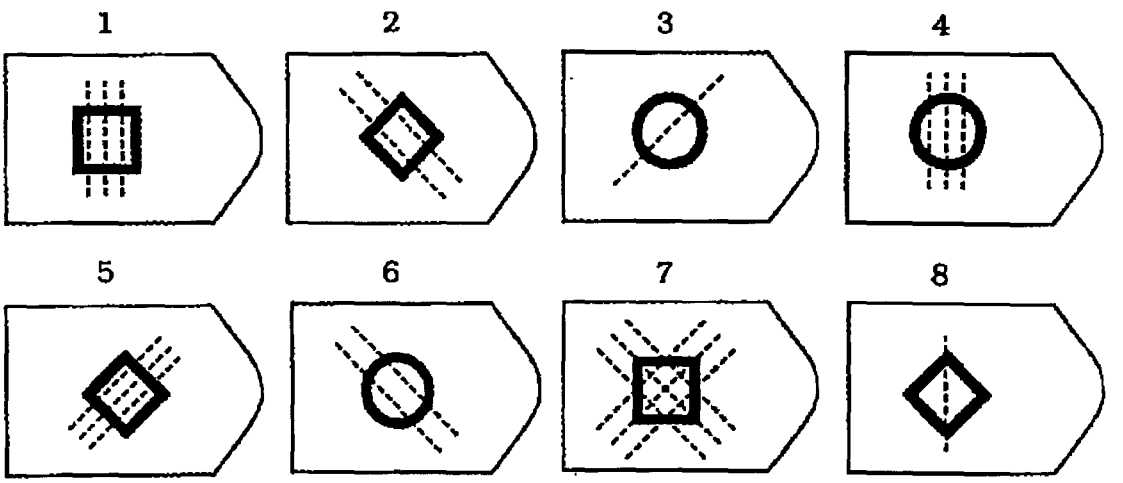
APPENDICES

APPENDIX A: AN EXAMPLE FROM THE RAVENS ADVANCED MATRICES (RAPM)

(Raven, Raven & Court, 1998)

1





APPENDIX B: EXAMPLES FROM THE ORGANIZER

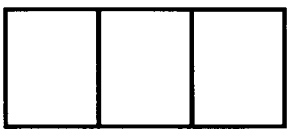
(Feuerstein, Rand & Hoffman, 1979)

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.



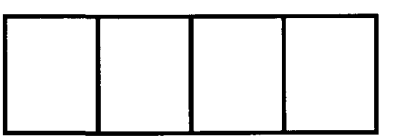
Place the four colours in the appropriate squares.

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.



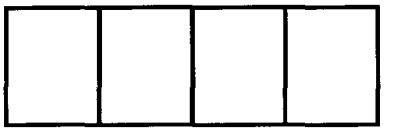
Place the four numbers in the appropriate squares.

A. 7 is to the right of 5.

B. 6 is beside 7.

C. The two numbers on the right are 2 and 6

The solution is:



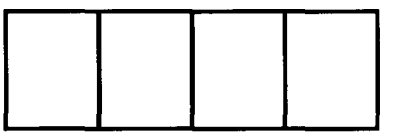
Place the four figures in the appropriate squares.

A. In squares 3 and 4 are the Diamond and the Square.

B. In squares 1 and 2 are the Triangle and Circle.

C. The Diamond and the Circle are in squares 2 and 3.

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



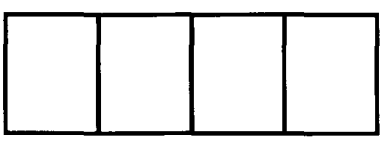
Place the four grains in the appropriate squares.

A. The Rye is <u>not</u> beside the Corn and <u>not</u> beside the Wheat.

B. The Oats are not beside the Wheat.

C. The Wheat is to the right of the Corn.

The solution is:



APPENDIX C: LEARNING AND STUDY STRATEGIES INVENTORY (LASSI)

(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 D: LASSI ANSWER SHEET

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

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

APPENDIX E: THE LOCUS OF CONTROL INVENTORY (LCI)

(Schepers, 1995)

- ***INSTRUCTIONS:***

This questionnaire deals with a variety of factors and circumstances which to a greater or lesser extent may influence your behaviour. Remember there are no ***right*** or ***wrong*** answers to the questions. We merely want to determine how the different factors and circumstances will influence your judgment and decisions on matters.

Read each question carefully and then decide whether the factor or circumstance, which is referred to, will influence your behaviour or not. Note the descriptions at the end-points of the seven-point scale which follows each question (item) and then decide whereon the scale to place your response.

Please mark your response below each item.

EXAMPLE:

Item 100 Not | 1 | 2 | (3) | 4 | 5 | 6 | 7 | To a great extent

Do not ponder too long over any one item. Your first spontaneous reaction is normally the most reliable.

Please ensure that you answer all the questions.

- ***EXAMPLES FROM THE THREE SCALES***

INTERNAL CONTROL SCALE

- How readily do you accept responsibility for mistakes that appear in your work?
- To what extent are you convinced that success is mainly related to a person's ability and dedication?
- To what extent does success encourage you to work harder and achieve greater heights?
- To what extent do you take personal responsibility for things that go wrong in your life?

EXTERNAL CONTROL SCALE

- How often does it happen that people obtain good positions simply because they know the right people?
- How strongly are you convinced that you are the object of fate?
- To what extent is your life influenced by coincidences?
- How strongly are you convinced that other people are in charge of your life and that they determine the outcome of issues?

AUTONOMY CONTROL SCALE

- How often do you make things happen through your own input, rather than wait for things to happen?
- To what extent do you like taking decisions yourself?
- To what extent do you like occupying a leadership position?
- How often do you take the first step in finding solutions for difficult problems?

APPENDIX F: THE COOPERSMITH SELF-ESTEEM INVENTORY (CSEI)

(Coopersmith, 1975)

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.	( )	( )