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SELECTION FOR REMEDIAL INTERVENTION: THE VALIDATION OF THE ACADEMIC PROFICIENCY ASSESSMENT BATTERY AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

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A research report submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Arts (Psychology)

Johannesburg, 2005

ABSTRACT

The Academic Proficiency Assessment battery evaluates language and study skills. This study focused on the internal consistency reliability and predictive validity of this battery for Information Technology students.

In terms of reliability, the Time management, Note-taking skills, and Debilitating stress scale on the achievement anxiety questionnaire were found to be internally consistent. However, the items in the English proficiency, Reading comprehension, Memorisation skills, concentration skills and motivating stress scale on the achievement anxiety questionnaire require modification or replacement. Intercorrelations across questionnaires necessitate further streamlining.

In terms of predictive validity, a significant negative relationship was found between Note-taking Skills and academic performance (R^2_{adj} = 8,3%). Matric results remain the best predictor accounting for 11% of the variance in CGPA. Cumulatively, Matric results and Note-taking skills accounted for 13,34% of the variance. None of the biographical variables significantly predicted CGPA.

Despite the apparent lack of relationship between individual predictors and the criterion, a discriminant function analysis indicated that all the academic proficiencies, with the exception of English proficiency, correctly predicted pass or failure in 72% of the cases. The lack of relationship between English proficiency and pass/failure can be accounted for in terms of the type of courses studied as part of an Information Technology programme.

Overall, the results would suggest that Matric results remain the best predictor of academic performance in Information Technology courses, but at a very low level. Given the lack of reliability in the majority of the

subtests of the Academic Proficiency Battery, the use of the APA battery for selection for remedial intervention for Information Technology students is not yet justified.

DECLARATION

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

_____

Shafeeka Yusuf Dockrat

11 February 2005

To Alisha

With apologies for my time taken away from her
to complete this degree

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- Peter Fridjhon and Mike Greyling for statistical support
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Chapter 1
INTRODUCTION

1.1. Need for this research project

In accordance with the White Paper on Higher Education (1997), tertiary institutions have a responsibility towards registered students to provide them with academic support programmes. These programmes have to be directed towards improving academic performance.

The need for academic support programmes is primarily attributed to the lack of academic, language and life skills in most learners from historically disadvantaged background; the high failure rate amongst first year students; and language policy. Consequently, the aim of academic support is to facilitate holistic development of learners in order to succeed academically, and thereby increase throughput figures (Celliers, 2000).

The Directorate for Student Development and Support at the Tshwane University of Technology (TUT) attempts to improve student's academic performance by enhancing language and study skills. Language development is accomplished through an English Proficiency course, and a Reading course that aims to increase reading speed and comprehension. Study skills are improved through a comprehensive study methods course that integrates the following modules: time management, note-taking skills, memory skills, examination stress, and concentration.

Eno, McLaughlin, Sheldon & Brozovsky (1999) assert that the success of such academic intervention programmes depends largely on accurately

identifying students requiring such services. An assessment that identifies students who lack the necessary academic competencies and language proficiencies may serve as an "early warning system" of students potentially at risk for academic underachievement. In order to identify such students, a battery of tests, collectively referred to as the Academic Proficiency Assessment battery (APA battery) is administered.

1.2 Problem statement

The Academic Proficiency Assessment used at Tshwane University of Technology is not a psychometric instrument. It is a set of questionnaires that have not been tested for reliability and validity. These questionnaires were initially selected simply on the basis of their face validity. What commenced as a seldom administered set of questionnaires to identify possible problem areas in terms of academic support proficiencies evolved into a formal assessment administered on a large scale. Considering the resources deployed in administering this battery of tests, validity and reliability studies become inevitable.

Furthermore, the Academic Proficiency Assessment is being utilised with the aim of identifying a student's proficiency level in terms of language and study skills. The present study also aims to determine if these skills are related to academic achievement, as the aim of administering the instrument is to identify developmental areas with regard to these skills on the assumption that if these skills are enhanced, academic performance will also improve too.

1.3 Research Questions

1. Are all the questionnaires of the Academic Proficiency Assessment (APA) battery reliable?

2. If any of the questionnaires in the APA battery are not reliable, what changes can be implemented to enhance their psychometric properties?
3. What is the predictive validity of the questionnaires in the APA battery?
4. Are there any additional variables that enhance the predictive validity for Information Technology students?

1.4 Objective

The objectives of this study are twofold. Firstly, to establish the psychometric properties of a battery of tests collectively referred to as the Academic Proficiency Assessment (APA) battery, and secondly to determine what variables predict academic achievement for Information Technology students.

1.5 Brief overview of dissertation

The dissertation proceeds in Chapter Two with a comprehensive review of existing literature on predictors of academic performance. Chapter 3 is devoted to the Academic Proficiency Assessment battery, particularly a discussion of a proficiencies evaluated by the instrument, and current issues surrounding the assessment thereof. Chapter 4 provides an overview of the methodology of the present research project, specifically the sampling, research design, and statistical analyses. The details and results of the data analyses are presented in Chapter 5. Chapter 6 concludes the research report, providing a summary of the findings as well as the recommendations.

Chapter 2
THE PREDICTION OF ACADEMIC PERFORMANCE

2.1 Introduction

This chapter examines the literature related to the prediction of academic performance. The chapter commences with a discussion of the value judgements in the choice of performance criteria, followed by the problems involved in the prediction of academic performance. The remainder of the chapter is devoted to an in-depth review of the factors related to academic performance.

2.2 Choice of performance criteria

Academic achievement is a complex and multi-faceted construct, encompassing numerous aspects. Academic performance at higher education compared to school achievement is more complex. Monteith (1988) defines school achievement as the results of a final examination. At school level, a student either passes or fails a grade year. At tertiary level, a learner accumulates credits for individual subjects, even though the learner may not necessarily be promoted to the following academic year. Due to this more complex promotion system, academic achievement is not easily measurable at higher education. Further complications include diverse study fields, differences in requirements and standards in varying fields of study, differences prevalent in different faculties (Swanepoel, 2002).

According to Fourie (1992), academic performance is not easily defined, and cannot be simply expressed by a single mark or symbol. There are

no valid norms to evaluate academic achievement. Academic performance has been defined in a number of ways, including success or failure in a subject, over- or under-achievement, poor, or no progress at academic level, graduating, completion of the qualification within the minimum period prescribed by the institution, intellectual curiosity, long-term career success of good and poor students, and the quality of verbal expression of graduate students (Rademeyer & Scheepers, 1998; Fourie, 1992; Lavin, 1965).

In the majority of studies of academic achievement, examination results are the only index of performance. Although examination results do not completely represent academic progress and adaptation, it is regarded as the most significant aspect of these processes. Examination papers in different subjects cover the content of a semester or a year. These are meticulously compiled and marked. Swanepoel (2002) contends that it is therefore fair to accept that examination results provide a valid and reliable indication of academic achievement.

Kruger (1972) suggested the use of examination results as performance criteria according to the following methods: Firstly, the information of pass and fail may be utilised as dichotomous criterion for academic achievement. The limitation of using it in this way is that this criterion does not include all the information about academic achievement. Secondly, the information about the number of subjects passed may also be used as a guideline, but when the requirements of different fields of study differ, the data is not always comparable. Thirdly, the marks obtained in different subjects may used as an average or as a total – again, the different subjects may jeopardise comparability. The practical problem when utilising these methods is to manipulate subject results in such a manner that they are comparable.

As a result of the variety of study fields, differences in evaluation measures and other factors, it is not always possible to reach consensus on the choice of performance criteria. Hence, it is necessary that specific points of departure or assumptions be formulated as a basis for the formulation of a criterion for tertiary achievement. Swanepoel (2002) sets forth the following assumptions, precedented by Smith (1979) as a point of departure when formulating criteria for tertiary selection: Firstly, it is assumed that a student's final mark in the examination, is an objective measure of academic performance. The second assumption is that the mark obtained in a specific subject is equivalent to the same mark obtained in another subject. Factors such as evaluation standards or differences in complexity between different subjects are not taken into account but condoned, as the pass mark is 50% for all subjects. Lastly, it is assumed that the degree of difficulty of different subjects on the same level is the same.

2.3 Factors influencing academic performance

Research on the factors influencing academic performance can be broadly group into three categories, namely, intellective factors, non-intellective personality characteristics, and sociological factors. Figure 1 illustrates the specific factors that will be highlighted in each category.

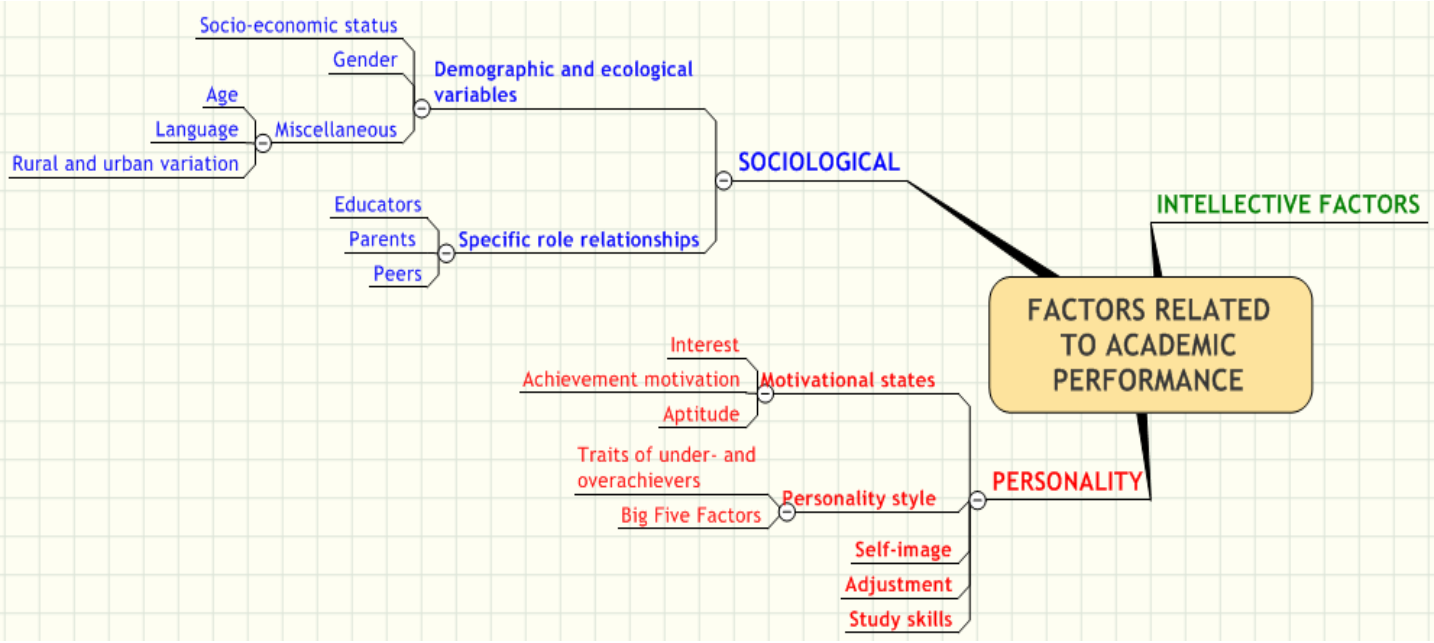


Figure 1. *Factors related to academic performance.*

2.4 Intellective factors as predictors of academic performance

This section focuses on measures of intellectual ability as predictors of academic performance. A summary of prevailing theories of intelligence, and the history of intelligence testing, contextualise the research on intelligence as a predictor of academic performance.

2.4.1 Theories of intelligence

Before even considering the relationship between intellectual ability and academic performance, the meaning of intelligence needs to first be understood. This section takes a brief look at the dominant theories of intelligence, specifically those of Galton and Cattell, Jenson and Vernon, Spearman, Thurstone, R. Cattell, Piaget, Guilford, Luria, Gardner and Sternberg.

Galton and Cattell saw sensory abilities as the basis of intelligence. They proposed that all information regarding the outside world passes through one's senses, leading them to believe that the more perceptive the senses, the larger the field upon which a person's judgement can act (Gregory, 1996).

Much later, researchers like Jensen and Vernon reported substantial correlations between reaction-time type measures and traditional intelligence tests (Gregory, 1996).

Spearman postulated that intelligence consisted two main types of factors, namely a general factor (g) and several specific factors (s_1, s_2, s_3, etc). Spearman utilised three principles of cognition to explain individual differences in the g-factor. These three factors were the apprehension of

experience, the eduction of relations, and the eduction of correlations (Gregory, 1996).

According to Thurstone, intelligence could be explained more clearly by several group factors instead of one general factor. He derived the primary mental abilities: verbal comprehension, word fluency, number, space, associative memory, perceptual speed and inductive reasoning (Gregory, 1996).

Cattell proposed intelligence as consisting of two major components, fluid and crystallised intelligence. Fluid intelligence is a largely non-verbal and culture-reduced form of intelligence which is related to a person's inherent capacity to learn and solve problems, while crystallised intelligence is highly cultural, and used for tasks requiring learned or habitual responses. Crystallised intelligence is therefore prevalent when fluid intelligence is applied in cultural settings where learnt behaviour is required (Gregory, 1996).

Piaget suggested that organised patterns of behaviour or mental structures called schemas evolve to greater maturity through a process of equilibration, where schemas are applied to objects, persons or events through the process of assimilation. If a schema is assimilated, a state of equilibrium arises. If not, the inequilibrium or tension requires the adjusting of the schema, until a state of equilibrium can be reached. The adjustment process is referred to as accommodation (Gregory, 1996).

Guilford developed the Structure of Intellect Model. In terms of this model, intelligence is three dimensional, the three dimensions being operations, contents and products that produce 5X5X6 or 150 different kinds of intellect (Gregory, 1996).

Luria's Information Processing Theory focuses on two different kinds of processing. Simultaneous processing is typified by the execution of several different mental operations at the same time. Forms of thinking and perception requiring spatial analysis require this type of processing. Successive processing organises information in a linear series, and is required where a proper sequence of activities must be followed. Most forms of information processing are dependent on interplay of both types of processing (Gregory, 1996).

Gardner proposed a theory of multiple intelligences. He suggested that intelligence constitutes multiple intelligences that are relatively independent, even though the exact nature, extent and number of the intelligences has not yet been established. He tentatively confirmed six natural kinds of intelligence, namely linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic and personal (Gregory, 1996).

Sternberg's theory stipulates three aspects of intelligence. Componential intelligence is responsible for intelligent behaviour, experiential intelligence deals effectively with novel tasks, and contextual intelligence deals with the adaptation to, shaping and selection of real-world environments (Gregory, 1996).

2.4.2 History of intelligence testing

In order to understand intelligence testing it is important to consider the evolution of intelligence testing, the defining of intelligence, and for the purpose of this study, studies on the correlation of academic performance and intelligence.

Intelligence measurement is by no means a new concept. As far back as the nineteenth century Galton and Wundt reasoned that all knowledge is derived from our senses. Intelligence testing for them was therefore

measuring individual differences in sensorial discrimination and psychomotor co-ordination. Cattell followed the same line of reasoning and measured intelligence by measuring properties like reaction time, sensory perception, mechanical memory and motor skills. However none of these measures were found to be effective predictors of academic performance or other facets of intellectual functioning. Binet invented the first modern intelligence scale in 1905. The main purpose of his test was to identify children who would not benefit from the conventional methods of formal education. The test was revised in 1908 by Binet and Simon, and again in 1911. In 1912, the concept of the intelligence quotient (IQ) was invented by Stern (Gregory, 1996).

For most of the twentieth century, attention was refocused on reaction time with the growth of experimental cognitive psychology, particularly the time taken to process cognitive tasks. Jensen's research during the eighties revealed a high correlation between reaction time on elementary cognitive tasks and the g factor. Terman also experimented with tests of complex abilities like creative imagination, logical reasoning, mathematical, language and learning ability, and insight. These tests showed positive correlations with academic performance. suggesting that the measurement of a single trait, viz. Intelligence was acceptable. Terman adapted the Binet scale, but later began using the intelligence quotient (IQ) as a measure of intelligence using the Stanford Binet scale. From a theoretical standpoint, the problem with this scale was that the content of items was different for different age groups. David Wechsler's scale grouped all items of a given type into subtests ant arranged the items in increasing order of difficulty. He accepted the notion of the deviation IQ scale, which ensured that IQ had a consistent standard deviation at each level (Owen & Taljaard, 1996).

2.4.3 Intelligence as a predictor of academic performance

An extensive body of research on intelligence as a predictor of academic performance exists. This section addresses how this body of research is subdivided, and focuses on relevant research.

2.4.3.1 Classification of studies

Studies usually differ on two dimensions. Firstly, in their concern with global as against multidimensional prediction in terms of both the predictor variable, as well as academic performance, and secondly on the educational level.

In terms of the first classification, global refers to the use of a single, overall measure of intelligence and/or academic performance, whereas multidimensional refers to the use of a number of specific dimensions of intelligence and/or performance. These distinctions are illustrated in Table 1 (Lavin, 1965). Although Lavin's work may be considered outdated, it is the author's opinion that it still provides an exemplary structure when attempting to classify studies on the prediction of academic performance.

Table 1

Types of studies relating ability and academic performance

Predictor	Criterion	
	Global	Multidimensional
Global	Global ability measure used to predict grade point average	Global ability measure used to predict grades in specific courses
Multidimensional	Several specific ability dimensions used to predict grade-point average	Several specific ability dimensions used to predict grades in specific courses

Note: From *The prediction of academic performance* (p.49), by D.E. Lavin, New York: Russel Sage Foundation. Copyright 1965 by Russel Sage Foundation.

In terms of educational level, study samples usually constitute elementary/primary school, high school, tertiary level and post-graduate students.

2.4.3.2 Findings at the tertiary level on intelligence as a predictor of academic performance

Due to vast amount of research available on intelligence as a predictor of academic performance, only findings at the college level will be highlighted, as these are most relevant to the present study of first year students. Findings will be organised according to the categories set forth in the previous section.

- **Global measures of ability and performance**

Research findings consistently reveal ability measures having low predictive validity for academic performance. Altink (1988) cited in Zaaiman (1998) ascribes the low predictive validity of ability tests to such

tests measuring constructs that are only hypothetically related to academic achievement and are therefore further removed from the performance to be predicted than either achievement or scholastic aptitude tests.

- **Specific ability dimensions used to predict GPA**

Of all the specific ability measures utilised in batteries of predictors, the one that constantly emerged as the best single predictor is high school marks. Using **academic performance at school** is the most conventional method of predicting academic performance at tertiary level. Smit (1992) operationally defines school performance as a pupil's performance in the different exams during his/her high school career, with specific reference to the performance in the Matric exams. Standard nine and Matric marks have been widely used as admission criteria at South African technikons and universities in the past, and continues to play a significant role. This is also the criterion primarily used for entrance to Tshwane University of Technology. Kotzé (1994) cites research by Behr (1985), Bloom (1976), Jencks, et al (1983), Monteith (1988) and Zietsman & Geringer (1985) as evidence of school performance being the only best predictor of future academic performance, and that it is an even better predictor than cognitive potential.

However, research by Potter and Jamotte (1985), and Kotzé, van der Merwe and Nel (1996), reveals that Matric results from the former Department of Education and Training and equivalent government school departments specifically at the lower ranges, are inaccurate reflectors of students' academic ability, and that there is a definite inconsistency between the results of attendees of "black schools" and university academic performance. Zietsman and Geringer (1985) note the influence of milieu disability, which leads to Matric results being a poor predictor of academic performance. Miller (1992), Gourley (1992) and Huysamen and Raubenheimer (1999) question the use of Matric performance as a

predictor of academic success as a result of the different instruction approaches at school and tertiary institutions.

Case studies by Pavlich and Orkin (1993) indicate the importance of developing alternate admission programmes that identify competent students without depending on Matric results, as school performance may have been negatively affected by disadvantage. Further necessitating the identification of alternative selection criteria is the introduction of the Further Education and Training Certificate (FETC) that will be replacing the Matric certificate when the National Qualifications Framework (NQF) will be implemented in the South African Education system. The FETC will then become the statutory minimum requirement for entry into all higher education programmes, and will be obtained through formal schooling or through adult basic education and training and recognition of prior learning, or a combination of these options. The predictive validity of the new FETC qualification will have to be investigated before it can be used for selection purposes (Zaaiman, 1998).

- **Several dimensions of intelligence used to predict grades in specific courses or course areas**

When the content of predictor batteries varies depending on the particular course for which grades are being predicted, this is regarded as the differential prediction technique. Horst has made a meaningful contribution to the development of this technique. His work is based on the rationale that while global predictors and criteria emphasise overall academic performance, it is likely that the performance of most students differ qualitatively from one subject area to another (Lavin, 1965).

This technique is also utilised at Tshwane University of Technology for selection. Selection batteries vary from course to course. In May 2001, the first phase of a project begun to identify alternative selection criteria for

students to admit students to the Information Technology (Information Technology) course at Tshwane University of Technology. 450 prospective students were assessed from May to June 2001 for admission into the Information Technology course. 140 students were selected. Two instruments were utilized, namely the Situation Specific Evaluation Expert (SpEEx) and the ITTS. The indices used from the SpEEx were Conceptualisation, Observance, Insight, Calculations, Environmental Exposure, Comparison, Perception, Object Assembly, and Reading Comprehension. The ITTS indices used were Verbal Reasoning, Advanced Calculations, Syntax Checking, and Diagramming. Neither the SpEEx battery, the ITTS battery, nor the two combined were able to make a significant contribution to the prediction of academic performance of Information Technology students at Tshwane University of Technology (Kriel, 2002).

Table 2

Results of multiple regression analysis in Kriel's (2000) study

Subject code	R^2 (SpEEx)	R^2 (ITTS)	R^2 (Best predictors)
ITS IIAA	0.13	0.09	0.24
ITS IIBA	0.13	0.03	0.11
ISY13AA	0.05	0.05	0.70
ISY13AB	0.15	-	0.15
SSF IIAA	0.08	0.10	0.13
DSO 15AA	0.11	0.07	0.11

From "n Uitgebreide keuringsbattery vir studente in Inligtingstegnologie" by H. Kriel, 2002, p.3.

The differential prediction technique is also utilised in another important way in South African assessment. It is used to ascertain test fairness. In psychometric and legal circles, the Cleary approach is currently regarded as the most accepted statistical approach to test fairness. The Cleary

regression model uses different subgroup criterion-predictor regression equations for prediction purposes when the equations differ significantly for different subgroups, assuming an unbiased criterion (Zaaiman, 1998).

- **Global ability measure is used to predict grades in specific courses**

Compared to the volume of research in the other categories, relatively little research is available in this group of studies. According to Thorndike (1986), global ability measures only provide a measure of general cognitive functioning, with Zaaiman (1998) adding that ability tests are non-subject specific.

2.5 Personality factors as predictors of academic performance

Although ability measures are the best single type of predictor of academic performance, they account only for a portion of the variance. Hence, it is essential to consider nonintellective factors too. This has led many researchers to study academic performance by concentrating on personality characteristics. This section first commences with an explanation of the classification of these studies, and then focuses on some of the personality variables that have been related to academic performance.

2.5.1 Classification of personality studies

These studies are organised into five areas. Firstly, achievement motivation, level of interest, etc. are grouped under motivational states. A second area is personality style, which includes factors like degree of interdependence, impulse control, and introversion. The third area is the cognitive level, which is the self-concept. A fourth group of studies focus on manifestations of pathology to account for achievement. Finally,

measures of study habits are more directed at the behavioural level. This final category of factors will be discusses at length in Chapter 3, as it is the focus of the present study (Lavin, 1965)

Two basic methods of analysis are utilised in research of personality variables. Firstly, the correlational method is used to evaluate the degree of relationship between the personality factor and academic performance. In these studies, ability is controlled either through a partial correlation analysis, or by a multiple correlation, where the contribution of a personality variable to a battery of intellective factors is assessed. With the second method of analysis, academic performance is researched by composing groups of high and low achievers or under- and over achievers, and assessing possible personality differences between such groups (Lavin, 1965).

2.4.5.1 Motivational states as a predictor of academic performance

Three motivational states are addressed in terms of their relationship with academic performance, namely interest, achievement motivation and aptitude.

- **Interest**

"Interest is an aspect of personality and can be defined as a spontaneous attraction to, or preference for, certain activities, as well as a spontaneous aversion to other activities" (Owen & Taljaard, 1996, p.396). Interest is an important component in the prediction of academic performance according to De Boer (cited in Engelbrecht, 1999), as a lack of interest can negatively impact on performance.

Measures of interest have been utilised in three ways to predict academic performance. In the first manner, scores on particular interest categories

have been related to performance in corresponding course work. Another approach has been to assess if any type of interests predict academic performance. The third group of studies does not deal with substantive interests per se, but with particular general dimensions that transverse content, like clarity and intensity of interests (Lavin, 1965).

Singh's (1986) study (cited in Padma, 2003) typifies the first group of studies. Using Samal's Vocational Interest Inventory, Singh failed to find a relationship between achievement in mathematics, and scientific interest, mechanical interest, interest in agriculture, business, social service, art, nor official activities.

- **Achievement motivation**

Achievement motivation may be defined as an individual's predisposition to approach or avoid a competitive situation. More widely defined, it embraces the concept of a desire to excel. From the mid-1950's through the mid-1970's, the theory of achievement motivation that attracted the most attention in psychological literature was the McClelland-Atkinson theory. This model proposes that achievement motivation depends two constructs: the motive to achieve success and fear of failure. The motive to achieve success is believed to represent a student's intrinsic motivation to engage in an activity, and fear of failure is a psychological construct related to cognitive state anxiety. The desire to enter such an activity is a function of the relative strength of the two constructs. If a student's self-confidence on a specific task is greater than the fear of failure at the task, that person will approach and perform the task. Another leading model was the test-anxiety approach, which proposed that fear of test taking or fear of failure (test anxiety) was the critical factor in determining whether or not an individual would approach or avoid an achievement situation. Students suffering from high levels of anxiety would therefore be expected to avoid achievement situations. The third model, namely the Crandall

approach emphasised the individual's expectation for reinforcement and on an individually set level of excellence. In practice, a student would compare social expectations with minimal standards of success. If expectations are too high or reinforcements too few, the student will drop out of the achievement situation (Cox, 1990).

Generally, studies examining achievement motivation as a correlate of academic performance, are sceptical about making inferences about this variable. Shanmugasundaram (1983), Deshpande (1984) and Sween (1984) found a positive relationship between the two variables. Rajput (1984) and Sontakey (1986), on the other hand, failed to find such a relationship. Mitra's (1985) study found that achievement motivation is positively and significantly related to academic performance, but this result is not applicable if intelligence is partialled out. Sharma (1981) studied the factors related to academic underachievement of secondary schools located in rural areas in a village in India. She also attempted to find out the specific contribution of variables towards high achievement and underachievement. Her results indicated that poor academic motivation was one of the factors that contributed to underachievement (Padma, 2003).

Goldberg (cited in Anderson & Keith, 1997) contends that student motivation historically has been regarded as the most significant area of difference between lower class and middle-class students. A greater emphasis on motivation is essential in comprehending and enhancing minority achievement. Motivation is a multidimensional construct that includes cognitive, environmental and behavioural components, is usually defined only by its cognitive component. Anderson and Keith (1997) cites Carroll's (1989) work which is the noted exception – rather than focusing on beliefs, expectancies, self-efficacy, and other attitudinal expressions of motivation, Carroll describes the actual amount of time spent on learning as the operational definition of motivation for learning. Estimates of

motivation that have included behavioural expressions have been more strongly related to achievement than those that have relied on cognitive, affective, or attitudinal expressions only.

- **Aptitude**

One of the earliest definitions of aptitude is provided by Bingham (1937, p.17) who defines aptitude as a "condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill or set of responses such as the ability to speak a language, to produce music, etc.". Bingham contends that aptitude is a present condition that refers to the future. Aptitude tests measure current achievement that provides an indication of future potentialities. Aptitude implies a fitness, or suitability for the activities in question. Gekokski accepts Bingham's definition, and additionally points out five characteristics of aptitude, namely, intelligence, interest, personality, special abilities and attitude. He believes that the five components are independent form one another and each is to a greater or lesser extent involved in a person's aptitude for a particular task. Guilford (1959) views aptitude differently. Guilford (1959, p.342) refers to aptitude as "underlying dimensions of ability that prepare a person for a certain level of performance in given activities and for learning new things." These underlying dimensions are perceptual, psychometric and intellectual abilities. Snow (1992) defines aptitude as apt, appropriate and suitable, implying that the definition of aptitude is situation-specific. The concept subsists in the person-situation interface, rather than solely in the person. Hence aptitudes imply initial states that subsequently affect later developments, given specified conditions, meaning a responsiveness to learn from a given situation.

Aptitude has been identified as a notable correlate of academic attainment in certain fields. Agarwal's (cited in Padma, 2003) investigation indicated

medical aptitude as one of the contributing factors associated with proficiency in medical examinations in five different medical colleges.

Owen and Taljaard (1996) assert that the scores from aptitude tests should be regarded as useful information that ought to be used with other information about a person in order to take certain decisions. Other information includes school performance, interests, attitudes, study habits, human relations, and specific likes and dislikes. Aptitude tests on their own should not be used as "decision makers".

Zaaiman (1998) concludes from Altink's (1988), Heyneman's (1988) and Jacobs's (1995) studies that prevailing scholastic aptitude tests are designed to assess subject-related skills, comprehension and insight, utilise non-routine problems that require minimal subject-specific knowledge.

The Senior Aptitude Test (SAT) is an example of an aptitude test which research has failed to uphold as a predictor of academic performance. Van Zyl, Terblanche and Jacobs (1992) found no significant difference between the SAT performance of successful and unsuccessful social work students. Fourie's (1990) investigation did also not find the SAT to be an effective predictor of academic performance.

However, a number of studies have provided some support for the predictive validity of aptitude tests. Skuy, Zolezzi, Mentis, Fridjhorn and Cockcroft (1996) found that Barker's Pattern Relations Test, which is a test of inductive reasoning and reasoning by analogy, predicted performance in Accounting for a group of students at the University of Witwatersrand. Pienaar (1991) concluded that specific subtests of the HSRC's Academic Aptitude Test (AAT) differentiated between successful and unsuccessful learners at higher education level, finding that the academically successful students performed significantly better on the Non-verbal Reasoning,

Verbal Reasoning and Reading Comprehension subtests. The predictive validity of the AAT was also researched by Samkin (1996), whose results indicated that the Reading Comprehension explained 14.4% of the variance of the final Accounting mark and Number Comprehension subtests.

2.5.1.1 Personality style

Studies investigating the relationship between personality style and academic performance tend to fall into two groups. The first group of studies aims to identify the difference in personality traits between overachievers and underachievers in specific areas. The second group of studies attempt to determine if specific personality traits are related to academic performance.

- **Personality traits of underachievers and overachievers**

Jahan's research (cited in Padma, 2003) compared the personality profiles of over and underachieving students studying in science, arts and commerce streams in preuniversity classes. The sample comprised 758 male and female students. Cattell's High School Personality Questionnaire (HSPQ) was used to measure personality. Thorndike's method of identifying over and under-achievers on the basis of discrepancies between actual achievement and that predicted on the basis of intelligence was employed. The significance of difference between the means of scores on the fourteen dimensions of HSPQ secured by the over and underachievers of the three streams were ascertained by a t-test. Overachievers of the science stream were more reserved, intelligent, emotionally stable, excitable, obedient, sober, conscientious, shy, self-assured, self-sufficient, controlled and relaxed as compared to the underachievers. Overachievers of the arts stream were more warm-hearted, intelligent, affected by feelings, undemonstrative, assertive,

enthusiastic, conscientious, zestful, apprehensive and tense. In the commerce stream, overachievers were reserved, intelligent, affected by feelings, sober, conscientious and self-assured (Padma, 2003).

Padma (2003) also discusses Puri's (1987) study that used the same instrument to make a detailed study of the personality traits of underachievers of 425 students at 12 intermediate colleges of Lucknow city. Underachievers were found to be more warm-hearted and easygoing, inactive, assertive, aggressive, stubborn and dominant, impulsive, lively, happy-go-lucky, and socially bold. They were generally over-protected, sensitive, individualist and reflective, apprehensive, worrying and troubled.

Snake's (1986) study cited by Padma (2003) found high achievers in the natural sciences to be less excitable, undisciplined, having self-conflict, relaxed, tranquil, and more unfrustrated than low achievers. In the biological sciences, high achievers were less excitable, tough minded, self-reliant and realistic.

- **Big Five factors of personality**

Zaaiman (1998) mentions studies by Rothstein et al. (1994), De Fruyt and Mervielde (1996) and de Raad and Scholuwenburg (1996) on the predictive validity of personality factors for academic achievement, referring to the current interest in the Big Five factors of personality. McCrae and Costa (1987) proposed a five-factor model of personality. McCrae and Costa assert that most personality traits are derived from just five critical traits, namely Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness. A description of each personality factor is described in Table 3 (see Appendix B).

Research thus far has indicated that the factor Conscientiousness shows the most promise as a predictor of academic achievement, with mixed results found for the other factors with the predictive validity and direction of prediction dependent on the performance context and type of achievement measure. To what extent and which personality traits predict academic performance was investigated by Chamorro-Premuzic and Furnham (2003) in a longitudinal studies of a British university sample. Academic performance was measured throughout a three-year period and used multiple criteria. In addition, several indicators of academic behaviour were also examined with regard to both academic performance and personality traits. In the first sample, the Big Five personality factors, specifically Neuroticism and Conscientiousness, were found to predict overall exam marks over and above several academic predictors, accounting for more than 10% of unique variance in overall exam marks. The results suggest that Neuroticism may impair academic performance, while Conscientiousness may lead to higher academic performance (Chamorro-Premuzic & Furnham, 2003).

Patel's study (cited in Padma, 2003) on the relationship between neuroticism and high achievement provided contradictory results. The sample consisted of medical students drawn from two medical colleges of Ahmedabad city. Eyesenck's Neuroticism Inventory was utilised for data collection. No relationship was found between the two variables.

One of the aims of Mitra's research (cited in Padma, 2003) was to ascertain the relationship between extraversion and academic performance. Eyesenck's Personality Inventory for Juniors adopted in Bengalis by Arti Sen was used to measure extraversion. Extraversion correlated positively and significantly with academic performance, but lost its significant effect when intelligence was partialled out (Padma, 2003).

2.5.1.2 Self-image

Padma (2003) cites studies by Shanmugasundaram (1983), Singha (1983), Sween (1984), and Pathani (1985) which all considered self-concept as a factor correlating with academic performance. Sween used the Deo Personality Word List, and found that students with high self-concept achieved significantly higher than those with a low self-concept. Similarly, Pathni concluded that self-concept is a significant predictor of both actual and perceived academic performance, using the Self-concept Scale. Shanmugasundaram's results differed from Sween's and Pathni's studies. Shanmugasundaram, using Mohsin's Self-concept Scale failed to differentiate between high and low achievers.

2.5.1.3 Adjustment

Numerous studies have been carried out on certain personality factors of students as correlates of academic performance. Personality traits are assessed using personality questionnaires or inventories (Padma, 2003).

Studies utilising the MMPI has indicated a positive relationship between personality and academic performance. A multiple correlation of 0.69 is found between adaptability and academic performance. Underachievers were also found to display the following characteristics: more emotionally labile, defensive and lacking a warm disposition to others. Students who performed well academically are more self confident and well adapted socially (Kotzé, 1994).

2.6 Sociological determinants of academic performance

Studies on sociological correlates of academic performance tend to fall into one of two groups. The first group examines the effects of role relationships on academic performance, and the second looks at the

effects of various ecological and demographic characteristics upon academic performance (Lavin, 1965).

2.6.1 Demographic and ecological variables

Demographic and ecological variables are related to academic performance as they symbolise specific uniformities of personality. Positions in the social structure like socio-economic status and gender tend to create particular similarities in personality among the occupants of these positions. Some of these personality characteristics are in turn related to academic performance (Lavin, 1965).

2.6.1.1 Socio-economic status (SES)

The term socio-economic status (SES) usually refers to the overall social position of a family as measured by the parents' economic and social achievements. Indices of SES typically utilise indicators of the educational, occupational and economic achievements of the parents. Relevant research indicates that low SES as defined by these factors contributes to educational disadvantage (Ainley, Graetz, Long & Batten, 1995).

Educational disadvantage may be characterised in terms of the educational opportunities available to a student (Ross, Flarish & Plunkett, 1988). It is the net effect of the features of a learner's environment that provide less than normal exposure to factors that motivate and facilitate educational growth. Within the South African context, a learner is therefore regarded as disadvantaged if s/he has had insufficient access to quality educational services, resulting in a lack of opportunity to fully develop her/his academic potential (Zaaiman, 1998).

A student's home background generally affects the educational opportunities available. The quality of education available to a student from a low SES background can be expected to be influenced by the student's peer group, the educational facilities available at the school, and the quality of teachers employed by the school (Zaaiman, 1998).

Padma (2003) cites studies by Das (1975), Dwiveldi (1983), Sarah (1983), Sharma (1984), Shukla (1984), Rajput (1984), Mehrotra (1986), Misra (1986), Singh (1986), Srivastava and Ramaswamy (1986), Sontakey (1986), and Trivedi (1987), which indicated a significant correlation between socio-economic status and academic performance of students. The environment provided to a student by his home has been researched by Grover (1979), Gaur (1982), Sarkar (1983), Lail (1984), Jagannadhan (1985), Maitra (1985), Paul (1986) and Trivedi (1987) (cited in Padma, 2003). The factors revealed in the abovementioned studies as being correlates of academic performance include educational environment, income, spatial environment, social background, provision of facilities, parent-child relationship, home environment, recognition of child's achievement, parental aspiration, forbearance for the child's wishes, parental affection and encouragement (Padma, 2003).

Anderson and Keith (1997) analysed longitudinal data from 8100 high school students in a national study to test a model of at-risk students' school learning, using structural equations analysis to fit their model to the data. Family socio-economic status was found to be one of the variables in their model that exerted a meaningful total effect.

2.6.1.2 Gender

Gender inequality is of international concern in terms of access to higher education, more especially in science- and technology-based study. The

Department of Education (1997) regards equal access for women as an important aim for the transformation of higher education in South Africa.

Anderson and Keith's (1997) study discussed above also included gender as a variable in the model. Gender was supported by the large, longitudinal dataset as a significant and important predictor of academic performance for at-risk high school students.

Padma (2003) cites Dhar's (1986) and Jasuja's (1983) research. Dhar's study which found no difference in the academic performance of intellectually superior and intellectually very superior Grade 11 boys and girls, while Jasuja's research found that adolescent girls achieved higher in the academic field.

Tinklin (2003) used the Scottish School Leavers Survey to examine factors related to high attainment and questioned whether they were different for males and females. A strong correlation was found between social advantage and high attainment within each gender, but no evidence of differential progression rates for males and females was found between the ages of 16 and 18. The only factor that displayed evidence of gender differences in achievement was that girls took school more seriously than boys, supporting theories that girls and boys experience different peer pressures that affect their academic performance.

Potential causes of the observed gender differences in academic performance are neurophysiological differences (Kahle, Parker, Rennie & Riley, 1993), different learning strategies (Meece & Ecclees, 1993), or attitudinal factors (Brusselmans-Dehairs & Henry, 1994). Humphreys (1986) and Young (1991) refer to continuous findings that tests of general intelligence, scholastic aptitude and high school grade point average underpredict female performance in higher education across course or subject choices. However, Young (1991) contends that such findings may

result from incomparability of criteria (course differences) rather than gender bias in the standardised tests (Zaaiman, 1998).

Concluding from the international literature, gender differences can be expected to occur in academic achievement. However, selection tests and other criteria need to be checked for bias on gender in order to ensure gender fairness (Zaaiman, 1998).

2.6.1.3 Miscellaneous ecological and demographic characteristics

Besides SES and gender, other ecological and demographic characteristics also impact academic performance. Variables that will be discussed are age and regional variation.

- **Age**

A factor possibly influencing student performance in South Africa is student age. School disruptions lead to many pupils taking longer to complete Matric and are substantially older than the norm of 18 or 19 years when applying for admission to a tertiary institution (Zaaiman, 1998).

Bot (1994) reported that Matric pass rates show a notable decrease with age for black students. In 1993, 50% of candidates under the age of 19 passed Matric. In the same year, only 33.3% over the age of 21 passed Matric. A large proportion of black matriculants are 22 years or older – this age group constituted 37% of the total number of black candidates in 1993. This is therefore not an age group that can be ignored during selection, and may need special assistance to be able to succeed in higher education.

Girija's (1980) comprehensive study discussed by Padma (2003) also found age to be one of the thirty-two potential contributors to cumulative

grade point average (CGPA), and Muffo, Dickey and Bodo (1999) also found age to predict first year retention and academic success. Wince and Borden (1995) indicated that age was the most significant demographic variable in terms of GPA prediction, and Farabaug-Dorkins (1991) reported that attrition rates of older students are higher than those reported for traditional-aged college student freshman.

- **Regional and rural-urban variation**

The concept of 'rurality' is often associated with the concept of educational disadvantage and lower educational participation. Klitgaard (1986) reports that students form urban areas are more likely to be admitted to universities than those from rural areas. Rosseaux (1993) studied rurality and educational opportunity in Australia. Wide variations exist among nations about the differentiation between rural and urban areas. Rural locations and populations are commonly defined in terms of population density and size, location and economic activity. In large countries, most regions contain a mix of both urban centres and rural areas. It is often assumed that when defining an area as rural or urban, there is a direct relationship between the quality and number of educational services available and the population size of the area. Relevant to rurality is the concept of remoteness implying isolation from educational services. In remote areas, generally access to services depends on the economic power of the community to meet the costs of overcoming the distance between the user and the available service (Rousseaux, 1993).

A classification of a school as being 'rural' rather than 'urban' on the basis of expected lower access conforms to the description of disadvantage outlined in section 4.7.1.1. However, in the South African context, it cannot naturally be assumed that population size necessarily corresponds with the services available. Many of the black ex-homeland areas have large populations, but are under-serviced. The general SES of the

population in these areas does not allow for access to services that may be available elsewhere. Students from the previously black-only township areas surrounding the metropolitan Gauteng area, as well as learners from the current principal provincial cities, had greater access to educational and other services that student from the non-urban areas (Zaaiman, 1998).

Padma (2003) cites a study by Doraiswamy (1985), which aimed to determine school differences in performance and compare the standards of attainment reached by children of different social composition studying in different school locations. Findings indicated that performance of students from hilly areas was slightly less. The performance of students in urban areas was better than that of students in rural areas.

What is different at South African universities and technikons is that most of these institutions are situated in urban areas. However, the institution serves as a melting pot for students from urban and rural areas. Girija (cited by Padma, 2003) conducted a study of intellectual and non-intellectual factors in academic performance of students from professional colleges. Place of permanent residence was one of the predictors of CGPA. Rather than utilising location of institution, location of permanent residence (urban/rural) could therefore be a more appropriate predictor in South African studies on academic performance at tertiary level.

2.6.2 Specific role relationships

This section focuses on the correlation between the role of significant other people in the student's life and academic performance. Three specific categories are investigated: educators, parents and peers.

2.6.2.1 Educators

Niebuhr and Niebuhr (1999) conducted an empirical study of student relationships and academic performance. Student-teacher relationships were assessed by a questionnaire, and academic performance was measured by GPA. Student-teacher relationships were positively correlated with performance, stressing that the importance of warm teacher involvement. Part of the necessary quality condition in the classroom is that as teachers allow their students to know them, and like them, the students will work harder, thereby increasing their opportunities for success.

Anderson and Keith (1997) cite Cool and Keith (1991) who considered a composite variable of quality of instruction defined by student ratings of teacher interest, quality of instruction and reputation of school within the community. The multidimensional quality of instruction variable directly influenced student's motivation, enrolment in academic coursework, and time doing homework, and indirectly through these variables, the teacher's interest and quality of instruction influenced academic performance (Anderson and Keith, 1997).

Watson and Munroe (1990) surveyed existing literature on the impact of teacher perception on academic performance. Studies report that teachers interact differently with students who are perceived to be at different achievement levels. Perceived high achievers received more questions and praise from their teachers, teachers consistently interacted more with the top third of the class, waited significantly longer for higher-achieving students to respond to a question, and teachers with artificially high expectations were related to enhanced student performance. Research attempting to induce teacher expectations by providing teachers with unreal information has generally not yielded significant results. However, naturalistic studies show the effects of expectancy. Continued research in

the area leads to a consensus that teachers' expectations affect teacher-student interaction and student outcome, along with the recognition that the processes involved are much more complex than originally believed. Most teacher expectations of student achievement are negative ones, where low expectations lead to lower achievement than might have been attained otherwise (Watson & Munroe, 1990).

Some researchers have focused their attention on the effect of the processes that occur in teaching-learning activity on the achievement of students. Some of the areas investigated include teaching methods and teacher behaviour (Padma, 2003).

Padma (2003) cites Nagpal (1983), Bhalwankar (1985), and Kumari (1985) who considered the impact of the method of teaching on academic success. Nagpal compared the effects of the Piagetian method of teaching, objective-centred teaching based on the Advanced Curriculum Model of Cognitive Learning and the traditional method on the achievement in Hindi of primary school students. Both methods of teaching were found to be superior to the traditional method, with the objective-centred method showing superiority of the Piagetian method. Bhalwankar's study examined the effects of expository and guided discovery method of teaching mathematics on achievement. The effectiveness of the two methods differed according to the different instructional objectives as well as the level of intelligence of the students. The research conducted by Kumari found no difference in students' achievement when taught by either the inductive or deductive strategy of instruction, but the combined strategy was more effective than either strategy taught separately (Padma, 2003).

Teacher behaviour was investigated by Yadav (cited in Padma, 2003) who attempted to find the relationship between indirectness in teacher behaviour and pupil achievement. The Flanders Interaction Analysis

Category System was used to measure indirectness. No relationship was found between indirectness and student achievement in high school biology.

With the increase in student numbers at South African tertiary institutions (massification) and limited subsidies, a lecturer is compelled to get through the contact faster in class. Personal contact with students is minimal. Schaap en Buys (cited in Engelbrecht, 1999) contend that this directly influences a student's attitude. A lecturer does not have sufficient class time available to devote the necessary interest and attention to each student. Consequently, the student does not believe that the lecturer can empathise with his/her problems. This, in turn negatively affects the trust and communication between the lecturer and student, which leads to poor academic performance (Engelbrecht, 1999).

2.6.2.2 Parents

Parents' education levels and their beliefs concerning their children as a correlate of academic performance was investigated by Hortacsu (1995) with a Turkish sample characterised by high levels of interdependence among family members, and high levels of parental control over children. Parents' level of education as an index of social context has both physical and psychological aspects and may therefore exert both direct and indirect influences on child outcomes. Direct effects may originate from differences in quality and quantity of educational opportunities available to children, and indirect effects may be attributed to values and beliefs concerning children. A high level of parents' education was association with endorsement of perspectivitistic beliefs and rejection of categorical beliefs for both parents, but the relationship between parent's beliefs and academic performance was different for both parents. Only the level of mother's education was directly related to the child's academic performance. The emergence of a significant relationship between

mother's level of education and GPA is consistent with earlier research involving a similar sample of Turkish children (Hortacsu, Ertem, Kurtoglu & Uzer (1990). Hortacsu (1995) attributes this finding to the fact that women are primarily responsible for childrearing in Turkey. Mothers with higher levels of education are capable of facilitating their children's education, whereas women with lower levels of education are not able to do so.

The relationship between parenting practices and academic performance was investigated by Hae-Song and Bauer (2003). The sample constituted Asian Americans, Hispanics, African Americans and European Americans. The results of the study show revealed that European Americans were more authoritative that other ethnic groups, and there was also only a significant relationship between having an authoritative parenting style and academic performance for this group (Hae-Song and Bauer, 2003).

2.6.2.3 Peers

Niebuhr and Niebuhr (1999) also investigated student-peer relationships. Student-peer relationships positively correlated with performance as well. A possible explanation was that a cohesive student group with high academic norms enhances student motivation, which is in turn related to academic performance. The results of this study suggest a need for future research to examine the impact that motivation has on student relationships.

Engelbrecht (1999) discusses the importance of interpersonal relationships. The vast majority of first-year students exchange familiar surroundings with an established circle of friend for a new environment with no familiar peers. The student's social skills will then determine how long it will take to establish a new social network. This implies that social isolation can become a reality, which may negatively impact academic

performance. The demands of the new peer group plays an important role in the extent to which the student will be able to adjust socially. An academically successful student has better interpersonal relationships and social skills than students who do not perform well academically.

Astin's (1983) Theory of Involvement model emphasises the importance of interaction with peers from the perspective of the active involvement in institutional activities. Astin (1983) contends that the more involved students are in the total college experience, the more satisfied they will be with the institution, they will tend to be well-integrated with their peers and perform better academically.

2.7 Conclusion

According to Daniels & Schouten cited in Louw (1990), cognitive factors constitute 50% of the variance in academic performance. According to the literature surveyed, intellective factors still emerge as the strongest predictor of academic performance. Information Technology students, the subjects in the present study, are also still selected on the basis of an intellective factor, namely Matric results which has consistently been upheld as the single best predictor of academic performance at tertiary level. However, this criterion is insufficient on its own, or else there would be no need for research on non-intellective factors. While the research surveyed in the literature review does not provide any unequivocal irrefutable results, it provides a basis for the wider exploration of certain factors as possible correlates of academic performance.

Chapter 3 also discusses correlates of academic performance, pertaining specifically to those measured by the APA battery, that is language abilities and study skills.

Chapter 3
THE ASSESSMENT OF ACADEMIC PROFICIENCIES

3.1 Introduction

This chapter focuses on the variables evaluated by the Academic Proficiency Assessment battery (APA battery). The APA was compiled by the Directorate of Student Development and Support at the Tshwane University of Technology (formerly Technikon Pretoria) in 2001 in order to assess academic proficiencies in two areas, namely language and study skills. It is not an instrument used for selection to higher education. It is an assessment that aims to identify students who lack the essential academic competencies and language proficiencies required at tertiary level thereby serving as an "early warning system" of students possibly at risk for academic underachievement. In other words, the APA tries to detect students who have already been selected by, and registered at the university, but still lack the necessary language and study skills for satisfactory academic performance.

Foxcroft and Roodt (2001) also note the utility of assessment for such purposes in higher education in South Africa. Other than assisting in admission decisions, another advantage of assessing learners at entry to higher education is that the resultant information can be used for the development of student support initiatives. Rather than only identifying learners who have the potential to succeed, assessment can serve a more developmental purpose that ultimately benefits the learner.

This chapter examines research on the academic proficiencies evaluated by the APA battery, and relevant issues in the assessment of academic proficiencies. It should be noted that no validation studies have been done to confirm that the APA does indeed measure these proficiencies.

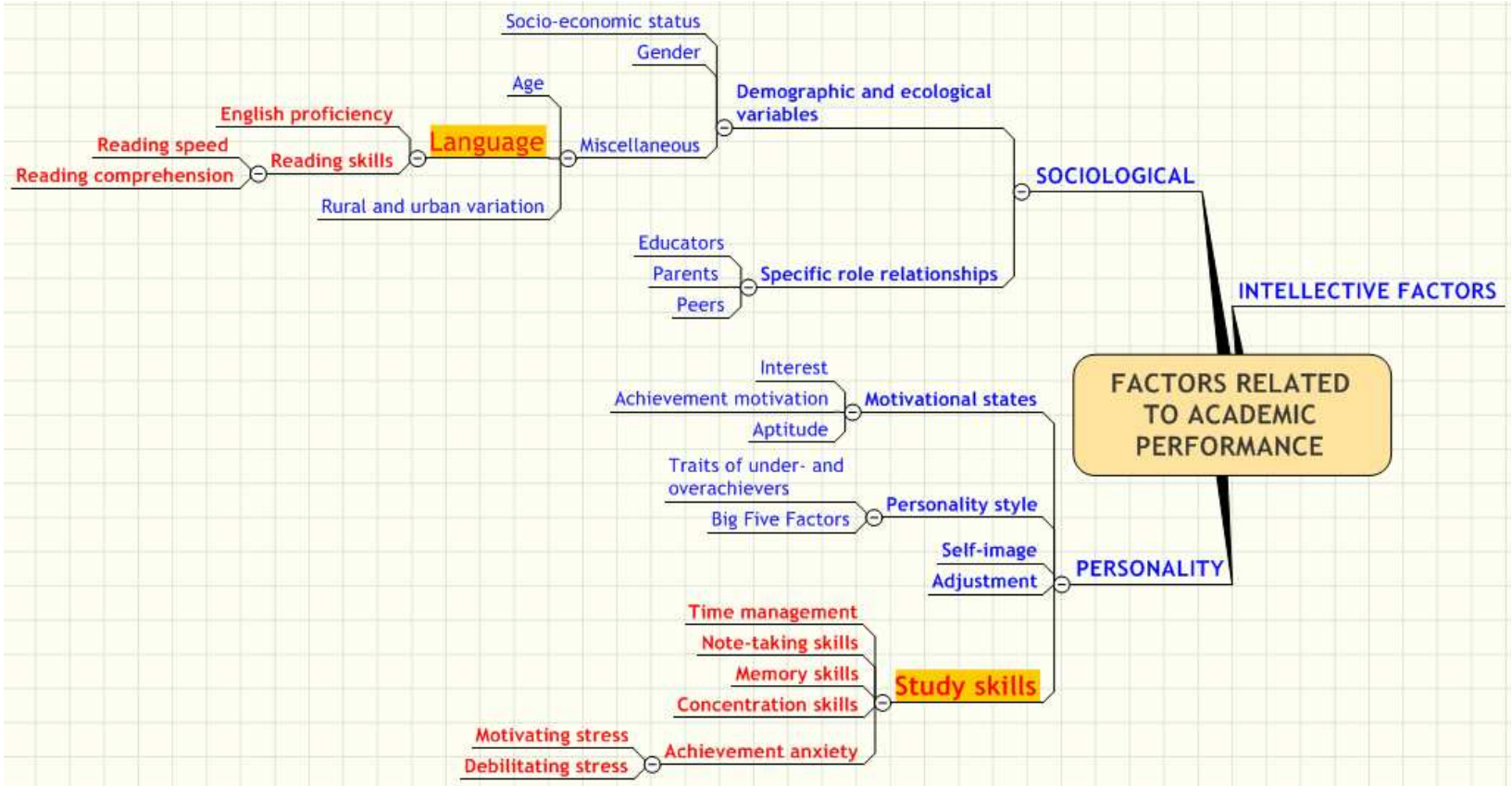


Figure 2. *Factors related to academic performance highlighting factors assessed by the APA battery*

3.2 Academic proficiencies

In this section, each of the seven academic proficiencies (English proficiency, reading skills, time management, note-taking skills, memory skills, examination stress, and concentration skills) will be investigated with regard to its operational definition within Tshwane University of Technology's academic skills development programme, and relevant studies on each variable as a predictor of academic performance

3.2.1 Language

The significance of language was highlighted in Celliers' (2000) research, which indicated that academic support practitioners regarded language as the most important skill required to enhance learners' academic success. Since the official academic languages at Tshwane University of Technology are English and Afrikaans, with lectures being predominantly in English, most learners at Tshwane University of Technology are disadvantaged, as English is the second or even third/fourth language. When entering the Technikon, these learners experience difficulties with language: reading, writing and communicating clearly. This is one of the most serious problems confronting higher education in South Africa, as language is a vehicle that enables learners to successfully complete their studies. Without adequate language competence, and communication skills, learners have a significant problem. Furthermore, learners cannot be given quick fixes in English. Language acquisition and proficiency requires years of constant practice and usage (Celliers, 2000).

Language proficiency is assessed and remediated in two basic ways at Tshwane University of Technology, through English proficiency and reading skills.

3.2.1.1 English Proficiency

Language proficiency will be explicitly defined within in its context, how English is enhanced, and studies on English proficiency as a correlate of academic performance will be discussed in this section.

Tshwane University of Technology's academic support programme attempts to enhance English proficiency using the English Word Power (EWP) program. This is not a basic English literacy course. It is aimed at learners who have basic English skills, but still need to increase their level of English communication considerably. In order to so, EWP attempts to enhance English spelling and grammar. Hence, within the context of this language program, English literacy refers to one's level of English spelling and grammar.

The primary outcome of the English Word Power (EWP) program is to enable the learner to write and speak English with grammatical integrity. It also aims to enhance one's vocabulary and comprehension (EWP, 2000).

The program consists of two modules. The first module aims to equip the learner with sound knowledge of English rules for word-usage, spelling and general vocabulary. The second module teaches how to structure sentences in each of the twelve different tenses. The learner also learns how to structure sentences in both the active and passive voice (EWP, 2000).

EWP has been structured to deliver effective results, whilst building self-confidence. The course commences with relatively easy exercises, and gets progressively more difficult. Each section starts with the learning of a rule, followed by an exercise to check progress, and ends with an assessment (EWP, 2000).

Existing research on the relationship between English proficiency and academic performance may be classified into two groups. The first group analyses the general relationship between the two variables, whereas the

second group focus on the relationship specifically amongst subjects who are the recipients of a bilingual education. According to Srivastava and Ramaswamy (cited in Padma, 2003) a bilingual education implies having a language other than one's mother tongue as a medium of instruction.

With regard to the first group, Padma (2003) cites Mukhopadhyay's and Deka's studies. Mukhopadhyay's indicated that comprehensibility of language used in science textbooks is significantly related to different levels of science achievement. Deka found that low proficiency in certain subjects including vocabulary and spelling, was significantly and positively related to school failure. Eggly, Musial and Smulowitz (1999) study of international graduated medical students using two tests of English proficiency, did not find scores on an objective test of medical knowledge related to English language skills.

In terms of the second group of studies investigating the relationship between English proficiency and academic performance, samples discussed below include limited English proficient (LEP) students, refugees and immigrants, and people for whom English is not the only language of communication. Graham (1987) asserts that there are difficulties in determining the relationship between English language proficiency and academic success amongst students for whom English is a second language, and who are attending an institution where English is the medium of instruction.

Students' inability to express themselves adequately in the medium of instruction has a negative effect on academic performance according to Hunter, and Stark and Lowther (cited by Engelbrecht, 1999). The lack of understanding and comprehension of concepts and principles implies that a student will be unable to conceptualise content, and cannot follow the logical sequence of a cardinal principle or idea. In practical terms, the lack of language proficiency in the medium of instruction, means that the student will not be able to meaningfully be able to talk and write, listen and understand what has been said, substantiate one's viewpoint, nor confidently read, write and communicate (Engelbrecht, 1999).

Hawson (1996) reviewed different perspectives on the relationship between academic performance and second-language learning, failing to find consensus on which factors affect academic outcomes for second language learners.

Saville-Troike (1991) too, concluded that tests of English language proficiency alone are not related to academic performance for limited English proficient (LEP) students. Academic competence is more related to knowing how to use language as a tool in acquiring knowledge and performing analytic processes, but those skills are more related to language competence in general.

A study by Taylor (1978) investigated the relationship between oral English language proficiency and scholastic achievement among Mexican-Americans and Anglo-Americans. A significant relationship was found between English proficiency and scholastic achievement of these fifth grade students.

Friedenberg and Curry (1981) did not find scores on the Michigan Test of English Language Proficiency a strong predictor of academic success. However, they found a significant relationship between English proficiency and grade point average amongst Cuban American students attending a bilingual teacher education programme in Florida.

In Bosher and Rowekamp's (1992) investigation of numerous factors that may be related to the academic success of refugees and immigrants in higher education, English language proficiency emerged as one of the most important predictors.

3.2.1.2 Reading Skills

In Tshwane University of Technology's academic support programme, reading skills are enhanced using the Readers are Leaders program. This program is not an initial reading program, but aims to develop essential reading skills, the two cardinal reading skills being reading speed and comprehension.

Developing reading speed or comprehension individually without the other promotes a mechanistic reading style. Reading speed without comprehension is useless, and maximum comprehension inhibits optimal scholastic achievement (Fourie and Venter, 2000)

Out of the four studies reviewed in this section, three studies found a correlation between reading skills and academic performance.

At-risk college students with reading strategy training earned significantly higher grade point averages than those who received basic reading skills instruction in reading-intensive courses (Stallworth-Clark, 1996). A study by Fields and Cosgrove (2001) examining the relationship between reading level and performance in a general psychology class found a significant relationship between reading level and grade-point average. Celliers' (2000) research undertaken in her own practice revealed that reading enhanced general academic performance. Reading programmes developed fluency, speed, vocabulary and comprehension, therefore overall language proficiency.

Srivastava (1984) cited in Padma (2003) investigated the relationship between reading ability and school achievement using 480 boys and girls from public and private schools. Srivastava's results contradicted the other studies reviewed by failing to indicate any significant relationship between various measures of reading ability and achievement in different school subjects.

3.2.2 Study Skills

3.2.2.1 What do Study Skills entail?

Study methods refer to the general planning, organising and work procedure adhered to attain an academic goal. It encompasses learning skills and conditions for mastering the content. Learning styles and learning strategies also form part of study methods (Kotzé, 1994).

Study methods are different from study habits. Study habits are established patterns of acting that are learnt by repetition. Positive study habits involve responsible learning with the aim of academic success. Motivation and study attitude impact strongly on study habits but not on study methods (Kotzé, 1994).

Kotzé (1994) cites studies by Bell (1985), du Toit (1970), Margrain (1978), Monteith (1984, 1987), Watkins (1982) and Weigel and Weigel (1967) all found a positive relationship between study habits and academic performance. Watkins (1982) found that study methods account for a 10% variance in academic performance at tertiary institutions.

The Tshwane University of Technology Study Methods Course covers the specific modules discussed below, specifically time management, notetaking skills, memory skills, examination stress, and concentration. These modules are also covered within the first year "Life Skills" curriculum as part of academic skills development.

3.2.2.2 Study Skills as a predictor of academic performance

Kriel (2000) found that first year students who attended the "Life Skills" course at Tshwane University of Technology, on average, performed better than those who had not attended the course in all eight subjects for which they were registered.

3.2.2.3 Specific study skills as predictors of achievement

- **Time Management**

Time Management involves more than just being punctual. It entails a sense of organisation and planning that predisposes a student to submitting tasks on time (Brown & Holtzman, 1983).

Studies investigating the relationship between time management and academic performance have provided some evidence for the existence of a significant relationship between the two variables. These studies include research by Smith and Smith (1988), Zhang and Richarde (1999), Lahmers and Zulauf (2000), and Girija's (1980) study (cited in Padma, 2003).

Smith and Smith (1988) assert that successful learners are people who have succeeded in organising themselves in such a manner that they have realised their full potential as students. Full time study varies from any other form of work in one important way: in any other occupation a person has fixed times to work that keep the person busy most of the day. However, at a tertiary institution, aside from the actual time of lectures and laboratories/practicals, there are no fixed times for working at an academic course. It is entirely the learner's responsibility to decide how to utilise the time optimally. Failure to do so, results in not getting the most out of one's studying.

The causal structure between academic performance and cognitive, psychological and facilitative variables during the freshman year in college was studied by Zhang and Richarde (1999). Data from 455 freshmen was used in the analysis. Their structural equation model on Freshman Academic performance indicated that the ability to prioritise study was essential to freshmen academic performance.

A recursive approach was utilised by Lahmers and Zulauf (2000) to identify factors associated with academic time use and academic performance for 79 college students. A regression analysis revealed that time management skills and study time were associated with quarter grade point average.

Girija's (1980) study (cited in Padma, 2003) study of intellectual and non-intellectual factors in academic performance of students from professional colleges also included "planning work efficiently" as a non-intellectual factor that served as a potential contributor to CGPA.

- **Note-Taking**

Note-taking refers to the process of making notes from written communication or written messages. Within the context of this study, note-taking refers to making notes specifically from the textbook. The student has to get his information from a list of books given to him by a lecturer, and has to isolate essential information from what is less important in the textbook (Mutua, Omulando & Otiende, 1992).

Several researchers have focused on the impact of note-taking on learning. Mutua, et al, (1992), Brown (1991), Driskell (2003) and Hult (1984) reported positive effects resulting from the note-taking process.

Mutua, et al (1992, p.35), asserts that good note-taking habits help to train a critical mind, assisting the learner to pass his examinations, and "develop a discerning, astute and appreciative mind which is quick at grasping relevant information". Good note-taking also enhances memory, as the extraction and writing of the notes sets the important facts in the learner's mind.

Brown (1991) conducted a study to evaluate the impact of teaching a structured notetaking procedure to students. Students who learned the technique reported higher success rates than students who had taken the same course the previous term.

Driskell's (2003) study also researched the effect of a system of guided notetaking on academic performance of entering University of Idaho freshmen with low predicted GPA's. Students were given verbal instruction, skills demonstration, class practice, and individual assignment in the notetaking. An analysis of grade point averages revealed that the instructional programme in notetaking had a significant positive impact on academic performance of the freshmen as a general group. The program had an especially marked effect on male subjects, and on those with quantitative majors rather than verbal majors.

Hult (1984) attempted to assess if notetaking effectiveness was positively related to learning. After a comparison of the notes of high and low effective notetakers, Hult concluded that note taking as an activity, and independent of note review, was positively correlated to learning.

Contradicting the previous three studies, Howe's (1976) review of studies on notetaking revealed no evidence that notetaking activities have a positive impact on learning. Howe (1976) suggested that future research needs to emphasise types of notetaking strategies and the use students make of notes.

- **Memorisation skills**

Memorisation skills refer to the different methods, aids and strategies used to enhance recall of significant information (Mutua, et al, 1992). The purpose of any assessment procedure is to test understanding. This is demonstrated by a student's ability to select only the facts and arguments that the question asks for. For this a firm grasp of the essential body of knowledge of the subject is required, and this essential body of knowledge has to be remembered. Memory skills improve one's ability to remember information (Williams, 1989).

Baehre & Gentile's (1991) classroom evaluation of 58 eighth grade students also found that students using the keyword mnemonic technique resulted in improved performance when learning social studies facts.

Memory was one of the seven modules in the University of Auckland's Intensive Learning Skills Course for university students on academic probation. Students who attended the course improved significantly in their academic performance than students on probation who did not take the course (Manalo, 1996).

- **Concentration Skills**

Concentration refers to mental tenacity. It is the ability to give one's mind an order and have the mind obey. Furthermore, it is the discipline of focussing on a chosen activity and ignoring all irrelevant matters, as well as having the strength to impose on time, people, and events one's priorities (Horn, 1991).

The benefits of optimal concentration are an increased output, optimal performance, decrease in time spent studying, enhanced self-confidence, and a student can accomplish desired goals and transcend one's abilities and circumstances (Horn, 1991).

Concentration was also one of the modules in the University of Auckland's Intensive Learning Skills Course where academic performance improved significantly after attending the course (Manalo, 1996).

- **Examination stress**

Examination stress can be positive or negative. Positive stress is known as *motivating stress*. It is characterised by greater mental alertness and enthusiasm, and results in enhanced academic performance. Negative stress is *paralysing stress*. This can result in a decline in health and affects different people in various ways. This negative stress condition also leads to a decline in academic performance (Beaty & Barling, 1982).

Stress is a two-stage process. Firstly, a person becomes aware of the different physical sensations. Secondly, the person interprets and labels each of the physical sensations. Typical sensations are sweating, increased heart/pulse rate, panic, "butterflies in the stomach". Whether one experiences these sensations as a help or barrier, determines whether the person labels the stress as motivating or paralysing (Beaty & Barling, 1982).

Paralysing stress levels are regulated in two predominant ways in study methods programmes. Firstly, through instruction in the use of relaxation

techniques, and secondly by equipping students with appropriate test-taking skills.

Test-taking techniques deal with the mental and physical components of stress (Ellis, 1997). Norton and Crowley (1995) questioned if students can be helped to learn how to learn by evaluating a British learning programme for first year degree students. The workshops focused on essay writing and test-taking skills. Regular attendees of the workshops had higher examination scores, but the results did not reveal as clear-cut results for differences in overall academic performance.

Carrier's (1984) study of 87 high school students indicated that anxiety was not necessarily detrimental to performance. Griffore's (1975) results supported the predicted relationship between achievement anxiety reaction type and academic performance, with the inverted-U hypothesis partially accounting for the relationship.

Padma (2003) cites Girija's (1980) comprehensive study, which also included performance anxiety as a possible factor affecting academic performance.

3.3 The assessment of academic proficiencies

This section reviews existing instruments assessing academic proficiencies. The Wrenn Study Habits Inventory, the Approaches to Studying Inventory, the Study Process Questionnaire and the Learning and Study Strategies Inventory (LASSI) and the Survey of Study Habits and Attitudes (SSHA) has been used in the assessment of study skills.

3.3.1 Learning and Study Strategies Inventory (LASSI)

3.3.1.1 Description of the Inventory

The LASSI is a 10-scale, 80 item assessment of students' awareness of the use of learning and study strategies, related to skill, will and self-regulation

components of strategic learning. The assessment covers both covert and overt thoughts, behaviours, attitudes and beliefs relevant to successful learning and that can be modified through appropriate educational interventions, like learning and study skills courses (Learning and Study Strategies Inventory, 2003).

The LASSI provides standardised scores and national (American) norms for ten scales, namely attitude towards college, level of motivation, time management skills, and anxiety about academic performance, concentration level, information processing skills, and ability to select main ideas, use of study aids, test preparation abilities, and utilisation of test strategies. Table 4 (Appendix B) provides some indication of the reliability of the instrument (Electronic Learning and Study Strategies Inventory, 2003).

The LASSI is both diagnostic and prescriptive. It provides students with a diagnosis of their strengths and weaknesses, and is prescriptive as it provides feedback on areas where students may require intervention (Learning and Study Strategies Inventory, 2003).

3.3.1.2 Learning and Study Strategies Inventory as a predictor of academic performance

Rugsaken, Robertson and Jones (1998) investigated the efficacy of the LASSI as an additional predictor of college students' academic performance. This study was very similar to the present research project. Common variables included traditional predictors (high school scores), academic performance, and a study skills questionnaire. The results of Rugsaken et al's study indicated that the LASSI scores provided a slight, but not significant increase in predictability of academic performance.

3.3.2 Survey of Study Habits and Attitudes (SSHA)

The SSHA is basically the only assessment categorised as a psychometric test in South Africa in the field of evaluation of study methods. However, the

reason it is no longer used as part of the academic development programme is because the score on the Study Habits scale only gives an overall score of the efficacy of study methods. The scoring system does not specify which specific aspect of the study method is a problem. Although valuable information may be gleaned from the assessment if individual responses to items are analysed qualitatively, this is logistically impractical and extremely time-consuming if done on a large-scale.

3.3.3 Biggs's Study Process Questionnaire (SPQ)

3.3.3.1 Description of the Questionnaire

Biggs' Study Process Questionnaire is a diagnostic tool that attempts to identify the learning approaches of students. The SPQ consists of 42 items. It provides feedback on the learning approaches in three domains: surface, deep and achieving domains (see Appendix A). Each domain is further subdivided into motives and strategies used (Hua, Williams & Hoi, 2003).

In order to ease facilitation and administration of the questionnaire, a web-based version of the questionnaire has been developed, that automatically generates the feedback to students and class profile reports to tutors (Hua, et al, 2003).

3.3.3.2 Biggs's Study Process Questionnaire as a predictor of academic performance

The correlation of the SPQ with academic performance indicates that students classified as surface learners tend to have lower academic performance. However, the low-achieving students were not necessarily at risk of failing the course (mathematics). Hence, the SPQ as a diagnostic tool to identify at-risk students is questionable. The researchers contended that there were 'noise' factors prevalent, which were not accounted for in the study (Hua, et al, 2003).

3.3.4 Approaches and Study Skills Inventory for Students

3.3.4.1 Description of the Inventory

The Approaches and Study Skills Inventory for Students appears to be very similar to the Biggs Study Process Questionnaire. It also proposes three approaches to learning, surface, deep and strategic. The Biggs instrument has chivvying as the third approach.

3.3.4.2 Predicting academic performance

Diseth and Martinsen (2003) analysed the relationship between the three approaches to learning and academic performance. A sample of 192 undergraduate psychology students with a mean age of 21.7 years participated. Surprisingly, the deep approach did not predict achievement, while the other two approaches significantly predicted academic performance.

An earlier study by Diseth (2002) found a curvilinear relationship between the surface approach and academic performance. Multiple regression analysis showed interaction effects between deep-strategic and surface-strategic approaches to learning as predictors of academic performance, supporting the construct validity of approaches to learning.

3.3.5 van Schoor's Study Process Questionnaire (SPQ)

Bearing the same name as the questionnaire by Biggs, it is however a different questionnaire. The questionnaire is utilised by the University of South Africa's Bureau for Student Counselling and Career Development. Unisa is a distance learning institution, and this questionnaire is appropriately web-based. The SPQ assists a student to identify possible problem areas in the way he or she studies. It is utilised to assess study habits, attitudes and environment, and can be used to prepare a study programme. The 70 items evaluate organisation of the study process, time management, external interruptions in the study space, concentration, internal/external motivation,

examination skills, classroom behaviour, library skills, attitude towards learning, psychosomatic symptoms, personal problems, uncritical learning approach, study venue, and academic confidence (Study Process Questionnaire, 2002).

3.3.6 Study Skills Questionnaire (SSQUES)

3.3.6.1 Description of the Questionnaire

The SSQUES is a 30-item questionnaire that assesses a student's study skills in four areas: reading comprehension, memorisation, concentration management and test taking (McCombs and Dobrovolny, 1980).

3.3.6.2 SSQUES as a predictor of academic performance

McCombs and Dobrovolny (1980) evaluated the potential reliability and predictive validity of the SSQUES in predicting student performance, and identifying students requiring some type of study skills remediation. The SSQUES demonstrated significant reliability, construct validity and predictive validity in predicting student achievement and to discriminate between students who would perform well as opposed to those who would perform poorly.

3.4 Assessment in the South African context

3.4.1 The utility of assessment measures in contemporary South Africa

Academics still maintain that testing has a significant role. The need for tests in a multicultural South Africa is greater than elsewhere as valid assessment is a necessary condition for equity and the effective management of personal development. Psychological assessment continues to assist in decision-making processes provided it is used fairly, ethically and responsibly. Testing is not regarded as perfect, but comparable to alternative assessment techniques utilised in selection, placement and guidance and contributes to a

more reliable, fair and cost-effective results (Plug, 1996).

3.4.2 Escalating diversity and accelerated change

Erasmus (1997) contends that the most critical issues pertaining to reliability and validity in testing in South Africa are escalating diversity and accelerated change.

Erasmus (1997) stresses the role of cultures in the performance on psychometric tests. He takes into account the references that suggest that Black Americans perform lower on intelligence tests than Whites and rationalises this as the tendency of American test constructors to select test items to favour the white culture since that culture represents the majority. This is very applicable to the South African situation too. Instruments historically used in South Africa were usually imported from other Western countries, and thereafter adapted to predominantly accommodate South African Whites.

The demographic character of contemporary tertiary institutions has altered drastically from that of the past. There is a rapid decline in the test takers conforming to the norms of the 'adapted adopted' instruments. A possible alternative to overcoming this test bias may be differential norms, where different cultural groups have different norms. However, this may be viewed as discriminatory (Erasmus, 1997).

Erasmus (1997) also discusses his research that indicates the speed at which test norms become outdated. Performance of a given group of testees changes from one year to the next. In the past environments were relatively stable, static and to a large degree homogenous.

3.5 Conclusion

Based on the studies reviewed in this chapter, a considerable body of research exists indicating the likelihood of language abilities and study skills

contributing to academic performance. Numerous batteries of tests have also been developed to assess such proficiencies. Given the existence of other batteries of tests, the purpose of this study is to identify if, the Academic Proficiency Assessment's (APA's) psychometric properties validate its addition it to the portfolio of such assessments. It does so by examining the internal consistency of each of the questionnaires in the APA. Recommendations are then made on how each questionnaire may be enhanced.

The study then attempts to validate the APA as a predictor of academic achievement. This is done by evaluating the extent to which each of the tests is a predictor of academic achievement by using a multiple regression analysis, and a discriminant function analysis.

Chapter 4
METHODOLOGY

4.1 Introduction

This chapter addresses the methodology of the present research project. The research questions are stated and variables specified, the sample and sampling method is elaborated upon, the instruments utilised are discussed, and the research design and procedure is explained. Finally, the methods of statistical analyses are introduced.

4.2 Research questions

4.2.1 Are all the questionnaire of the Academic Proficiency Assessment (APA) battery reliable?

This research question addressed the psychometric properties of the APA, with specific reference to the internal consistency reliability of the questionnaires forming part of the battery.

The questionnaires that constituted the APA battery were:

- English proficiency
- Reading comprehension
- Time management
- Note-taking skills
- Memorisation skills
- Concentration skills
- Achievement anxiety (debilitating stress scale)
- Achievement anxiety (motivating stress scale)

4.2.2 If any of the questionnaires in the APA are not reliable, what changes can be implemented to enhance its psychometric properties?

After addressing the first research question, for those of the APA questionnaires listed below that were found to be unreliable, the second research question investigated the reasons for the inadequate reliability, and options to enhance the reliabilities of the relevant questionnaires:

- English proficiency
- Reading comprehension
- Time management
- Note-taking skills
- Memorisation skills
- Concentration skills
- Achievement anxiety (debilitating stress scale)
- Achievement anxiety (motivating stress scale)

4.2.3 What is the predictive validity of the tests in the APA battery for Information Technology students?

This research question investigated the validity of the questionnaires in the APA battery as a predictor of academic performance for Information Technology students.

The response variable was academic performance and the predictor variables were:

- English proficiency
- Reading comprehension
- Time management
- Note-taking skills
- Memorisation skills
- Concentration skills

- Debilitating stress
- Motivating stress

4.2.4 Are there additional variables that predict the academic performance of Information Technology students?

Although the literature survey indicated that were many additional variables that could have been included in this research, the scope of the present study limited the investigation of additional predictors to biographical variables and Matric results. The three biographical variables (age, gender and predominant language of communication) solicited in the biographical questionnaire were investigated as predictors of academic performance. Matric results were also included as a variable, as Matric has consistently emerged as the best predictor in a number of previous studies, and is also the primary selection tool for admission to the Information Technology course.

This research question was added as an additional question, and not included with research question three as the sample size prevented statistical analysis with the chosen statistical techniques using all the variables (academic proficiencies, biographical variables and Matric results) in a single analysis. Most authors suggest that one should have at least ten to twenty times as many respondents as one has variables, otherwise the estimates of the regression line are probably very unstable and unlikely to replicate if one were to do the study over (StatSoft, Inc., 2001). Although the size of the sample was 133 respondents, depending on the variables in question, due to the missing cases, the sample size ranged from 97 to 107. This implied that a maximum of ten predictor variables could be included ina regression, whereas the study consists of thirteen predictor variables.

4.2.5 An integrated regression model

In order to consolidate the results of research questions three and four, an additional multiple regression analysis was executed, including as predictor

variables, the variables that were found significant in research questions three and four.

4.3 Sample

The type of sampling as well as the subjects who constitute the sample is discussed in this section.

4.3.1 Sampling method

A nonprobability convenience sampling method was used, as the sample had not been randomly selected. More specifically, purposive sampling had been used. There had been an intentional attempt to obtain a representative sample by utilising a presumably typical group of students studying a particular course as the sample (Kerlinger, 1986). The present research project was the second phase investigating correlates of academic performance for Information Technology students at Tshwane University of Technology. As SpEEx, the supplementary selection tool for admission to Tshwane University of Technology was found to have limited utility in the prediction of academic performance (Kriel, 2002), alternate predictors were sought, thereby having presented Information Technology students as a convenient sample.

4.3.2 Description of the sample

The sample constituted 133 first year Information Technology students at Tshwane University of Technology. The sample was made up of 53 females and 79 males (Figure 4). Afrikaans was the most spoken language amongst the Information Technology students. Afrikaans was the predominant language of communication for 28 students, 18 were English, and the rest of the students' predominant language was one of the official African languages (Figure 5). Home language was classified in this way, as the University's official languages at the time were English and Afrikaans. Examinations could be written in one of the two languages. Most of the subjects were between 19

and 24 years (Figure 6). However, only 23% of the sample was 18 or 19 years old – the age usually expected for first year students. 25% of the sample was older than 21, indicating that adult learners also made up a substantial proportion of the group.

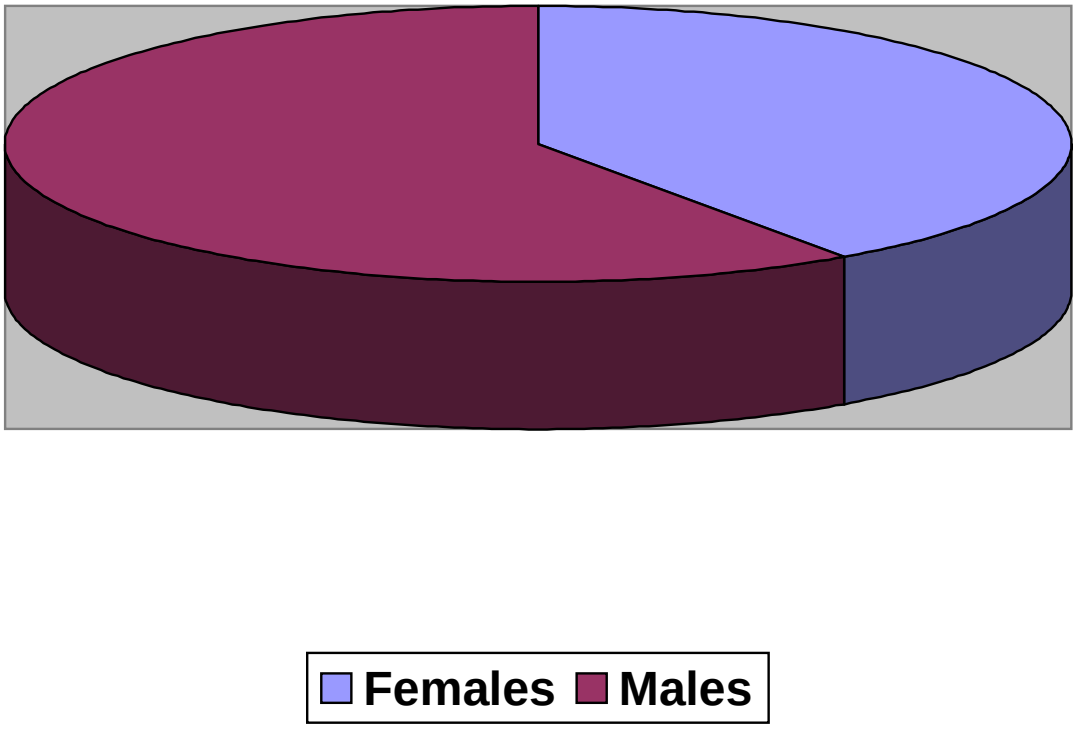


Figure 4. *Gender.*

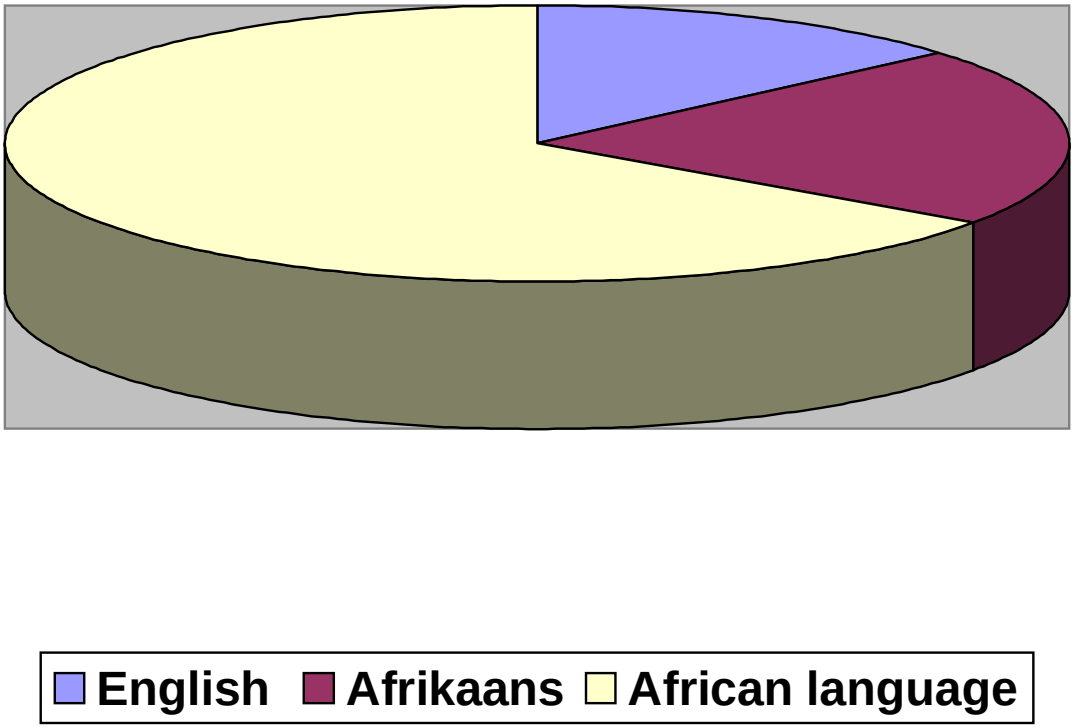


Figure 5. *Predominant language of communication.*

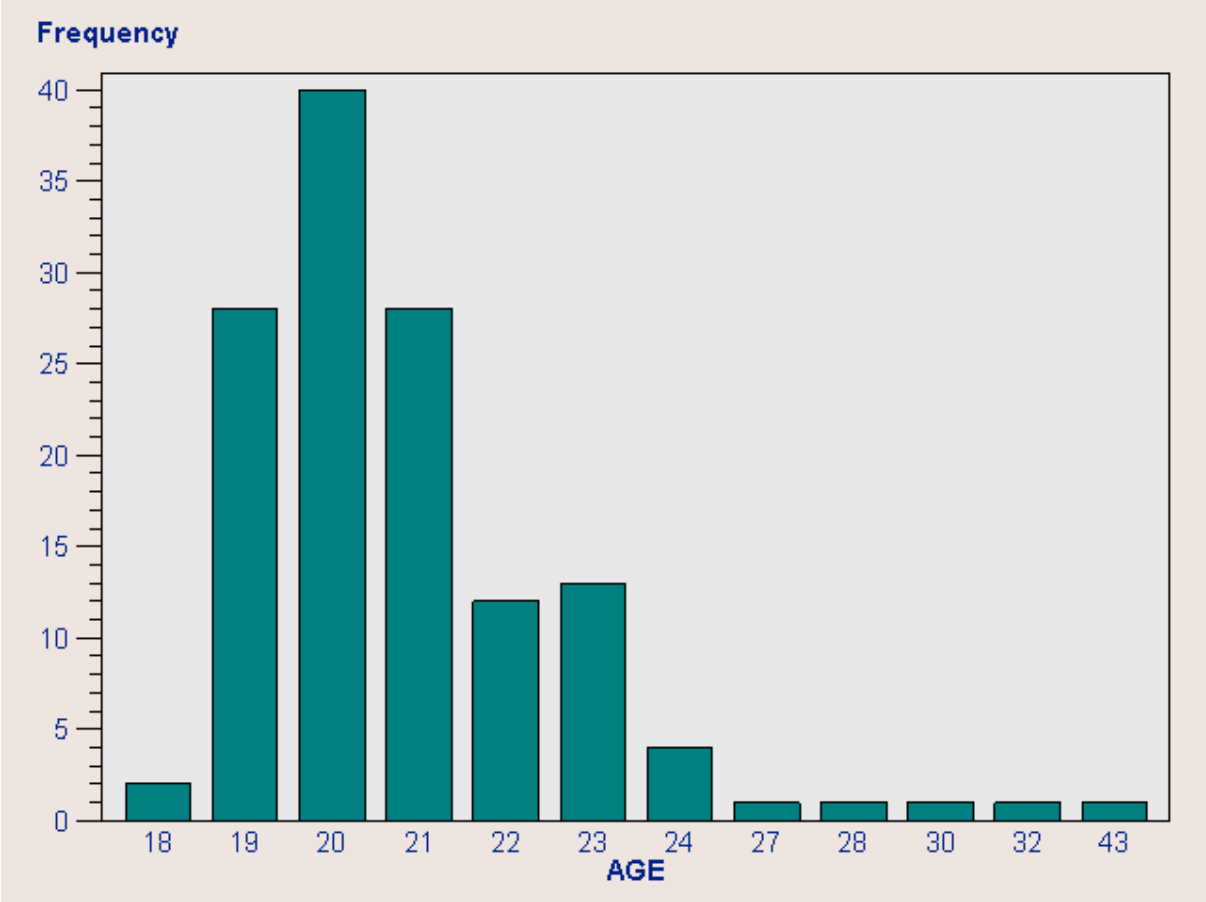

Frequency
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27
28
30
32
43
AGE

Figure 6. *Age.*

4.4 Instruments

Data for the research was obtained from three sources: the APA battery database, questionnaires eliciting biographical details and Matric results, and the Integrated Tertiary System database.

4.4.1 Academic Proficiency Assessment battery

The battery of questionnaires that constituted the Academic Proficiency Assessment (APA) battery were the primary focus of this study.

4.4.1.1 English proficiency

The English proficiency questionnaire is directly related to the "English Word Power" English enhancement programme. It consisted of 100 multiple-choice items testing spelling and grammar, and was a criterion-referenced achievement test.

4.4.1.2 Reading skills

The reading skills test had two components. Reading speed was indicated in words per minute by timing how long a student took to read a passage on the appropriate grade level. The result of the reading speed test was the only norm-referenced item amongst all the questionnaires in the battery. Thereafter, a comprehension test on the passage was answered to assess understanding of the passage read. The comprehension test was also a criterion-referenced achievement test.

4.4.1.3 Time Management

Time management was measured using a questionnaire adapted from the Delay Avoidance scale on the Survey of Study Habits and Attitudes (du Toit, 1970).

4.4.1.4 Note-taking skills

The use of appropriate note-taking and summarising skills were evaluated from an adaptation of Brown's (1994) checklist.

4.4.1.5 Memorisation skills

The utilisation of memory techniques was assessed using a nine-item questionnaire (Horn, 1991).

4.4.1.6 Concentration

Concentration skills while studying were tested using Horn's (1991) modified nine-item questionnaire.

4.4.1.7 Examination stress

Examination stress levels were identified using an adaptation of the Achievement Anxiety Test. This questionnaire had two subscales namely paralysing exam stress and motivating exam stress (Alpert & Haber cited in Barling & Beaty, 1982).

The dimensionality and utility of the AAT was investigated by Watson (1988). Her analyses suggested the viability of a unidimensional construct, and had potential for separating debilitating and facilitating test anxiety aspects.

Plake's (1981) investigation of the concurrent and predictive validity of the AAT raised concern about the quality of the difference score as a result of the nonindependence of the two scores. Furthermore, the underlying structure of the instrument seems to be more complex than initially hypothesised. Plake (1981, April) also examined the factor structure of the AAT. A principal component factor analysis specifying a two-factor solution was selected to provide a check on the soundness of considering AAT as comprising two

independent factors. Results of the two-factor varimax rotation showed that 16 of the 19 items had sufficiently high loadings on either of the factors, using 0.40 as the cut-off value.

4.4.2 Biographical questionnaire

Biographical details (age, gender and predominant language of communication) were obtained from a biographical questionnaire that was completed by the subjects during the same session that the APA battery was completed. The biographical questionnaire also included a consent section, which asked the subject if the researcher could utilise his/her Matric, APA and course results for research purposes.

4.4.3 Integrated Tertiary System (ITS)

The ITS is the central database utilised by Tshwane University of Technology. Course results were obtained from this database.

4.4.3.1 Matric results

Three details of the Matric results were captured: subjects, symbols and grades (higher/standard/lower).

The conventional methods of quantifying matriculation symbols are by conversion to an M-score or by using the Swedish Formula. For the present study, the matriculation symbols were converted using the Swedish formulae, and aggregated. The results were obtained for six subjects were utilised. If a student had results available for more than six subjects, the lowest scores were omitted.

Table 5

Quantification of matriculation symbols using the Swedish formula

Matric symbols	HG	SG
A	8	6
B	7	5
C	6	4
D	5	3
E	4	2
F	3	1

4.4.3.1 Course results

In the first year of studying Information Technology at Tshwane University of Technology, eight modules were usually studied. These modules spanned four subjects, the first module of the subject being studied in the first semester, and the second module in the subsequent semester. The four subjects were Information Systems, Development Software, Systems Software and Information Technology Skills. A continuous measure of academic performance was the cumulative grade point average (CGPA) which was obtained from the mean of the results of the eight modules.

However, the CGPA may not necessarily be the best measure of academic performance, particularly when selecting for remedial intervention. When selecting for remedial intervention, it may be necessary to differentiate between successful and unsuccessful students, as unsuccessful students are likely to require remediation. A dichotomous measure of academic performance was categorising students as successful or unsuccessful. A successful student would be a student likely to obtain the Information Technology qualification in three years, which is the minimum duration of the course. A student was coded as successful if he/she passed six, seven or eight of the eight subjects, as such a student could possibly qualify in three

years without remedial intervention. A student was coded as unsuccessful if zero to five of the eight subjects were passed. Students were classified in this manner, as this would

Swanepoel (2002) and Smith's (1979) assumptions are adopted for the present study:

1. It is assumed that a student's final mark for each subject, is an objective measure of academic performance.
2. The mark obtained in a specific subject is equivalent to the same mark obtained in another subject.
3. The degree of difficulty of the four different subjects is the same.

4.5 Design and Procedure

The research design and procedure for conducting the study are explained in this section

4.5.1 Design

This was a non-experimental, correlational and descriptive study. These concepts will be elaborated upon in this section.

4.5.1.1 Non-experimental

The study was non-experimental, as the independent variable (academic performance) was not manipulated, there was no control over extraneous variables, and there was no random assignment of subjects to different conditions. The role of the researcher was essentially that of an observer who was attempting to quantify the relationship between academic performance and the various independent variables (academic proficiencies, biographical variables and Matric results) to determine if there was a correlation. No experimental treatment was executed (Potter, 1998).

This type of research is especially useful for descriptive and construct-seeking, rather than for inferential purposes. Its explanatory power can be enhanced through cross validation/replication. However, the disadvantage of this design is that there are many potential threats to the internal validity of the study, like the third variable problem, and problems due to causal arrow ambiguity (Potter, 1998).

4.5.1.2 Correlational

Correlation refers to a co- or joint relationship between or amongst two variables. Correlational research entails obtaining pairs of observations on a group of subjects, comparing the scores, and calculating an index representing the relationship between the two sets of scores. In the present study, a relationship between academic performance and the various independent variables (academic proficiencies, biographical variables and Matric results) was sought. The relationships found indicated a relationship of association rather than of causation (Potter, 1998).

The present study was one approach to a correlational design – a longitudinal design. A longitudinal design is usually used for predictive validation purposes. The predictor variables, the APA battery was administered at the beginning of the academic year, and the response variables were obtained at a different point in time, that is the subject results were obtained at the end of the year. This form of prediction should be utilised cautiously. This design is criticised due to lack of randomisation, control over variables by the researcher, and the absence of a control group, and history was a genuine threat to internal validity. As the literature survey indicated, a myriad of other factors have been linked to academic performance. Only a few of those factors have been investigated in this study. It is likely, and even probable, that some of those additional factors may have affected student academic performance during the duration of the study (Potter, 1998).

4.5.1.3 Descriptive

Descriptive research has an investigatory focus that tends to attempt to carefully map out a situation or set of events in order to describe what is occurring behaviourally. This type of focus is usually considered a necessary first step in the development of a programme of research, as it establishes the foundation of any future ventures. However, it is seldom regarded as sufficient, as a point will be reached where the reasons and processes underlying the behaviours will be questioned (Rosenthal & Rosnow, 1991).

This study is descriptive, as it aimed to depict the psychometric properties of the APA. It is the starting point for further research into enhancing and validating the APA.

4.5.2 Procedure

The Academic Proficiency Assessment battery was administered to the sample group when they commenced with their course. A biographical questionnaire was also administered during the testing session. At the end of the academic year, academic performance was correlated with the biographical variables and the APA battery. Students who had received any remedial intervention during the year were excluded from the study, as their APA scores were likely to have changed after the intervention.

4.6 Statistical analyses

A variety of statistical methods were utilised to analyse the data. The data were processed using Enterprise Guide.

4.6.1 Statistical methods for research question 1

In order to assess the internal consistency reliability of the questionnaires, Cronbach's coefficient alpha (r_α) and the Kuder-Richardson formula 20 (KR-20) were utilised.

4.6.1.1 Cronbach's coefficient alpha (r_α)

There are two basic approaches of estimating the reliability of an individual test without developing alternate forms and without administering the test twice to the same subjects. The first approach correlates the results from one half of the test with other half of the test, and is referred to as split-half reliability. The second approach, which was the one utilised in the present study, examines the internal consistency of individual test items, determining whether the items tend to measure the same factors (Gregory, 1996).

Cronbach (1951) criticised the reliance on a single split, advocating taking a more typical value such as the mean of the split-half coefficients resulting from all possible splittings of a test to estimate the reliability of a psychological test. Coefficient alpha may be regarded as the mean of all possible split-half coefficients, corrected by the Spearman-Brown formula. Coefficient alpha ranges from 0 to 1.00 (Gregory, 1996).

A high coefficient alpha implies that not matter how the test is split, scores on the two halves almost always correlate to a very high degree. This would indicate that the individual test items must be homogenous, that is, the items tend to measure a single trait. If the individual items were multifactorial, then many of the possible split-half combinations would include large numbers off one trait at the expense of the other traits measured by the test. In those cases, the two split halves would measure different characteristics, correlating minimally or not at all, lowering the average split-half correlation among all possible half-tests. Hence, coefficient alpha may be regarded as an index of the degree to which a test measures a single factor. Homogenous tests that are unifactorial yield high values of coefficient alpha. Therefore, coefficient alpha is referred to as an index of internal consistency (Gregory, 1996).

To assess internal consistency reliability of the English Proficiency of the Time Management, Note-Taking Skills, and Memorisation Skills, Concentration Skills, and Achievement anxiety questionnaires, Cronbach's coefficient alpha

(r_α) was used as an index of internal consistency. For the Achievement Anxiety questionnaire, the debilitating stress and motivating stress scales were analysed separately. Other factors held constant, coefficient alpha will be high to the extent that many items are included in the scale, and the items are highly correlated with one another (Hatcher, 1994).

4.6.1.2 Kuder-Richardson formula 20 (KR-20)

The scores on the Reading Comprehension questionnaire were on a nominal scale, where responses were scored either incorrect (zero) or correct (one). Hence, Kuder-Richardson formula 20 (KR-20) was a more appropriate measure of internal consistency. The KR-20 formula is relevant to the special case where each test item is scored 0 or 1 (e.g., wrong or right). Coefficient alpha is basically the general application of the KR-20 formula, which is a more specific formula (Gregory, 1996).

4.6.1.3 Interpretation of reliability coefficients

What is an acceptable level of reliability? There is no clear-cut answer to this question. Many authors suggest that reliability should be at least .90 for decisions about individuals, with .95 being the desired standared. Hatcher (1994) mentions Nunnally's (1978) widely used rule of thumb of .70, and many standard tests with reliabilities as low as .70 have proven to be very useful. Tests with even lower reliabilities have been useful in research (Gregory, 1996). Owen and Taljaard (1996) state a reliability coefficient of .60 can provide useful information as long as the test results are interpreted appropriately. On the contrary, Galpin (2001) contends that a value under 0.6 is regarded as indicating poor reliability. Thorndike (1951) asserts that reliability coefficients as low as .40 or .50 are even acceptable if urgent decisions need to be made, and the only measurements available are unreliable. For the purpose of this study, Nunally's general rule of thumb of .70 will be applied as the acceptable standard of reliability.

4.6.2 Statistical methods for research question 2

An analysis of the Cronbach's coefficient alpha and the item-difficulty values for the two achievement tests (English proficiency and Reading comprehension) provided the guidelines for recommendations for enhancing the internal consistency of the questionnaires.

4.6.2.1 Cronbach's coefficient alpha

An inadequate coefficient alpha, may be improved by dropping from the scale those items that demonstrate poor item-total correlations. An item-total correlation is the correlation between the individual item, and the sum of the remaining items in the scale. A low item-total correlation is regarded as evidence that the item is not measuring the same construct that is measured by the items in the scale (Hatcher, 1994).

4.6.2.2 Item difficulty

The difficulty value of an item (p_i) is the proportion or percentage of individuals who answer the items correctly.

$$p_i = \frac{\text{Number of people who answered the item correctly}}{\text{Number of people who took the measure}} \text{ X } 100$$

The higher the percentage of correct responses, the easier the item. The optimal level of item difficulty is 50%, ranging between 30% and 70%, in order to for the test to maximise the information provided about the differences between testees. The exception to this rule is true/false or multiple-choice items. The optimal level of item difficulty for these two formats is computed from the formula:

$$\text{Optimal level of } p_I = \frac{1.0 + g}{2} \quad X\ 100$$

$$\text{where} \quad g = \text{Chance success level} = \frac{1}{\text{Number of options}}$$

4.6.3 Statistical methods for research question 3

This research question addressed the predictive validity of the APA battery as a predictor of academic performance. In a predictive validation study, scores are used to estimate measures obtained at a later time. The criterion measures are obtained in the future, usually months or years after the test scores are obtained. Predictive validity is one approach to criterion-related validity. Criterion-related validity is exhibited when a test is shown to be effective in estimating a testee's performance on some outcome measure. The variable of primary interest is the outcome measure, regarded as the criterion. The test score is useful to the extent that it accurately predicts the criterion. In this case the criterion is academic performance which is obtained almost eleven months after the APA questionnaires are administered (Gregory, 1996).

4.6.3.1 Multiple regression

When tests are utilised for prediction purposes, it is necessary to develop a regression equation that describes the best-fitting straight line for estimating academic performance from the APA's scores. The relationship between the APA's scores and academic performance may be expressed in various ways. The most common approach is to compute the correlation between the two (r_{xy}). This is known as the validity coefficient. The higher the validity coefficient r_{xy} the more accurate the APA battery is in predicting academic performance (Gregory, 1996). In order to compute this validity coefficient, multiple regression analyses was used to analyse the data captured for determining the predictive validity of the APA battery. The multiple regression

procedure comprised two main parts. In the first part of the analysis, a correlation matrix was extracted. The second part entailed performing the actual multiple regression analyses (StatSoft, Inc., 2001).

- **Correlation**

Correlation is an index of the relationship between two variables. Pearson's *r*, is the most widely used correlation coefficient . *r* ranges from –1.00 to +1.00. (StatSoft, Inc., 2001). Hatcher (1994) provides an approximate guide for interpreting the strength of the relationship between two variables:

±1.00 = perfect correlation
±.80 = strong correlation
±.50 = moderate correlation
±.20 = weak correlation
±.00 = no correlation

The assumptions for Pearson's *r* are that both the predictor and criterion variables should be at least an interval level of measurement, there should be random sampling, a linear relationship between the criterion variable and predictor variable, and the pairs of scores should follow a bivariate normal distribution (Hatcher, 1994).

Two or more explanatory variables in a regression model being highly correlated is referred to as multicollinearity. Multicollinearity makes it difficult to separate the individual effects of the correlated variables on the dependent variable (Vogiatzi, 2002). One way to assess the extent of the multicollinearity between two variables is to compute the simple correlation coefficient between two explanatory variables. When two or more independent variables in a regression model are correlated, they contribute redundant information. Hence, even though each independent variable contributes information for describing and predicting the dependent variable, some of the information overlaps (Bowerman & O' Connell, 1990).

Multicollinearity is not a problem if the aim of the analysis is to simply predict *Y* from a set of *X* variables. The predictions will still be accurate, and the R^2_{adj} will still quantify how well the model predicts the *Y* values. However, if it is imperative to understand the individual contribution of each *X* variable to the prediction of *Y*, then multicollinearity is a serious problem. One problem is that the individual *p* value can be high, even though the variable is important. So, a variable may be excluded from the model although it may possibly be significant. A second problem is that the confidence intervals on the regression coefficients will be very wide, and may even include zero. Thus, one cannot even be confident whether an increase in the *X* value is related to a change in *Y* (Motulsky, 2002).

- **Multiple regression equation**

The actual multiple regression analysis involves finding a regression equation to predict academic performance on the basis of a number of predictors (the questionnaires in the APA battery). The equation is represented as:

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + ... + b_nx_n$$

where *y* is the dependent variable, *a* is the intercept, *b* is the coefficient of the respective *x,* and *x* is the independent variable/predictor/regressor. The coefficient indicates what relationship the specific variable has with the dependent variable, when all the other independent variables are held constant (Howell, 1992; Lea, 1997).

- **Assumptions underlying multiple regression**

The assumptions for multiple regression are that all the variables are in the equation, errors are uncorrelated, errors have the same variance throughout, there is no change of regime, there are no outliers, there are no influential points, and residuals are normally distributed (Galpin, 2001).

- **Model and variable selection**

When there is a large set of independent variables, multiple regression attempts to determine which subset of them are most useful for predicting the dependent variable. A screening procedure is required to identify the most important subset of independent variables. The stepwise selection procedure is a useful technique of variable selection in the exploratory phases of research, or for the purpose of prediction. Stepwise methods include forward selection, backward elimination and the combined method (Lea, 1997; Menard, 1995).

For the present analysis a forward selection model was utilised. In a forward selection model, all simple linear regression models involving only one independent variable at a time are considered, in order to determine which gives the best regression. That variable is then included in the regression equation. Once that variable is entered into the regression model, it is never removed. The remaining variables are then considered in turn to identify which variable gives the greatest improvement in the fit of the regression equation, given the variables already in the model. At the second step, the variable is included which in conjunction with the variable already in the model, provides the greatest improvement over the best equation with only the variable selected in the first step. This process continues step by step, with the variable about to be entered into the model being tested at each step, to determine if it will have a significant regression coefficient on being included in the equation. If not, the process terminates (Galpin, 2001).

Hosmer and Lemeshow (1999) contend that the criterion for including a variable in a model varies amongst scientific disciplines. The aim is to minimise the number of variables in a model so that the resultant model may be numerically stable. Rothman and Greenland (1998), on the other hand, advocate including all or many intuitively relevant variables, irrespective of their statistical significance. This may lead to the model being 'overfit' resulting in a numerically unstable estimate.

The forward selection model was preferred for the present study, as it is important to identify the contribution of each predictor variable to the regression model. By being able to determine each individual predictor's contribution to the regression model, it enables selection of the variables with the highest validity to be retained in the final APA battery (Kriel, 2001).

- **Goodness of fit**

Having found the best straight line, the next consideration was how well it described the data. Goodness of fit may be assessed from the R^2- adjusted (R^2_{adj}) or the F-value.

The R^2_{adj} ranges from zero to one, but is usually represented as a percentage in practice. It indicates how well the regressors taken together explain the variation in the dependent variable. Lea (1997) provides the following rough guidelines for interpretation of the R^2_{adj} value:

> 90% = rare in psychological data - questionable
75% – 90% = very good
50% – 74% = good
25% – 49% = fair
< 25% = poor, perhaps unacceptable

The F statistic in the ANOVA portion of the regression output indicates if the regressors taken together are significantly associated with the dependent variable. The higher the F value, the more significant it will be for given degrees of freedom.

4.6.3.2 Discriminant function analysis

This analysis was included in addition to the multiple regression analysis because CGPA may not necessarily be the optimal indicator of academic achievement, particularly when selecting for remedial intervention. When selecting students requiring remedial aid, there may be a need to discriminate between successful and unsuccessful students, which renders the dependent

variable dichotomous. In such a case multiple regression is not a suitable technique as the dependent variable has to be continuous in order to use multiple regression, and discriminant function analysis is appropriate.

Discriminant function analysis is a special case of multiple regression in which there is a dichotomous variable. The discriminant function is the set of optimal weights that best discriminates whether subjects are members of one or another group, given the predictor variable (Rosenthal & Rosnow, 1991).

A backward elimination method was utilised. With the backward elimination method, all variables are brought into the equation. The coefficients of each variable are examined individually, and the variable with the least significant coefficient is eliminated. The equation is recalculated, and the process repeated. The process stops when all coefficients are significant at the desired level (Galpin, 2001). This method is considered a reasonable procedure, specifically for researchers who prefer to commence with all the possible independent variables in the model, and not overlook any important variables (Bowerman & O' Connell, 1990).

4.6.4 Statistical methods for research question 4

Multiple regression analysis was also used for the fourth research question, as it entailed finding a regression equation to predict academic performance on the basis of a number of predictors. In this research question the criterion variable was CGPA, and the predictor variables were age, gender, and predominant language of communication and Matric results. As gender and predominant language of communication were on a nominal scale, and one of the assumptions of multiple regression is that the variables should be at least on an interval level of measurement, dummy variables will be used.

4.6.5 An integrated regression model

As the sample size was too small to include the predictor variables from research questions three and four in a single multiple regression analysis,

another set of statistical analyses is executed in addition to those performed for research questions three and four. This multiple regression analysis contained as predictor variables, the variables that emerged as significant in the previous two research questions. The response variable was CGPA.

4.7 Conclusion

In answering the research questions, the assumption was that unreliable questionnaires would have limited value for predictive purposes. The first level of analysis thus focused on the reliability of the tests used. Unreliable questionnaires were analysed to indicate areas in which each instrument could be improved.

Once the reliability of each of the tests had been established, the second level of analysis involved examination of the questionnaires as individual predictors, to establish the amount of variance in academic performance which could be predicted through their individual use. The predictive value of the questionnaires was then considered in combination. As not all the questionnaires may have been reliable, the predictive value of additional variables (biographical variables and Matric results) was also established.

The final level of analysis involved drawing conclusions relating to future use of the instruments in the battery. This was based on examination of the reliability and validity analyses of each test, and an assessment of their predictive value.

Table 6 provides a summary of the research design.

Table 6

Research design table

	Research question	Data	Investigating	Statistical analysis	Interpretation
1	**Are all the questionnaire of the Academic Proficiency Assessment (APA) battery reliable?**	Each item's score in each of the following tests: • English proficiency • Reading comprehension • Time management • Note-taking skills • Memorisation skills • Concentration skills • Achievement anxiety (debilitating stress) • Achievement anxiety (motivating stress)	Internal consistency reliability	Cronbach's coefficient alpha KR-20 for Reading Comp. only	.70 = acceptable
2	**If any of the questionnaires in the APA are not reliable, what changes can be implemented to enhance its psychometric properties?**	Each item's score in each of the following unreliable tests: • English proficiency • Reading comprehension • Memorisation skills • Concentration skills • Achievement anxiety (motivating stress)	Item- total correlation Item difficulty	Cronbach's coefficient alpha KR-20 for Reading Comp. Item difficulty (p_I) value	.70 = acceptable Optimal level of p_I formula

	Research question	Data	Investigating	Statistical analysis	Interpretation
3	**What is its predictive validity of the questionnaires in the APA battery for Information Technology students?**	Response variable: CGPA Predictor variables (all the total scores on the tests in the APA): • English proficiency • Reading comprehension • Time management • Note-taking skills • Memorisation skills • Concentration skills • Debilitating stress • Motivating stress	Predictive validity	Inter-correlations Multiple regression analysis Forward selection	±1.00 = perfect ±.80 = strong ±.50 = moderate ±.20 = weak ±.00 = no correlation > 90% = questionable 75% – 90% = very good 50% – 74% = good 25% – 49% = fair < 25% = poor
		Response variable: Successful student (passed 6/7/8 subjects) Predictor variables: All the total scores on the tests in the APA	Predictive validity	Discriminant function analysis Backward stepwise	> 90% = questionable 75% – 90% = very good 50% – 74% = good 25% – 49% = fair < 25% = poor
4	**Are there any additional variables that enhance the predictive validity for Information Technology students?**	Response variable: CGPA Predictor variables: • Matric results • Age • Gender • Language	Predictive validity	Multiple regression analysis Forward selection	> 90% = questionable 75% – 90% = very good 50% – 74% = good 25% – 49% = fair < 25% = poor

Research question	Data	Investigating	Statistical analysis	Interpretation
An additional regression model	Response variable: CGPA Significant predictor variables from research questions 3 and 4: • Matric results • Note-taking skills	Predictive validity	Inter-correlations	±1.00 = perfect ±.80 = strong ±.50 = moderate ±.20 = weak ±.00 = no correlation
			Multiple regression analysis Forward selection	> 90% = questionable 75% – 90% = very good 50% – 74% = good 25% – 49% = fair < 25% = poor

Chapter 5
RESULTS

5.1 Introduction

Chapter 5 presents the results of the data analysed. For each research question, the question will be stated, followed by where the relevant data to test the hypothesis was located. The statistical method utilised to analyse the data will be indicated, and the results and interpretation of the results will also be discussed.

5.2 Results for research question 1

Are all the questionnaires of the Academic Proficiency Assessment (APA) battery reliable?

In order to evaluate if the questionnaires in the Academic Proficiency Assessment battery were internally consistent, the internal consistency reliability within the questionnaires were calculated. The internal consistency within questionnaires were each examined.

The data used to examine the internal consistency were located in the items on the English Proficiency, Reading Comprehension, Time Management, Notetaking Skills, Memory Skills, Concentration Skills, and Achievement Anxiety questionnaires. The Kuder-Richardson formula 20 was utilised to calculate the internal consistency of the English proficiency and Reading comprehension questionnaires as these tests were scored on a two-point scale (right/wrong). Cronbach's coefficient alpha was used

to assess the internal consistency reliability for the remaining questionnaires.

Table 7

Internal consistency of questionnaires in the APA battery

	Internal consistency
English proficiency	0.53
Reading comprehension	0.40
Time management	*0.84*
Note-taking skills	*0.77*
Memorisation skills	0.52
Concentration skills	*0.66*
Achievement anxiety (debilitating stress)	*0.73*
Achievement anxiety (motivating stress)	0.38

According to the general rule of thumb a reliability value of 0.7 is adequate in the early stages of validation research (Nunnally and Bernstein, 1994). Questionnaires evaluating time management, note-taking, and achievement anxiety (debilitating stress) have adequate internal consistency. The questionnaires assessing English Proficiency, Reading Comprehension, Memorisation Skills, Concentration Skills and Achievement Anxiety (motivating stress) exhibited inadequate internal consistency values.

5.3 Results for research question 2

If any of the questionnaires in the APA are not reliable, what changes can be implemented to enhance the psychometric properties of those questionnaires?

The questionnaires assessing English Proficiency, Reading Comprehension, Concentration Skills, Memorisation Skills and Achievement Anxiety (motivating stress) exhibited inadequate internal consistency values. The internal consistency of these five questionnaires will be discussed in more detail, in order to determine how to enhance their internal consistency reliability. Two factors affect the internal consistency coefficient, namely the correlations between the items, and the number of items. Hence, in order to increase the internal consistency, the correlations between items must be increased, or there needs to be a greater number of items (Murphy & Davidshofer, 1996).

5.3.1 English proficiency

The internal consistency of the English proficiency questionnaire was not high enough. None of the items correlated very highly with the total. Increasing the number of items on this questionnaire is not an option, as this is already a lengthy scale with one hundred items. The correlations with the total ranged from 0 to .38. Some items do not have an item-total correlation as all the respondents responded exactly the same. These eight items (E9, E86, E88, E90, E91, E94, E99 and E100) need to be dropped completely from the scale and replaced with new different items. There are also four items (E68, E72, E78 and E79) with an item-total correlation of 0.00. These items also need to be dropped. Twenty-seven items correlate negatively with the total, and also need to be discarded. Eliminating the thirty-nine items instantly raises the KR20 value from 0.53 to 0.79.

Table 8

Item analysis of English Proficiency questionnaire

Item	Correlation with Total	KR 20	Item difficulty	Optimal level of difficulty
E1	-.18	0.55	74.58	75
E2	-.10	0.53	88.14*	75
E3	0.18	0.51	38.98**	75
E4	0.19	0.52	96.55*	75
E5	0.08	0.52	91.53*	75
E6	-.00	0.53	45.76**	67
E7	-.16	0.53	6.78**	67
E8	-.10	0.54	28.81**	67
E9	.	0.53	0**	67
E10	0.15	0.53	96.55*	67
E11	-.03	0.53	62.71*	75
E12	0.30	0.51	94.92*	75
E13	0.06	0.53	50.85**	75
E14	0.15	0.52	94.92*	75
E15	0.22	0.51	83.05	75
E16	0.34	0.50	35.39**	75
E17	0.11	0.52	89.83*	75
E18	0.10	0.52	77.97	75
E19	0.03	0.52	86.44*	75
E20	0.15	0.52	94.92*	67
E21	0.08	0.52	96.61*	67
E22	0.27	0.51	81.36*	67
E23	-.05	0.53	94.92*	67
E24	0.34	0.50	54.24**	75
E25	-.21	0.54	81.36*	67
E26	0.12	0.52	52.54*	67
E27	0.10	0.52	71.19	67
E28	0.17	0.52	79.66	75
E29	0.22	0.51	43.10**	75
E30	0.08	0.52	79.66	75
E31	0.18	0.52	84.75*	67
E32	0.28	0.52	91.38*	67
E33	-.24	0.55	64.41	75
E34	0.08	0.52	96.61*	75
E35	0.02	0.53	96.61*	67
E36	0.47	0.49	43.10**	75
E37	-.03	0.53	89.83*	75
E38	-.04	0.53	81.36	75
E39	0.14	0.52	66.10	75
E40	0.33	0.50	72.88	75
E41	-.02	0.53	27.12**	75
E42	0.37	0.51	8.47**	67
E43	-.10	0.54	55.93**	75
E44	-.11	0.54	38.98**	67
E45	0.10	0.52	50.85**	75
E46	0.03	0.53	93.22*	75
E47	-.11	0.54	66.10	75
E48	0.38	0.50	18.64**	75
E49	-.01	0.53	22.03**	75

Item	Correlation with Total	KR 20	Item difficulty	Optimal level of difficulty
E50	-.08	0.54	54.24	67
E51	0.28	0.51	22.03**	75
E52	-.31	0.56	42.37**	75
E53	0.23	0.51	66.10	75
E54	-.01	0.53	88.14*	75
E55	-.02	0.53	44.07**	75
E56	-.04	0.53	98.25*	75
E57	-.15	0.54	94.92*	67
E58	0.21	0.52	86.44	75
E59	0.17	0.52	37.29**	75
E60	0.19	0.51	47.46**	75
E61	0.06	0.52	94.92*	75
E62	0.04	0.53	67.80	75
E63	0.17	0.52	38.98**	75
E64	0.08	0.52	98.31*	75
E65	0.10	0.52	93.22*	75
E66	0.19	0.51	62.71**	75
E67	-.03	0.53	86.44	75
E68	0.00	0.53	83.05	75
E69	-.17	0.54	22.03**	75
E70	0.28	0.52	96.61*	75
E71	0.21	0.51	77.97	75
E72	0.00	0.53	88.14*	75
E73	-.07	0.53	83.05	75
E74	0.22	0.51	52.54**	75
E75	0.17	0.52	91.53*	75
E76	0.03	0.53	94.92*	75
E77	0.17	0.52	94.92*	75
E78	0.00	0.53	37.29**	67
E79	0.00	0.53	94.92*	75
E80	0.23	0.52	91.53*	75
E81	-.15	0.54	83.05	75
E82	0.15	0.52	45.76**	75
E83	0.15	0.52	88.14*	75
E84	0.27	0.52	98.21*	75
E85	0.12	0.52	86.44	75
E86	.	0.53	100*	75
E87	0.30	0.51	96.61*	75
E88	.	0.53	98.31*	75
E89	0.30	0.50	69.49	75
E90	.	0.53	100*	75
E91	.	0.53	100*	75
E92	-.22	0.55	30.51**	75
E93	0.30	0.51	96.61*	75
E94	.	0.53	100*	75
E95	0.23	0.52	94.82*	75
E96	0.32	0.51	96.61*	75
E97	0.22	0.51	66.10	75
E98	0.08	0.52	94.92*	75
E99	.	0.53	100*	75
E100	.	0.53	98.31*	67

Note. * indicates too easy. ** indicates too difficult.

5.3.2 Reading comprehension

The individual items correlation with the total reading comprehension score range from 0.08 to 0.32. None of the items have a sufficiently high correlation with the total. All the items need to be revised in order to raise the internal consistency of the Reading Comprehension questionnaire to an acceptable level. As this test has already very few items, discarding items is not desirable, as too many items would have to be removed.

Table 9

Item analysis of Reading Comprehension questionnaire

Item	Correlation with total	KR 20	Item difficulty (p_i)
RC1	0.13	0.39	63.49
RC2	-0.09	0.47	62.70
RC3	0.17	0.37	*29.37*
RC4	0.10	0.40	73.02
RC5	0.17	0.37	73.02
RC6	0.21	0.36	58.73
RC7	0.19	0.37	65.87
RC8	0.08	0.41	76.19
RC9	0.30	0.32	63.49
RC10	0.32	0.31	75.40

Note. Optimal level of difficulty is 66.67%.

5.3.3 Memorisation skills

None of the items correlated highly with the total. This questionnaire requires complete revision in order to enhance the internal consistency of the scale. The questionnaire either needs to be replaced with another questionnaire assessing memorisation skills or all the items need to be

rewritten to ensure a more homogenous questionnaire. This test has even fewer items than the Reading Comprehension test. Eliminating items from this test would make the test too short.

Table 10

Internal consistency of Memorisation Skills questionnaire

Item	Correlation with Total	Alpha
MS1	0.18	0.50
MS2	0.18	0.50
MS3	0.29	0.47
MS4	0.11	0.53
MS5	0.29	0.47
MS6	0.21	0.49
MS7	0.38	0.44
MS8	0.52	0.39
MS9	-0.04	0.57

5.3.4 Concentration

This test also has only ten items, but the internal consistency is higher than the other 'inconsistent' tests. Eliminating the two items with the lowest values (CS2 and CS10) raises the value to 0.69.

Table 11

Internal consistency of Concentration Skills questionnaire

Item	Correlation with Total	Alpha
CS1	0.40	0.61
CS2	0.15	0.67
CS3	0.41	0.61
CS4	0.34	0.63
CS5	0.46	0.60
CS6	0.24	0.65
CS7	0.36	0.62
CS8	0.31	0.63
CS9	0.43	0.61
CS10	0.09	0.68

5.3.5 Achievement anxiety (motivating stress)

This questionnaire presents the same problem as the preceding one. The questionnaire either needs to be replaced with another questionnaire assessing memorisation skills or all the items need to be rewritten to ensure a more homogenous questionnaire.

Table 12

Internal consistency of Motivating Stress questionnaire

	Correlation with Total	Alpha
AAT3	0.53	0.17
AAT1	-0.30	0.53
AAT2	-0.30	0.51
AAT5	0.05	0.38
AAT11	0.25	0.29
AAT12	0.31	0.26
AAT13	0.40	0.19
AAT14	0.24	0.29
AAT19	0.35	0.24

5.4 Results for research question 3

What is the predictive validity of the questionnaires in the APA battery?

This research question was addressed using two different types of analyses: multiple regression and discriminant function analysis. The rationale for including two different statistical techniques was explained in section 4.6.3.2.

Given the low reliabilities of a number of subtests, increases the likelihood of a multiple regression analysis capitalising on random features in the data. The analysis was nonetheless executed as the present study is exploratory, and if evidence supporting the predictive validity of the APA battery was found, it would have motivated the procedure of further refining and enhancing the psychometric properties of the battery.

5.4.1 Multiple regression analysis

The dependent variable was CGPA. The CGPA was obtained from the average of eight modules: two modules each of Information Systems, Technical Programming, Systems Software and Development Software.

The total scores obtained for each of the questionnaires in the Academic Proficiency Assessment battery (APA battery) were used as the explanatory variables. These variables were:

- English proficiency
- Reading speed
- Reading comprehension
- Time management
- Note-taking skills
- Memorisation
- Concentration
- Debilitating stress
- Motivating stress

Although the APA battery is to a large extent not sufficiently reliable, it was nonetheless utilised to calculate a regression equation as the nature of the study is conceptual and exploratory. Data was also modified in an attempt to enhance the reliability of the battery.

As a result, certain scores required adjustment for the analysis. In the English proficiency questionnaire, the scores for the items to be dropped were eliminated from the total score. This enabled analysis using a more reliable battery. The distribution of the English proficiency scores also showed a sharp upward and downward curve at both extremes, indicative of the tails of the distribution being too heavy to be regarded as normal. These scores therefore had to undergo a square-root transformation to

meet the assumption of normality required for multiple regression. The scores from two items that needed to be dropped from the Concentration Skills questionnaire were also excluded from the total Concentration score. The Reading Speed, and Debilitating Stress distributions were positively skewed, and the scores required log transformations in order to achieve normality. The Note-taking Skills distribution displayed a flattening at the extremes, indicating that the tails were lighter than normal (Galpin, 2001). Hence, the Note-taking skills scores were transformed using a cube-root transformation (P. Fridjhon, personal communication, December, 2004).

- **Multicollinearity**

Before commencing with the multiple regression analysis, the correlation and/or multicollinearity between the independent variables were investigated, ustails of thing Pearson's Correlation Coefficient (Table 13).

Correlation coefficients ranged from ±0.00822 to ±0.67888. A large number of the correlations was significant enough to indicate the presence of multicollinearity.

The correlation between English proficiency and reading speed was understandable. The more proficient one's English is, the faster English word recognition would be, thereby contributing to the increase in reading speed. The reason for having these two tests separately, is that the development of English proficiency, and the enhancement of reading speed, are facilitated as two independent courses. Hence, diagnosis for selection to an English proficiency programme, or a reading enhancement programme is executed independently.

There was also a significant correlation between English proficiency and memory skills, and a significant correlation between Reading

comprehension and motivating stress. These correlations are likely to be incidental.

Fourteen of the fifteen correlations of the study skills questionnaires were significantly correlated at the 0.05 level of significance, and the remaining one correlation was significant at the 0.1 significance level. The correlation matrix indicates a significant correlation between CGPA and Time management, Note-taking skills, and Memorisation skills. But, Time management, Note-taking skills, and Memorisation skills are significantly correlated too. This has notable implications, both in terms of the present statistical analyses, as well as the far wider implication of the construction of the assessment itself. In terms of the statistical analysis, the R^2_{adj} will still quantify how well the model predicts academic performance. But, because of the multicollinearity, as well as the poor reliability of the questionnaires, gauging the individual contribution of each independent variable to the prediction of academic performance is problematic, as some variables may be excluded from the model although they may be significant (Motulsky, 2002). Others may also be included even though they are unreliable. In terms of the logic of the assessment battery as a whole, the high intercorrelation across the questionnaires, indicates that there is considerable overlap in the respective questionnaires. This implies that the assessment battery could be shortened considerably, in order to avoid reassessing the same constructs.

Table 13

Correlation matrix of explanatory variables

	Pearson Correlation Coefficients Prob > |r| under H0: Rho=0										
	CGPA	English proficiency	Reading speed	Reading comp.	Time man.	Note-taking skills	Memory skills	Concen-tration skills	Debilitating stress	Motivating stress	Age
English proficiency	0.03 0.7782										
Reading speed	-0.02 0.83	*0.25* *0.0110*									
Reading comp.	0.09 0.3052	-0.01 0.9330	0.02 0.8151								
Time man.	*-0.19* *0.0455*	-0.04 0.6882	0.05 0.5864	0.03 0.7428							
Note-taking skills	*-0.29* *0.028*	0.09 0.3717	0.09 0.3597	-0.15 0.1322	*0.52* *<.0001*						
Memory Skills	*-0.21* *0.0350*	*0.35* *0.0003*	0.16 0.1087	-0.17 0.0799	*0.31* *0.0013*	*0.50* *<.0001*					
Concen-tration skill	-0.11 0.2824	0.07 0.4920	-0.03 0.7750	-0.09 0.3546	*0.68* *<.0001*	*0.37* *0.0001*	*0.30* *0.0018*				
Debilitating stress	0.13 0.1798	0.19 0.0526	0.08 0.4387	-0.13 0.1882	*-0.49* *<.0001*	*-0.34* *0.0004*	*-0.20* *0.0390*	*-0.50* *<.0001*			
Motivating stress	-0.13 0.1689	*0.20293* *0.0361*	0.04482 0.6467	*-0.22533* *0.0196*	*0.28660* *0.0028*	*0.34578* *0.0003*	*0.39262* *<.0001*	*0.35588* *0.0002*	-0.16312 0.0932		
Age	-0.01 0.8876	-0.11 0.2556	-0.13 0.1839	-0.02 0.8456	0.08 0.4091	-0.07 0.4999	-0.11 0.2450	0.007 0.9436	0.006 0.9544	-0.15 0.1367	
Matric results	0.32 0.0011	0.11 0.2975	0.05 0.6011	0.001 0.9910	-0.18 0.0733	*-0.20* *0.0419*	-0.09 -0.3520	-0.07 0.5085	0.07 0.4705	-0.15 0.1432	-0.12 0.2244

Note. Significant correlations in italics.

- **Multiple regression analysis**

A forward selection model was preferred for the analysis, as it enabled the researcher to examine the contribution of each predictor variable to the regression model independently. The significance level to enter the model was set at 0.05. The significance level is usually between 0.05 and 0.1, with 0.05 being the common practice (Bowerman & O'Connell, 1990).

The results of the multiple regression analysis are presented in Tables 14 to 17.

Table 14

R^2 for research question 3

R-Square	0.0826
Adj R-Sq	0.0737

Table 15

Parameter estimates for research question 3

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	84.95	10.35	7103.94	67.35	<.0001
Note-taking skills	-8.24	2.69	987.30	9.36	0.0028

Table 16

Summary of forward selection for research question 3

Step	Variable Entered	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	Note-taking skills	1	0.08	0.08	-3.37	9.36	0.0028

Table 17

Analysis of variance for research question 3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	987.30	987.30	9.36	0.0028
Error	104	10970	105.48		
Corrected Total	105	11958			

The regression was a rather poor fit with a R^2_{adj} value of 8,3%, but the overall relationship was significant ($F_{1,104}$ = 9,36, p < 0.05). The only variable that met the 0.05 significance level for entry into the model was Note-Taking Skills. With other variables held constant, CGPA was negatively related to Note-taking Skills.

The regression equation is:

CGPA = 85 – 8,24 Note-taking Skills

In terms of answering the research question, the statistical analysis suggested that the Note-Taking skills questionnaire was the only variable that contributed as a predictor of academic performance for Information Technology students. Unfortunately, the relationship was an inverse one, implying that if a student performed poorly on this questionnaire, there was

a likelihood that he/she would have a good CGPA! This finding certainly cannot be implemented when selecting for remedial intervention. Although statistically justifiable, the APA battery is likely to lose face validity with the students upon communication of the results.

At this stage of the analyses, based on the results of research question one and the multiple regression equation in the present research question, it may be concluded that the APA is unreliable and invalid.

5.4.2 Discriminant function analysis

This analysis was included in addition to the multiple regression analysis, in an attempt to establish whether the tests were predicting performance criteria on the Information Technology course, and in particular whether the students were academically successful or not.

Although a number of the subtests yielded unsatisfactory internal consistency values, the discriminant function analysis was undertaken in order to determine if the battery had potential validity, thereby providing a motive for the exercise of substantially modifying the test battery and rewriting the items.

The dependent variable was a dichotomous variable: successful or unsuccessful students. A student was coded as successful if he/she passed six, seven or eight of the eight subjects, and unsuccessful if zero to five of the eight subjects were passed. This classisfication was used as students passing all eight subjects, or failing one or two subjects were still able to complete their national diploma in the minimum duration of three years.

The same explanatory variables and transformed scores were used as for the previous analysis. These variables were:

- English proficiency
- Reading speed
- Reading comprehension
- Time management
- Note-taking skills
- Memorisation
- Concentration
- Debilitating stress
- Motivating stress

A backward stepwise discriminant function analysis was also executed. This model was preferred, as the variables that were not contributing to the prediction of a student as successful or unsuccessful, could be removed. Only one variable, namely English Proficiency was eliminated from the model.

The results of the discriminant function analysis are tabulated in Tables 18 to 22.

Table 18

Linear discriminant function for research question 3

Linear Discriminant Function for Successful students		
Variable	0	1
Constant	-604.39	-600.94
Reading speed	113.78	113.24
Time management	-1.15	-1.21
Debilitating stress	223.05	220.28
Note-taking skills	42.46	42.08
Reading comprehension	6.28	6.28
Memorisation skills	-0.68	-0.73
Motivating stress	-0.04	-0.06
Concentration skills	387.64	393.49

Table 19

Classification table for research question 3

Number of Observations and Percent Classified into Successful students			
From Successful student	0	1	Total
0	22	8	30
	73.33	26.67	100
1	22	55	77
	28.57	71.43	100
Total	44	63	107
	41.12	58.88	100
Priors	0.5	0.5	

Table 20

Average R^2 for discriminant function analysis

Average R-Square	
Unweighted	0.01
Weighted by Variance	0.02

Table 21

Univariate test statistics for research question 3

F Statistics, Num DF=1, Den DF=105							
Variable	Total Std. Dev.	Pooled Std. Dev.	Bet. Std. Dev.	R^2	$R^2/(1-R^2)$	F Value	Pr > F
Reading speed	0.13	0.13	0.02	0.01	0.01	0.77	0.38
Time man.	10.74	10.68	2.13	0.02	0.02	2.13	0.15
Debilitating stress	0.12	0.12	0.01	0.004	0.004	0.43	0.52
Reading comp.	1.85	1.85	0.07	0.001	0.001	0.08	0.77
Memory skills	5.73	5.69	1.26	0.02	0.03	2.64	0.11
Motivating stress	4.65	4.65	0.57	0.01	0.01	0.79	0.38
Conc. skills	0.09	0.09	0.003	0.001	0.001	0.09	0.77
Note-taking skills	0.37	0.37	0.08	0.02	0.02	2.43	0.12

Table 22

Multivariate and exact F statistics for research question 3

S=1 M=3 N=48					
Statistic	Value	F Value	Num D F	Den DF	Pr > F
Wilks' Lambda	0.91	1.17	8	98	0.33
Pillai's Trace	0.09	1.17	8	98	0.33
Hotelling-Lawley Trace	0.10	1.17	8	98	0.33
Roy's Greatest Root	0.10	1.17	8	98	0.33

72% of the cases were correctly predicted. This is a good level of accuracy within social science research, indicating that the proficiencies (except English proficiency, which was the only variable eliminated) measured by the APA battery, predicted the likelihood of a student being successful or unsuccessful to a fairly good extent.

The discriminant regression equation is:

Success = -600.94 - 0.06 Motivating stress - 0.73 Memorisation skills - 1.21 Time management + 6.28 Reading comprehension + 42.08 Note-taking skills + 113.24 Reading speed + 220.28 Debilitating stress + 393.49 Concentration skills

Except for English proficiency, all the independent variables contributed to the prediction of academic success. Two things need to be noted regarding this result. Firstly, the English proficiency questionnaire scores used eliminated the scores of the items that needed to be dropped. Hence a reliable questionnaire was used, but yet it was the only questionnaire that failed to contribute to the prediction of academic success. A possible reason for this could be, that the programming languages studied in Information Technology, is a completely different type of ‘language’ with different grammatical rules compared to English.

Secondly, although eight of the tests contributed significantly to the prediction of academic success, three of these are unreliable. Revision of these unreliable questionnaires is firstly required, but these results indicate that the battery may have potential utility. This issue could be revisited after revision of the APA battery.

5.5 Research question 4

Are there any additional variables that could enhance the predictive validity of the APA battery for Information Technology students?

Multiple regression analysis was used for this part of the analysis. As with the previous multiple regression for Research Question Three, a forward selection model was again used and the significance level to enter the model was set at 0.05.

Availble biographical information solicited in the biographical questionnaire were included as explanatory variables. Matric results were also included, based on consistent research on Matric results as a good predictor of academic performance, and Matric results are also the primary selection tool for admission to the Information Technology course.

CGPA was the dependent variable. The four explanatory variables were investigated for this research question was:

- Age
- Gender
- Predominant language of communication
- Matric results (symbols of each subject converted using the Swedish formula, and aggregated).

The data for the first three variables was obtained from the biographical questionnaire. The Matric results were obtained from the ITS system.

Matric results were transformed to normality using a log transformation, in order to meet the assumptions for multiple regression. Gender and predominant language of communication were coded using dummy variables.

- **Multicollinearity**

The correlations between age and Matric results were examined in Table 11 in order to determine the presence of multicollinearity. Gender and predominant language of communication were excluded from this analysis, as they are nominal variables, and one of the assumptions for performing correlations is that the data must at least be on an interval level of measurement (Hatcher, 1994). The correlation between age and Matric results (-0.12) may be regarded as a weak and insignificant correlation. Hence, multicollinearity is not a problem.

- **Multiple regression**

A forward stepwise selection model was used. The results of the analysis are tabulated in Tables 23 to 26.

Table 23

R^2 for research question 4

R-Square	0.1097
Adj R-Sq	0.1004

Table 24

Parameter estimates for research question 4

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	7.67	13.33	32.89	0.33	0.5662
Matric results	32.84	9.55	1174.38	11.83	0.0009

Table 25

Summary of forward selection for research question 4

Step	Variable Entered	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	Matric results	1	0.11	0.11	0.40	11.83	0.0009

Table 26

Analysis of variance for research question 4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1174.38	1174.38	11.83	0.0009
Error	96	9530.23	99.27		
Corrected Total	97	10705			

This regression was also a poor fit with a R^2_{adj} value of 11%, but the overall relationship was significant ($F_{1,96} = 11.83$, $p < 0.05$). The only variable that met the 0.05 significance level for entry into the model was Matric results. None of the biographical variables were included in the model. With other variables held constant, CGPA was positively related to Matric results.

The regression equation is:

CGPA = 7,67 + 32,84 Matric results

This result supports one of the present criteria for selection for admission into the Information Technology course at Tshwane University of Technology. If the present admission criteria are maintained, the regression model can be used to identify students at-risk according to this equation, and recommend these students for remedial intervention.

5.6 An integrated regression model

As the sample size prevented including the predictor variables from research questions three and four in a single multiple regression analysis, another set of statistical analyses were executed in addition to those performed for research questions three and four. This multiple regression analysis contains as predictor variables, the variables that emerged as significant in the last two research questions. The response variable is CGPA.

- **Multicollinearity**

The correlation between Matric results and Note-taking skills presented in Table 11 was examined in order to detect the presence of multicollinearity. Although the correlation between Matric results and Note-taking skills is significant ($P<0.05$), it is a weak negative relationship ($r = -0.2039$).

- **Multiple regression analysis**

The results of the multiple regression analysis are presented in Tables 27 to 30.

Table 27

R^2 for the integrated regression model

R-Square	0.1502
Adj R-Sq	0.1334

Table 28

Parameter estimates the integrated regression model

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	35.84	18.89	356.02	3.60	0.0609
Matric results	28.35	9.75	836.14	8.45	0.0045
Note-taking skills	-5.77	2.74	436.77	4.41	0.0383

Table 29

Summary of forward selection for the integrated regression model

Step	Variable Entered	No. Vars In	Partial R-Square	Model R-Square	R-Square change	C(p)	F Value	Pr > F
1	Matric results	1	0.10	0.10	0.10	5.41	11.37	0.0011
2	Note-taking skills	2	0.04	0.14	0.04	3.00	4.41	0.0383

Table 30

Analysis of variance for the integrated regression model

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1601.15	800.58	8.09	0.0006
Error	96	9499.35	98.95		
Corrected Total	98	11100			

Both Matric results and Note-taking skills met the 0.05 significance level for entry into the model was Matric results. Cumulatively, Matric results and Note-taking skills contributed 13,34% towards accounting for the variance in CGPA, which is a poor fit. The overall relationship was significant ($F_{2,96} = 8.09$, $p < 0.05$).

The regression equation is:

CGPA = 35.84 + 28.35 Matric results – 5.77 Note-taking skills

5.7 Conclusion

Three questionnaires (time management, the note-taking skills, and the debilitating stress scale on the achievement anxiety test) yielded adequate Cronbach alpha values, while five tests (English proficiency, reading comprehension, memory skills, concentration skills and motivating stress scale on the achievement anxiety questionnaire) produced Cronbach alpha coefficients less than 0.70, indicating an inadequate level of internal consistency reliability. Thirty-nine items in the English proficiency questionnaire need to be eliminated completely. The remaining items will benefit from modification. All the items in the Reading Comprehension questionnaire need to be revised. Two items in the Concentration Skills

require removal. The Memory Skills questionnaire can be dropped and replaced with a new scale. The motivating stress subscale on the Achievement Anxiety questionnaire also needs to be eliminated.

If the results of the multiple regression analysis are to be accepted using CGPA as a performance indicator, very little can be extracted from the scores of the questionnaires in the APA when selecting for remedial intervention. The only significant relationship was with Note-taking Skills, and that too was a negative relationship. It should be noted that due to the multicollinearity, some variables may have been excluded from the model although they may be significant.

However, the results of the discriminant function analysis, where the number of subjects passed was used as a performance criterion, indicated that a good level of accuracy could be achieved in predicting successful and unsuccessful students were the APA battery revised. All the academic proficiencies except English proficiency contributed to the prediction.

Overall, the results would suggest that matric results remain the best predictor of academic performance, but at a very low level. Given the lack of reliability in the majority of the tests, the use of the APA battery for selection for admission to TUT, or for selection for remedial intervention, is not yet justified.

Chapter 6
CONCLUSION

6.1 Introduction

This final chapter presents a synopsis of the study, a summary of the major findings, the strengths and limitations of the study, some recommendations for future research, as well as the conclusions that may be drawn from the present study.

6.2 Synopsis of the study

According to the literature surveyed, intellective factors still emerge as the strongest predictor of academic performance. Information Technology students, the subjects in the present study, are also still selected for admission to Tshwane University of Technology on the basis of an intellective factor, namely Matric results which has consistently been upheld as the single best predictor of academic performance at tertiary level. However, this criterion is insufficient on its own, or else there would be no need for research on non-intellective factors. While the research surveyed in the literature review does not provide any unequivocal irrefutable results, it provides a basis for the wider exploration of certain factors as possible correlates of academic performance.

A substantial body of research exists indicating the likelihood of the variables that the APA aims to assess, namely language abilities and study skills contributing to academic performance. Numerous assessments have also been developed to assess such proficiencies,

APA attempting to add to the collection of such assessments. The present study attempts to firstly gauge the internal consistency reliability of each of the questionnaires in the APA battery, and secondly to validate the APA battery as a predictor of academic achievement by evaluating the extent to which each of the proficiencies in the test is a predictor of academic achievement.

6.2.1 English proficiency

The internal consistency of the English proficiency questionnaire was inadequate. None of the items correlated very highly with the total. Eight items did not have an item-total correlation as all the respondents responded exactly the same, and needed to be dropped completely from the scale and replaced with new different items. There were four items with an item-total correlation of 0.00 that need to be dropped, and twenty-seven items correlate negatively with the total and also need to be discarded. Eliminating the thirty-nine items instantly raises the KR20 value from 0.53 to 0.79.

English proficiency did not correlate with academic performance for Information Technology students at TUT.

6.2.2 Reading skills

The reading skills test has two components: reading speed comprehension. Both reading speed and reading comprehension contributed to the prediction of the likelihood of a student being successful following the results of a linear discriminant function analysis. However, none of the items in the Reading Comprehension test have a sufficiently high correlation with the total. All the items need to be revised in order to raise the internal consistency.

6.2.3 Time Management

The Time management questionnaire exhibited a high degree of internal consistency with a reliability of 0.84.

According to the linear discriminant function analysis Time management scores were able to contribute to prediction of the likelihood of a student being successful, but had a low negative regression coefficient.

6.2.4 Note-taking skills

The note-taking skills questionnaire was adequately internally consistent yielding a reliability value of 0.77.

A multiple regression analysis with all the APA questionnaires found Note-taking skills to be the only significant predictor of academic performance, accounting for 8,3% of the variance. However, there was a negative relationship between the variables. The linear discriminant function analysis indicated that Note-taking skills contribute to prediction of the likelihood of a student being successful.

Considering that the two sets of analyses show the direction of the relationship differently, it would be unwise to utilise the scores of the Note-taking skills subtest for selection purposes.

6.2.5 Memorisation skills

A linear discriminant function analysis found Memorisation skills to be able to successfully predict the likelihood of a student being successful. However, bearing in mind that the memorisation skills questionnaire exhibited an unsatisfactory reliability of 0.52, one needs to sceptical about making inferences regarding this relationship.

6.2.6 Concentration skills

Eliminating two items from the concentration skills questionnaire raised the reliability value from 0.66 to 0.69.

The linear discriminant function analysis also indicated that Concentration skills are able to contribute to predicting the likelihood of a student being successful. According to the results of this analysis, Concentration skills had by far the highest regression coefficient out of the eight subtests that were included in the model. Based on these results, it would be to the advantage of Information Technology students who obtain low scores on this subtest, to receive remedial assistance to enhance their concentration skills.

6.2.7 Examination stress

The Achievement Anxiety Test had two scales, debilitating and motivating stress. Although the debilitating stress scale was sufficiently reliable (0.73), the motivating stress scale exhibited unsatisfactory internal consistency (0.38). The questionnaire either needs to be replaced with another questionnaire assessing memorisation skills or all the items need to be rewritten to ensure a more internally consistent questionnaire.

According to the linear discriminant function analysis both scales are able to contribute to predicting the likelihood of a student being successful. However, the motivating stress scale has very low reliability, hence very little confidence may be attached to its predictive validity. The debilitating stress scale had the second highest regression coefficient out of the eight subtests that were included in the model. As it is a reliable scale, students obtaining a high score on this scale of the Achievement Anxiety subtest, would benefit from stress management therapy.

6.2.8 Additional predictors

None of the biographical variables, namely age, gender and predominant language of communication emerged as significant predictors of academic performance. Consistent with the literature, Matric results emerged as the best predictor variable in this study too, validating Matric results as one of the present admission criteria for the Information Technology course at TUT.

6.3 Summary of findings

An overview of the findings will be presented addressing the research questions.

6.3.1 Are all the questionnaires of the Academic Proficiency Assessment (APA) battery reliable?

The time management questionnaire, the note-taking skills questionnaire, and the debilitating stress scale on the achievement anxiety test yielded adequate Cronbach alpha values. The English proficiency, reading comprehension, memorisation skills, concentration skills and motivating stress scale on the achievement anxiety questionnaire produced Cronbach alpha coefficients less than 0.70, indicating an inadequate level of internal consistency reliability.

6.3.2 If the APA is not reliable, what changes can be implemented to enhance its psychometric properties?

Several questionnaires require modification. Several items in the English proficiency questionnaire need to be eliminated completely. The remaining items will benefit from modification. All the items in the Reading Comprehension questionnaire need to be revised. Two items in the Concentration Skills require removal. The Memory Skills questionnaire can

be dropped and replaced with a new scale. The Study Skills Questionnaire (SSQUES) has a subscale on memorisation that could be investigated. The motivating stress subscale on the Achievement Anxiety questionnaire also needs to be eliminated.

6.3.3 What is the predictive validity of the questionnaires in the APA battery?

The results of the multiple regression analysis using CGPA as a performance indicator, reveal that very little can be extracted from the scores of the questionnaires in the APA when selecting for remedial intervention. The only significant relationship was with Note-taking Skills (R^2_{adj} = 8.3%), and that too was a negative relationship. Though, as a result of the multicollinearity, some variables may have been excluded from the model although they may have been significant. The intercorrelations amongst the variables also indicate that the questionnaires tend to measure the same factors, and can therefore be streamlined even further.

However, the results of the discriminant function analysis, where the number of subjects passed was used as a performance criterion, indicated that a good level of accuracy (72%) in predicting successful and unsuccessful students could be established by weighting the scores from the variables in the analysis. This would suggest that prediction of academic performance is possible, provided that the existing battery is substantially modified.

Given the lack of reliability in the majority of the tests, the use of the APA battery for selection for remedial intervention, is not yet justified. The high proportion of pass rates of students predicted by the tests in combination would suggest that the battery has potential, and that work on improving its psychometric qualities should be undertaken.

6.3.4 Are there any additional variables that could enhance the predictive validity of the APA battery for Information Technology students?

None of the biographical variables significantly predicted CGPA. Matric results was positively related to CGPA (R^2_{adj} = 11%), validating Matric results as one of the present criteria for selection for admission into the Information Technology course at TUT. If the present admission criteria are maintained, the regression model can be used to identify students at-risk according to this equation, and recommend these students for remedial intervention.

6.4 Strengths of the study

The two main strengths of the study are that it investigates multiple variables and that it likely to be ecologically valid in South Africa.

6.4.1 Multiple variables under investigation

From the literature surveyed, it is apparent that there is not a single factor that determines the academic performance of students. The academic success or failure of a student cannot be attributed to a unitary factor, but to a multitude of variables that work either independently or in conjunction with other factors (Engelbrecht, 1999). The present study investigated several variables as predictors of academic performance. These factors are highlighted in Figure 6.

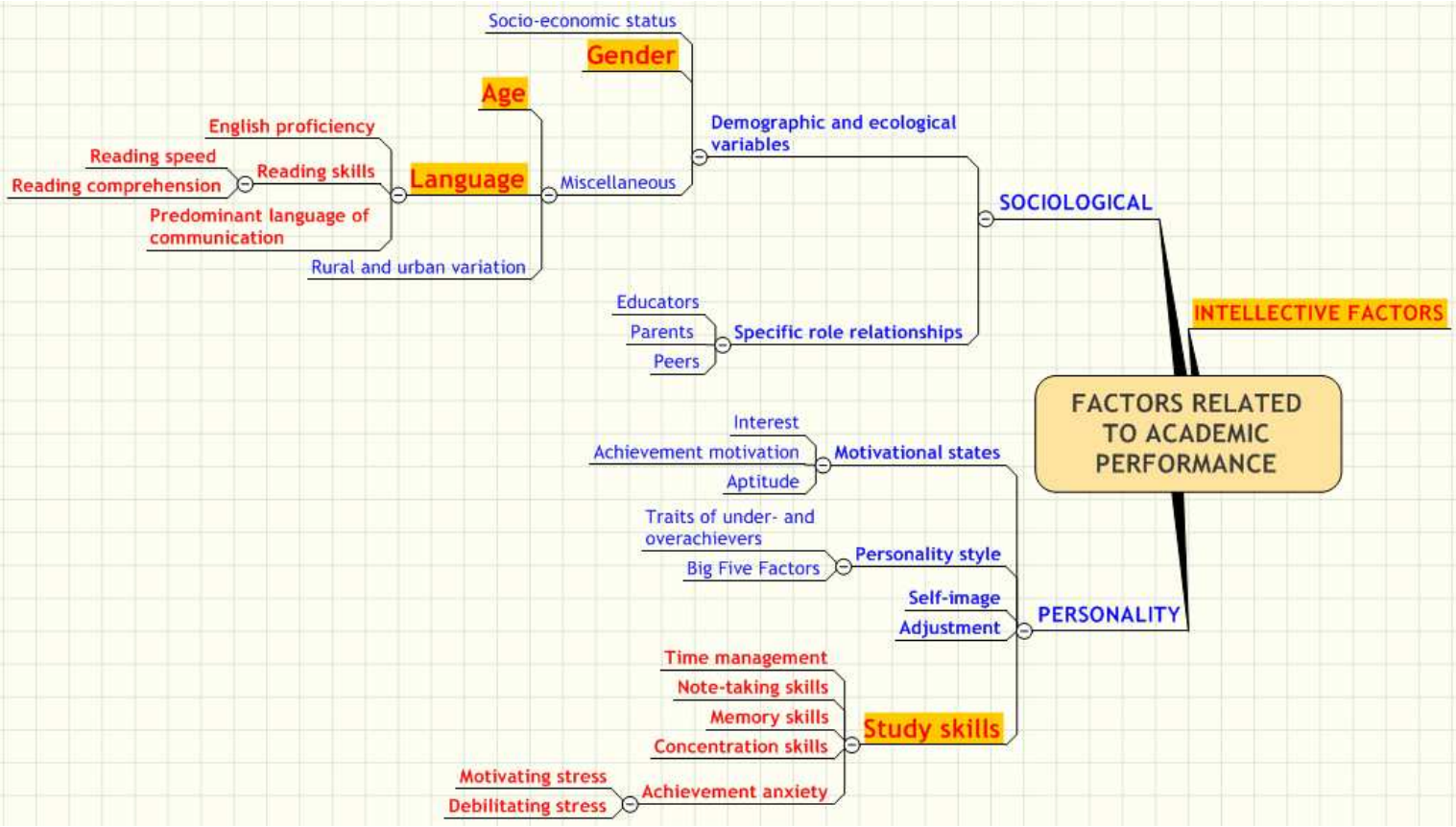


Figure 6. *Factors investigated in the present study highlighted.*

6.4.2 Ecological validity

Ecological validity implies the extent of generalisability from one context to another, specifically across geographic areas (Potter, 1998). It is highly likely that the findings could be generalised to Information Technology students at other Technikons/Universities of Technology within South Africa. Tshwane University of Technology has the largest student population amongst all South Africans, and students originate from all regions within the country.

6.5 Limitations of the study

The limitations of the study were the factors threatening the internal and external validity of the study, and the sample size.

6.5.1 Threats to internal validity

Internal validity refers to the degree of validity of the statements made regarding the relationship between the variables (Rosenthal & Rosnow, 1991). Maturation, instrument reactivity and history could have possibly reduced the internal validity of the present study, as follows:

6.5.1.1 Maturation

The period between the administering of the APA battery and the final examination was almost a year, which presented a substantial duration for the occurrence of processes that may have differentially changed in the subjects. Those processes may have introduced other influences into the study that may have confounded the phenomenon observed, and the results obtained (Potter, 1998). This could have been overcome by administering the APA battery shortly before the final examinations.

However, that would have raised an ethical issue, as there would have been insufficient time to provide effective intervention to students amongst whom developmental areas were identified.

6.5.1.2 Instrument reactivity

Instrument reactivity refers to the APA battery reacting with the variables it measures, thereby distorting the true measurements. Within the social sciences, it is often difficult to know when reactivity is severe enough t be problematic. There is a vast body of literature on the effects an experimenter can have on the behaviour of subjects, a number of which could be regarded as instrument reactivity (Potter, 1998).

6.5.1.3 History

Many events could have potentially affected the subjects in addition to the independent variables. History refers to such environmental events besides the independent variables that may have occurred over the period of the investigation, which may possibly have impacted the results of all subjects in the study (Potter, 1998). For example, the literature review cites research on specific role relationships as a sociological factor related to academic performance.

6.4.2Threats to external validity

External validity is indicative of the generalisability of the study. Factors threatening external validity impair the ability to generalise the results of the study to other situations and contexts (Kerlinger, 1986). Population validity was the most serious threat to external validity in the present study.

6.4.2.1 Population validity

The problem of generalisability prevails, as the sample selected is so specialised that conclusions may only be generalised to a limited population (Potter, 1998). In terms of the predictors considered in this study, it may be difficult to generalise the conclusions to all courses presented at Tshwane University of Technology, especially with theory-oriented courses like Tourism Management, Nature Conservation or Horticulture.

6.4.3 Sample size

The sample size affected the manner in which the data were analysed. The sample size prevented the inclusion of all the variables in a single multiple regression analysis. There should have at least ten to twenty times as many respondents as variables (StatSoft, Inc., 2001). Although the size of the sample was 133 respondents, depending on the variables included, due to the missing cases, the sample size ranged from 97 to 107. This implied that a maximum of ten predictor variables could be included in the regression, whereas the study consists of thirteen predictor variables. Hence, instead of one multiple regression analysis, there were three analyses.

6.5 Recommendations

6.5.1 "Back to the drawing board"

The changes suggested in Research question 2 should be implemented, in order to enhance the internal consistency of the test. When modifying the questionnaires, there are some other findings that need to be considered too. The intercorrelations across several of the questionnaires

suggest that the content of the questionnaires overlap to a large extent. Further analyses need to be executed, in order to streamline the questionnaires even further, thereby eliminating redundant items and questionnaires. This would reduce the length of the APA battery, reduce testing time and enhance the psychometric properties of the battery. Although Note-taking Skills was one of the internally consistent tests, this test has to be revisited in its entirety, in an attempt to determine the inverse correlation with academic performance.

6.5.2 Intervention programmes

A significant correlation between English proficiency and reading speed was found, having implications for the manner in which English, and reading development courses are presented. Presently, they are facilitated individually as independent programmes. Programme managers should investigate the impact of integrating the two courses for maximum impact.

6.5.3 Selection for remedial intervention

Although the results of the discriminant function analysis indicate that all the academic proficiencies, except English proficiency, contribute to predicting whether a student will be successful or unsuccessful, it is questionable if the results of the APA battery can be used as a basis for selection for remedial intervention. Out of the eight predictors, four questionnaires are not internally consistent. From the remaining four tests, Note-taking had a negative relationship with academic performance. Only three are left: Reading speed, Time management and the Debilitating Stress scale on the Achievement Anxiety test. With only three out of the nine scales having utility in the prediction of academic performance, the APA battery as a whole does not appear suitable for selection for remedial intervention.

6.6 Conclusion

The present research project addressed two issues. Firstly, the psychometric properties of the Academic Proficiency Assessment battery, and secondly the predictors of academic performance.

Regarding the APA battery, the Time management, Note-taking skills, and Debilitating stress scale on the achievement anxiety questionnaire were found to be internally consistent. The internal consistency reliability within several questionnaires was inadequate. The English proficiency, Reading comprehension, Memorisation skills, Concentration skills and Motivating stress scale on the achievement anxiety questionnaire questionnaires require modification or replacement. The intercorrelations across the questionnaires also suggest that the questionnaires may be evaluating the same factor, and would therefore benefit from further revision.

In terms of the relationship between the APA battery and academic performance, a significant negative relationship was found between Note-taking Skills and academic performance, yielding a R^2_{adj} value of 8,3%. However, as this is an inverse relationship it would suggest minimal practical utility. While these results indicated that the test battery accounted for low levels of variance in CGPA, a discriminant function analysis correctly predicted pass or failure in 72% of the students registered for the Information Technology course. This would indicate that all the proficiencies measured by the APA, with the exception of English proficiency, predicted the likelihood of a student being successful or unsuccessful to a fairly good extent.

The present study is also consistent with the volume of existing research supporting Matric results as an effective predictor of academic performance. Matric results, however, were positively related to CGPA

accounting for 11% of the variance in CGPA. Although a poor fit, these results would suggest the value of using Matric results as one of the criteria for selection for admission into the Information Technology course at Tshwane University of Technology.

Cumulatively, Matric results and Note-taking skills contributed 13,34% towards accounting for the variance in CGPA, which was also a poor fit. It should be noted that due to the presence of multicollinearity, some variables may have been excluded from the model although they may be significant. The intercorrelations across the questionnaires also suggest that the questionnaires may be evaluating the same factor, necessitating further revision and streamlining of the APA battery.

The biographical variables age, gender and predominant language of communication failed to have a significant relationship with academic performance in this study.

Overall the results of the study would thus suggest that matric results remain the best predictor of academic performance, but predict a low amount of the variance in academic performance.

Given the lack of reliability in the majority of the tests, the use of the APA battery for selection for remedial intervention, is not yet justified. The high proportion of pass rates of students predicted by the tests in combination would suggest that work on improving the psychometric qualities of the APA should be undertaken, and would also indicate that additional individual predictors other than those examined in this study, should be examined in future studies with Information Technology students.

Chapter 7

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Appendix A

FIGURES

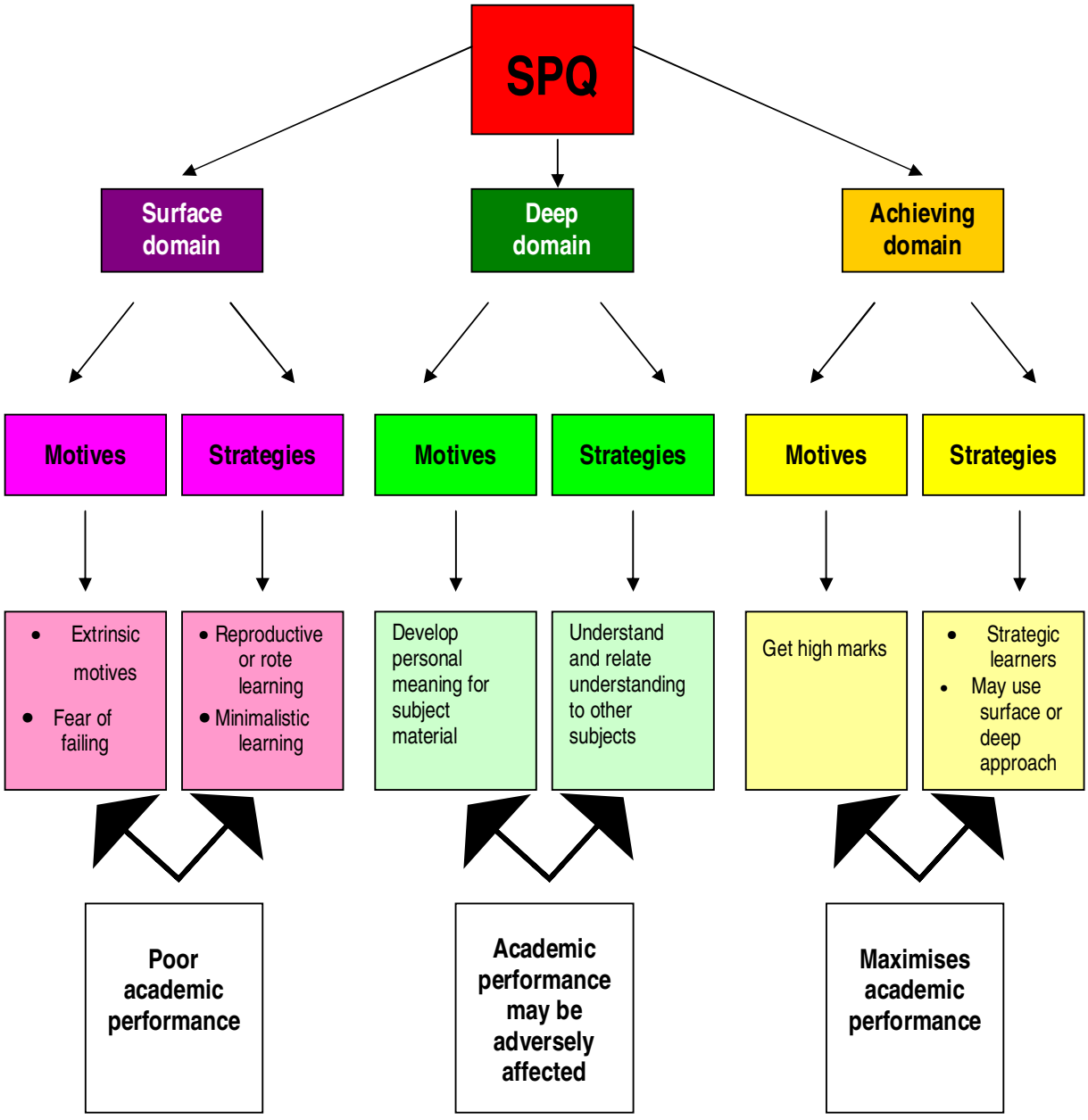


Figure 3. *Study Process Questionnaire (SPQ).*

Appendix B
TABLES

Table 3

McCrae and Costa's Five-Factor Model of Personality

Factor	Description
Neuroticism	Anxious, insecure, guilt-prone, self-conscious
Extraversion	Talkative, sociable, fun-loving, affectionate
Openness to experience	Daring, nonconforming, showing unusually broad interests, imaginative
Agreeableness	Sympathetic, warm, trusting, co-operative
Conscientiousness	Ethical, dependable, productive, purposeful

From "Psychology – Themes and Variations" by W. Weiten, 1989, p.422. Copyright 1989 by Wadsworth, Inc.

Table 4

LASSI Scales

Scale	Coeffecient Alpha	Test-retest Correlation Coefficient
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
Test Strategies	.75	.78

From 'LASSI User's Manual' by C.E. Weinstein, 1987, p.13. Copyright 1987 by H&H Publishing Company, Inc.