

**THE RELATIONSHIP BETWEEN COGNITIVE TESTS
AND THE ACADEMIC PERFORMANCE OF STUDENTS
ON AN MBA PROGRAMME**

by

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DECLARATION

I, Ciara Bux (student number 48447196) declare that this dissertation entitled,

“The relationship between cognitive tests and the academic performance of students on an MBA programme”

is my own work, and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

Ciara Bux
2014

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dissertation is dedicated to you.

SUMMARY

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The objective of this study was to determine if a statistically significant positive relationship exists between the cognitive tests (APIL and Critical Reasoning Test Battery - NCR2 and VCR2) and the academic performance of students on an MBA programme. A quantitative cross-sectional study was conducted on a non-probability purposive sample (N=329) of MBA students at an institution of higher learning in South Africa.

A theoretical relationship was established between the variables. The empirical relationship revealed statistically significant relationships between the cognitive tests and academic performance on an MBA programme.

The findings contribute valuable knowledge to the field of psychological assessment that can be applied in the selection of students for higher education.

KEY TERMS

Cognitive tests; MBA; academic performance; psychometrics; intelligence; students.

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CHAPTER 1. SCIENTIFIC ORIENTATION TO RESEARCH

The focus in this dissertation is on the relationship between cognitive tests and the academic performance of students on an MBA programme.

1.1 BACKGROUND AND MOTIVATION

Master in Business Administration (MBA) programmes' are the cornerstone of many business schools' postgraduate delivery, with an exponential increase in both the number of programmes and students taking MBA's globally (Williams, Parkes & Davies, 2013). Several factors have contributed to the growing demand for management education (Temtime & Mmereki, 2011). Rapid economic growth, global competition, downsizing, deregulation, privatisation, mergers and other changes have placed an increasing premium on management skills and management careers, leading to a surge in demand for management education in the form of MBA degrees (Temtime & Mmereki, 2011). It has become the most prestigious managerial qualification for current and potential managers as it prepares them to take on new challenges and multiple management tasks (Temtime & Mmereki, 2011).

In South Africa, MBA programmes are positioned within the broader landscape of postgraduate education (Kotze & Griessel, 2008). According to the Council on Higher Education (CHE), there have been low graduation rates across all provider types of MBA qualifications in South Africa (Kotze & Griessel, 2008). This is despite the fact that Business Schools strive to admit students that are most likely to succeed. According to Taylor (n.d.), institutions offering MBA programmes are empowered by the Higher Education Act to set up their own admissions processes. The goal of the admissions processes and policies is stated in the preamble of the Higher Education Act 101 of 1997 (as amended). This Act reflects the need for institutions of higher education to strike a balance between:

- 1) taking appropriate measures to admit students in order to redress past inequalities, whilst also,

2) pursuing academic excellence in order to contribute to the advancement of knowledge and scholarship in keeping with international standards of academic quality.

In order to ensure that requirements set out by the CHE and Higher Education Act are upheld, the academic environment is faced with a challenging task (Taylor, n.d). This task entails determining a balancing point between the responsibility of affording students a chance to register for and obtain an academic qualification, and at the same time being responsible in their admission processes, so that students are not set up for failure by admitting them to a level of academic programme that is above their levels of capability (Bischoff, 2012). According to Petit (2013), the senior leadership of graduate schools of business administration within institutions of higher education are also under immense pressure to build resources, improve rankings and grow revenues within each respective school. Ramteke and Deshmukh (2012) stated that in order to gain admission into an MBA programme, a student should provide evidence for/to: 1) will he/she be willing and able to pursue an MBA programme?; 2) is he/she really eligible to register for the programme?; and 3) will he/she successfully complete the programme? According to Tamteke and Deshmukh (2012), such knowledge is needed to enable policy makers to make selection decisions that will inevitably benefit the institution as well as its students.

Bischoff (2012), stated that poor success rates on MBA programmes result in the loss of revenue for the academic institution, time spent by lecturers on students not completing or passing the course and the potential damage to the image of the institution. Additionally, the student suffers a loss of money and time, damaged self-esteem and lower self-confidence. These are but a few of the consequences for failing or dropping out of the academic programme (Bischoff, 2012). Against this background, the identification of reliable factors that help predict students' performance becomes imperative for the selection process, as it will ensure a higher success rate and improves college reputation (Tabsh, 2015).

As a result of the above considerations, psychometric instruments still play a major role in most admission processes for MBA programmes (Taylor, n.d.). It is believed that psychometric instruments are able to provide insight into an applicant's future academic success (Taylor, n.d.). The importance of such a prediction is beneficial not only because it ensures the most efficient use of both the institution and the applicant's resources as stated by Bischoff (2012). It also has a bearing on the funding of the institution. According to Braxton, Hirschy and McClendon (2011), at a time when funding for higher education is diminishing, maintaining and retaining students is key to solving one of the key challenges and problems of higher education.

As previously discussed, South African institutions offering MBA programmes' do not have high graduation rates (Kotze & Grissel, 2008). Therefore, institutions offering an MBA programme should employ stringent selection processes. The Graduate Management Admission Test (GMAT) is a standardised test used internationally by over 4,500 graduate management programmes at 1,900 schools to make admissions decisions (Kass, Grandzol & Bomer, 2012). Therefore, it is common practice for many of the institutions abroad and in South Africa, that offer an MBA programme to make use of GMAT as a selection tool (Kass et al., 2012). The GMAT measures general verbal (GMAT-verbal) and mathematical skills (GMAT-quantitative) (Kass et al., 2012). According to Kass et al. (2012), there has been considerable support for the validity of the GMAT in predicting the academic performance of students on MBA programmes' (e.g., Kuncel, Crede & Thomas, 2007; Oh, Schmidt, Shaffer & Le, 2008).

The institution investigated in the study differs from others as it utilises the APIL (learning potential assessment), as well as the CRTB2 Numerical and Verbal Reasoning Tests. The APIL has been designed to identify candidates with the greatest potential to learn new skills and knowledge (Taylor, n.d.). This test aims to assess the candidate's capacity to learn new skills in the future (Taylor, n.d.). The competencies assessed by the CRTB2 Numerical and Verbal Reasoning Tests are likely to be fundamental skills for many of the subjects studied in an MBA programme (Taylor, n.d.). The above selection

battery is viewed as essential in identifying candidates who will be successful on an MBA programme and also provides candidates from all spheres a fair chance of being selected.

No institutional research has been conducted on the use of the above tests in the context of MBA selection and success in South Africa. As a result, the aim of this study is to make a valuable contribution to institutions in terms of highlighting the usefulness of the selection battery in predicting academic performance, thereby enabling its adaptation at other institutions. It further provides insight for further research in the area. It was anticipated that the findings from this research would serve as a systematic evaluation of the selection procedures at the investigated tertiary institution.

1.2 PROBLEM STATEMENT

Many studies (Kotze and Griessel, 2008; Siergert, 2008; Truitt, 2002) evaluated admissions criteria, to try and determine the best predictors of student's academic success on MBA programmes. However, previous researchers who conducted these studies, focused on specific institutions, the majority of which use the GMAT. Their results have therefore been limited to that specific environment.

According to Cilan and Can (2014) studies aiming to define the success factors of MBA students date back to the 1970's. Deckro and Woudenberg's study was accepted as one of the basic studies on this topic (in Cilan & Can, 2014). In their study, GMAT and undergraduate Grade Point Average (GPA) were found to be accurate predictors of MBA success.

More recently, Taher, Chen and Yao (2011) investigated key predictors of MBA student's performance. Results from the study revealed a significant correlation between personality traits and MBA students' performance. Kass et al. (2012) investigated whether the GMAT is a predictor of academic success. Results revealed that the GMAT (both quantitative and verbal

sections) significantly predicted performance on an MBA programme. A study by Sulaiman and Mohezar (2006) found that demographic factors such as work experience, age, gender, and ethnicity were ineffective as predictors of academic success at the graduate level in business programmes. Research conducted by Hill et al. (2011) found that GMAT scores, particularly the composite of the GMAT verbal and quantitative, were reliable predictors of success on MBA programmes. There may be various factors that could impact on the success of students, and these factors need to be identified so that the findings of a study could be used to assist other students, policy makers and institutions in their selection decisions (Ramteke & Deshmukh, 2012).

Based on the above, the problem statement for this study reads:

There is limited evidence of empirical studies that have been conducted using the proposed battery of tests to predict academic performance of students on an MBA programme. It is vital to analyse the use of the selection processes used by the investigated tertiary institution. Therefore, the purpose of this study was to determine if there is a statistically significant positive relationship between cognitive tests and the academic performance of students' on an MBA programme.

Flowing from the background, the above-identified issues and the problem statement, the research was designed to answer the following literature and empirical questions:

1.2.1 Research questions with regard to the literature review:

With regard to the literature study, the following research questions were the focus of this study:

- How are cognitive tests conceptualised in the literature?
- How is academic performance conceptualised in the literature?

- Is there a theoretical relationship between cognitive tests and academic performance?
- What are the implications of the theoretical relationship between cognitive ability and academic success?

1.2.2 Research questions with regard to the empirical study:

With regard to the empirical study, the following research questions were attended to:

- Does a statistically significant positive relationship exist between the APIL and the academic performance of students on an MBA programme?
- Does a statistically significant positive relationship exist between the CTRB2 Verbal Reasoning Test (VCR2) and the academic performance of students on an MBA programme?
- Does a statistically significant positive relationship exist between the CTRB2 Numerical Reasoning Test (NCR2) and the academic performance of students on an MBA programme?
- Which one or more of the tests in the battery of tests used for admissions decision-making are the most significant predictors of MBA academic performance?
- Based on the findings of this study, what recommendations can be formulated for the practice of industrial and organisational psychology, and for further research?

1.3 AIMS

1.3.1 General Aim:

The general aim of the research was to explore the relationship between cognitive tests and the academic performance of students on an MBA programme.

1.3.2 Specific Aims:

The specific aims relating to the literature review were:

- To conceptualise cognitive tests from a theoretical perspective.
- To conceptualise academic performance from a theoretical perspective.
- To explain the theoretical relationship between cognitive tests and academic performance of students on an MBA programme.
- To highlight the implications of the theoretical relationship between cognitive tests and academic performance.

The specific aims relating to the empirical study were:

- To investigate the statistical relationship between the APIL and the academic performance of students on an MBA programme.
- To investigate the statistical relationship between the CRTB2 Verbal Reasoning Test (VCR2) and the academic performance of students on an MBA programme.
- To investigate the statistical relationship between the CRTB2 Numerical Reasoning Test (NCR2) and the academic performance of students on an MBA programme.
- To integrate the results and determine which one or more of the tests in the battery of tests used for admissions decision-making are the most significant predictors of MBA academic performance.
- To formulate recommendations for the discipline of industrial and organisational psychology, and for further research.

1.3.3 Central Hypothesis

The central hypothesis of the research is stated below:

To investigate the relationship between cognitive tests and the academic performance of students on an MBA programme.

1.3.4 Research Hypotheses

The following research hypotheses were empirically tested in this study:

H₀1: There is no significant positive relationship between scores on the APIL and the academic performance of students selected for an MBA programme.

H₁1: There is a statistically significant positive relationship between scores on the APIL and the academic performance of students selected for the MBA programme.

H₀2: There is no significant positive relationship between scores on the CRTB2 Numerical Reasoning Test (NCR2) and the academic performance of students selected for an MBA programme.

H₁2: There is a statistically significant positive relationship between scores on the CRTB2 Numerical Reasoning Test (NCR2) and the academic performance of students selected for an MBA programme.

H₀3: There is no significant positive relationship between scores on the CRTB2 Verbal Reasoning Test (VCR2) and the academic performance of students selected for an MBA programme.

H₁3: There is a statistically significant positive relationship between scores on the CRTB2 Verbal Reasoning Test (VCR2) and the academic performance of student selected for an MBA programme.

1.4 PARADIGM PERSPECTIVE

1.4.1 The intellectual climate

The literature review on cognitive tests and academic performance is presented from the cognitivist paradigm, and the empirical review is presented from the positivist paradigm.

1.4.1.1 Literature review

The literature review on cognitive tests and academic performance is presented from the cognitivist paradigm. The cognitive psychology paradigm may be defined as the scientific study of the mind and how it processes information (Levitin, 2002). According to Good and Brophy (1990), Merriam and Caffarella (1999) and Simon (2001) (as cited in Yilmaz, 2011), the cognitive school views are; 1) learning as an active process which includes the attainment or reformation of cognitive structures through which humans process and store information, and 2) the learner as an active participant in the process of knowledge acquisition and integration. The theory portrays knowledge acquisition as a mental activity involving internal coding and structuring by the learner and suggests that learning happens optimally under conditions that are aligned with human cognitive architecture (Yilmaz, 2011, p.206). Cognitive psychologists place emphasis on what learners know and how they come to acquire it, rather than on what they do (Yilmaz, 2011).

The cognitivist paradigm was relevant for this study as the assumption is that students' academic performance is aligned with their human cognitive abilities.

1.4.1.2 Empirical study

The empirical review is presented from the positivist research paradigm. With the positivist paradigm, observation and reason are the best means of understanding human behaviour (Dash, 2005). The focus of this paradigm is on experimental and quantitative methods to verify hypotheses in the search of facts. Burrell and Morgan (as cited in Krauss, 2005) stated that positivism aims to explain and predict what happens in the social world by seeking out

consistencies and causal relationships that occur between its constituent elements. The value of the paradigm for this study lies in its assertion that real events can be observed empirically and explained with logical analysis.

1.4.2 Meta-Theoretical statements

Meta-theoretical statements are an important category of assumptions that underlie the theories, models and paradigms that form the context for research (Babbie & Mouton, 2001). In social sciences, meta-theoretical beliefs or values are seen to create the intellectual climate for a particular discipline (Babbie & Mouton, 2001). The meta-theoretical statements for this research are presented below.

1.4.2.1 Industrial psychology

According to Schreuder and Coetzee (2010), industrial and organisational psychology is a field of specialisation in psychology. It is the study of how individuals behave within work settings (Schreuder & Coetzee, 2010).

Industrial and organisational psychology, together with its research focus areas has evolved to address the changing needs of societies and organisations and to generate new knowledge and technology with a view to dealing with the demands of globally and nationally changing contexts (Schreuder & Coetzee, 2010). According to Barnard and Fourie (2007), industrial psychology currently comprises the six widely acknowledged subfields of psychometrics, personnel psychology, organisational psychology, career psychology, consumer psychology and ergonomics. The research presented in this study will fall within the speciality area of psychometrics, and as such places its emphasis in industrial psychology.

1.4.2.2 Psychometrics

Psychometrics refers to the science of psychological assessment, and whilst it is seen as a branch of psychology, its impact is much broader than this (Rust & Golombok, 2014). According to Foxcroft and Roodt (2009) psychometrics refers to both the systematic and scientific way in which psychological

measures are developed and the technical standards (e.g. validity and reliability) required of measures. Psychometric tools make it possible to assess (measure) human behaviour (Foxcroft and Roodt, 2009). The scientific principles that underpin psychometrics apply equally well to assessment in academic contexts and in clinical or occupational contexts (Rust & Golombok, 2014).

1.4.2.3 Psychological assessment

The field of psychological assessment forms a core discipline in most fields of industrial psychology. Foxcroft and Roodt (2009) stated that psychological assessment is a process-orientated activity aimed at gathering a wide array of information by using psychological assessment measures (tests) and information from many other sources. The use of psychological tests in predicting the academic performance of students on an MBA programme is the focus of this research.

1.4.3 Theoretical model

The study was anchored on the three main traditions of cognitive assessment, namely; the conventional or structural approach, the information processing approach and the dynamic or learning potential approach that were reviewed by Taylor (1994). Each of the three dimensions, which can either be categorised, as static or dynamic dimensions, is important in everyday life (Taylor, 1994). According to Taylor (1994) each of the three approaches developed fairly independent of each other, therefore there is very little theory to link them to each other.

The researcher was guided by the theory of the three approaches in the quest for answers to the queries made.

1.4.4 Applicable concepts and constructs

The following concepts and constructs were applicable to the research.

1.4.4.1 Cognitive tests

Cognitive tests are commonly used for the purposes of selection (Foxcroft & Roodt, 2009). Foxcroft and Roodt (2009) defined cognitive ability as the range of intellectual (or cognitive) skills that are available to a person at a given point in time. Kuncel and Hezlett (2010) concluded that tests of cognitive ability are seen as samples of this range of skills. According to Kuncel and Hezlett (2010) standardised tests of cognitive abilities, such as college admissions tests, are some of the strongest and most consistent predictors of performance in educational settings. Most assess a combination of reasoning, verbal, and quantitative skills or discipline-specific knowledge, which are correlated and fit into a hierarchical structure with a single overarching general ability (Kuncel & Hezlett, 2010). Standardised tests of cognitive abilities are grounded in the psychometric approach to intelligence, which has focused on understanding individuals' ability to reason, plan, solve problems, think abstractly, learn and adapt, and process and comprehend complex ideas and information (Ones, Visweswaran & Dilchert, 2005).

1.4.4.2 Academic performance

According to Rohde and Thompson (2007) academic performance is the outcome of education (i.e. the extent to which students' achieved their goals). Individual differences in academic performance have been linked to differences in cognitive ability (Rhode & Thompson, 2007). It has been found that those with a higher cognitive functioning generally achieve higher results in academic settings. It is the aim of this study to explore this relationship (Rohde & Thompson, 2007).

1.4.4.3 Masters in Business Administration (MBA)

The MBA is a Masters in Business Administration (MBA) degree (Williams et al., 2013). The programme at the institution under study is completed over two years. During the programme, students complete core courses, electives and

a compulsory research project (dissertation). An MBA programme at the institution aims at creating well-rounded and effective managers.

1.4.5 Methodological convictions

The methodological convictions that were applicable to this study are presented below.

The positivist paradigm is a meta-theory, which is based on the key assumption that the social sciences should follow the lead of the natural sciences and model its own practices on that of successful natural sciences (Babbie & Mouton, 2001). The positivist paradigm asserts that real events can be observed empirically and explained with logical analysis (Terre Blanche Durrheim & Painter, 2006). The criterion for evaluating the validity of a scientific theory is whether knowledge claims are consistent with the information that is obtained. In this context, the ontology, epistemology and methodology of the positivist paradigm are presented below.

(a) Ontology

Ontology specifies the nature of reality that is to be studied, and what can be known about it (Terre Blanche et al., 2006). This study falls within the positivist paradigm, as such the nature of reality is

- Stable and external
- Law-like

(b) Epistemology

Epistemology specifies the nature of the relationship between the researcher (knower) and what can be known (Terre Blanche et al., 2006). The epistemology of the research study is

- Objective
- Detached observer

(c) Methodology

Methodology specifies how researchers go about practically studying whatever they believe can be known. The methodologies used in the study include

- Quantitative
- Hypothesis testing

1.5 RESEARCH DESIGN

A research design encompasses the methodology and procedures used to conduct scientific research (Terre Blanche et al., 2006). Designs are presented according to the research approach and method used (Terre Blanche et al., 2006).

1.5.1 Research approach

An ex post facto design was used for this study. The study followed a non-experimental strategy since there was no need to manipulate, control or interfere with any of the variables. According to Terre Blanche et al., (2006) in a quantitative study, specific and narrow questions are asked about a topic, and numerical data is then collected from participants in order to answer those questions. Once collected, data is analysed using statistical methods. A quantitative approach makes it possible to conduct research in an unbiased and objective manner (Terre Blanche et al., 2006). For the study secondary data was utilised, as the data already existed and was used for purposes other than that for which it was originally collected (i.e. selection of MBA students). A correlational approach was followed for the purpose of data analysis.

1.5.2 Research variables

Babbie and Mouton (2001) defined a variable as any concept that can be measure or counted. An independent variable is presumed to cause an effect

or outcome on something else, whilst a dependent variable is the outcome of another variable (Terre Blanche et al., 2006). In this study, the independent variables were cognitive tests and the dependent variable was academic performance. The study therefore focused on determining whether there is a statistically significant relationship between these cognitive tests and the academic performance of students on an MBA programme.

1.5.3 Reliability and validity

The following methods were put into place to ensure a valid and reliable research process.

1.5.3.1 Reliability

According to Foxcroft and Roodt (2009) the reliability of a measure refers to the consistency with which it measures whatever it measures. Simply stated, if a psychological test is repeatedly administered to the same person, it would yield similar results. Consistency always implies a certain amount of error in measurement (random error and systematic error) (Bryman, 2012). Random error refers to the random fluctuations in performance, whilst systematic error refers to the non-random bias that impacts on the reliability of a measure.

In this study, the reliability of the literature review was ensured through the use of existing literature sources, theories and models. For the empirical study, it was not possible to test the participants twice in order to confirm test-retest reliability. Reliability for the study was ensured through the correct and proper use of valid and reliable measuring instruments (the reliability of the specific measuring instruments will be discussed in Chapter 3). In this way, the overall reliability of the research was improved.

1.5.3.2 Validity

The validity of a measure concerns what the test measures and how well it does so (Babbie 2013; Foxcroft & Roodt, 2009). In other words, does the psychometric instrument measure what it is supposed to measure? Validity

does not refer to a specific property of a measure, but rather the specific purpose of an instrument.

The validity of the literature review was ensured through an attempt of achieving theoretical validity by means of the clarification of concepts. For the empirical study, the internal validity of the study was confirmed with the measuring instruments used, namely the APIL and CRTB2 Numerical and Verbal Reasoning Tests. The measuring instruments previously demonstrated good psychometric properties, thereby eliminating any doubt that reliable scores were obtained through their use. Additionally, in terms of the external validity of the study, findings were not generalised to other populations, but only to the sample in the study.

1.5.4 Unit of analysis

The unit of analysis refers to the objects or things that are researched in order to formulate generalisations of these objects and to further explain differences among them (Terre Blanche et al., 2006). Typically, in social science research the unit of analysis is the individual person. However, it may also be a group, social artefact, social action/event or intervention (Babbie & Mouton, 2001). The unit of measurement for this study is at an individual level (cognitive test results and academic performance), however, the unit of analysis is correlation, which is group based. The sample will consist of students on an MBA programme who will individually form the sample. Academic performance was obtained on an individual basis.

1.5.5 Methods to ensure ethical research principles

Ethical guidelines as stipulated by the Health Professions Council of South Africa (HPCSA) and the department of Industrial and Organisational Psychology, formed the basis of the study. Ethical clearance to conduct the study was applied for through the Research Committee of the Department of Industrial and Organisational Psychology. Informed consent was obtained from the Institution to conduct the study and all data and results were dealt

with the utmost confidentiality. Consent forms were used to obtain permission from students at the time of the assessments. To ensure confidentiality, students were tracked by their student numbers, which were subsequently changed to sequential numbers. The results obtained were communicated only to the organisation from which the data was obtained, and any recommendations made were to the benefit of the organisation.

1.6 RESEARCH METHOD

The research is presented in two parts: the literature review and the empirical study

1.6.1 Phase 1: Conceptualisation and literature review

The following is proposed in this phase

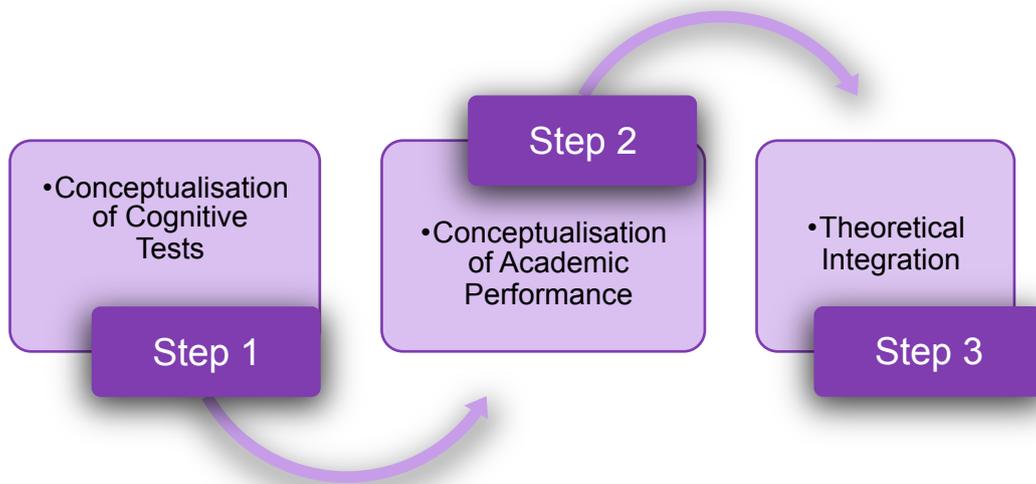
- Step 1: Conceptualisation of cognitive tests from a theoretical perspective
- Step 2: Conceptualisation of academic performance from a theoretical perspective
- Step 3: Integration of the variables and conceptualisation of the theoretical relationship between the variables
- Step 4: Formulation of the study hypothesis to achieve the study objectives

1.6.2 Phase 2: Empirical study

The empirical study is presented in the form of a research article, which is to be found in Chapter 3. The contents of the research article includes the key focus of the study, background to the study, trends from the research literature, the research design (which covers the research approach and method), results from the empirical study, a discussion of the results, conclusions, limitations of the study, and lastly recommendations for future research.

Figure 1.1 outlines this process.

LITERATURE REVIEW



EMPIRICAL STUDY

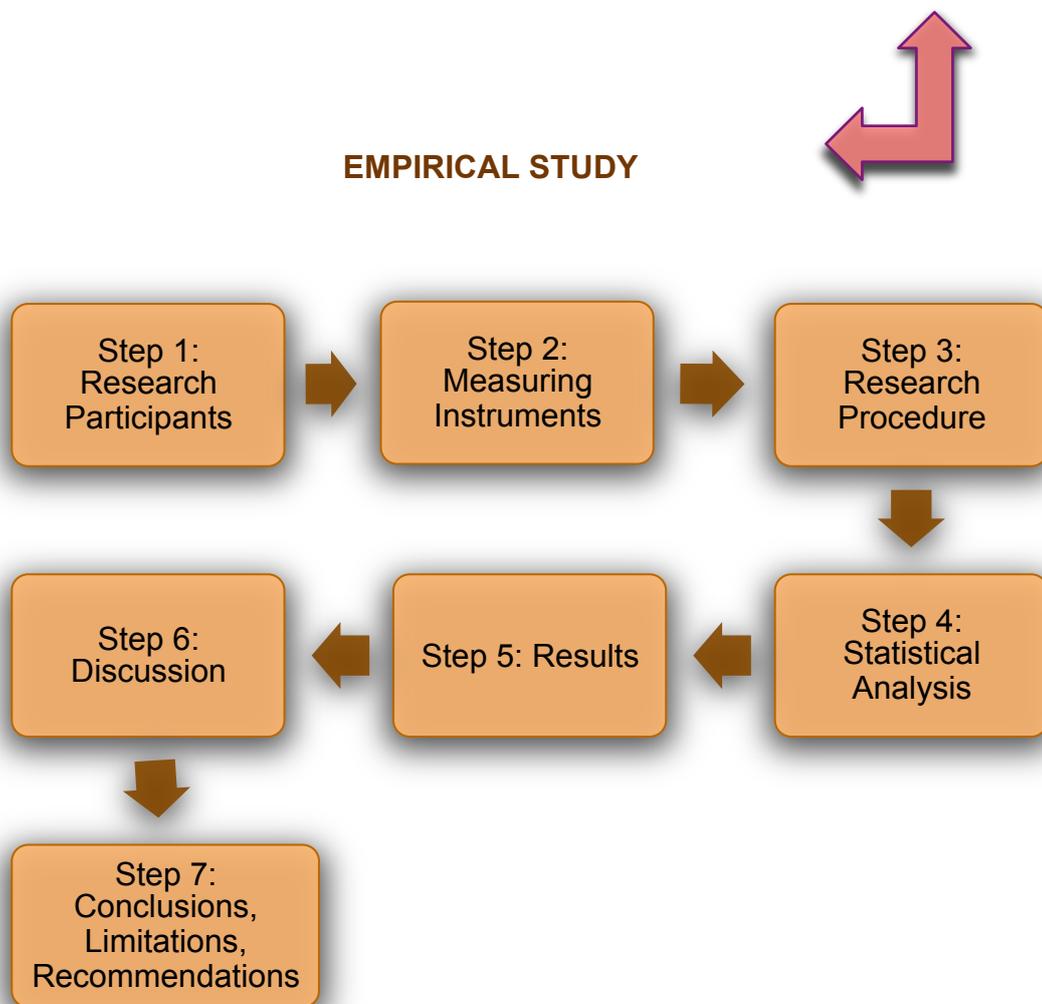


Figure 1.1: Overview of Research Model

1.7 CHAPTER LAYOUT

In terms of the chapter layout, the structure of the study is as follows:

Chapter 1: Scientific orientation to the study

The background to and motivation for the study were discussed. This chapter included a discussion on the nature of and need for the use of cognitive tests as a predictor of academic success. Additionally, the problem statement, research hypotheses, research aims, paradigm perspective used and the research design and methodology were mentioned.

Chapter 2: Literature review

Chapter 2 includes; discussions into psychometric assessments and assessing intelligence, conceptualisations into cognitive tests and academic performance, an explanation into the theoretical relationship between cognitive tests and academic performance, and lastly, the implications for academic performance are discussed.

Chapter 3: Research Article

Results are presented in article format. The empirical procedure is presented in terms of sample, measuring instruments, administration of the questionnaires, data collection and processing, statistical methods and formulation of the hypothesis. The results are discussed against the formulated hypothesis, and are presented in tables and figures. Conclusion, recommendations and limitations are presented on the research findings.

Chapter 4: Conclusions, limitations and recommendations

Conclusions are drawn in terms of the specific aims of the research. The limitations of the research are discussed and revealed, and recommendations are made on the findings of the research.

1.8 CHAPTER SUMMARY

In this chapter the background to and motivation for the research, the research problem, the aims, the paradigm perspective, and the research design and method were discussed. The chapter ended with the chapter layout. The next chapter focuses on the literature review and conceptualising the cognitive tests and academic performance.

CHAPTER 2: LITERATURE REVIEW: COGNITIVE TESTS AND ACADEMIC PERFORMANCE

2.1 INTRODUCTION

Some individuals obviously and consistently understand new concepts quicker, solve unfamiliar problems faster, see relationships that others don't, and are more knowledgeable about a wider range of topics than others (Coaley, 2014). For this reason, cognitive ability has received increasing attention, both in research and practice from philosophers, researchers and scholars (Coaley, 2014). Results from cognitive ability assessments are often used in the educational context to determine school readiness, to obtain a comprehensive picture of specific aptitudes or to assist with decision-making (De Beer, 2011). The prediction of determining eventual successful candidates is necessary as academic institutions are often oversubscribed by candidates and are concerned with whether their candidates have the necessary capabilities of passing their programmes of choice (Bischoff, 2012).

For the purposes of this study, the literature review covered; discussions into psychometric assessments and assessing intelligence, conceptualisations into cognitive tests and academic performance, an explanation into the theoretical relationship between cognitive tests and academic performance, lastly, the implications for academic performance were discussed.

2.2. DEFINING PSYCHOMETRIC ASSESSMENT

According to Rust and Golombok (2014), psychometrics refers to the science of psychological assessment, and whilst it's seen as a branch of psychology, its impact is much broader than this. Coaley (2014), stated that psychological assessment is a process-orientated activity aimed at gathering a wide array of information by using psychological assessment measures (tests) and information from many other sources, e.g. through interviews, an individual's history which includes scholastic performance, qualifications, life and work history etc. The scientific principles that underpin psychometrics apply equally

well to assessment in academic contexts and in clinical or occupational contexts (Rust & Golombok, 2014).

Kaplan and Saccuzzo (2012) stated that the most basic concept underlying psychological assessment pertains to individual differences. The psychology of individual differences seeks to describe the ways in which people differ, and to understand how and why these arise (Coaley, 2014; Kaplan & Saccuzzo, 2012). In order to adequately determine individual differences amongst people, measurement becomes important. According to Coaley (2014), psychometrics is designed to do a measurement; the term is an abbreviation for 'psychological measurement'. A psychological test is essentially an objective and standardised measure of sample behaviour Coaley (2014). They form the branch of the wider field referred to as psychological assessment, which seeks to understand the psychology of an individual (Coaley, 2014).

At its most basic, psychological assessment provides dynamic insights into the inner workings of an individual, yielding invaluable information (Wright, 2010). In other words, assessment is the organized collection of descriptive and judgemental information necessary to make effective decisions. Kaplan and Saccuzzo (2012) argued that psychological assessment involves the classification of behaviours into categories measured against a normative standard. Typically psychological tests have been used in three different areas: (1) in occupational settings tests are employed in personnel selection and vocational guidance; (2) in education they are useful for selection; and (3) in clinical work psychologist tests are used as adjuncts to clinical decision making (Kaplan & Saccuzzo, 2012).

In South Africa, a test is classified as a psychological test when the purpose of the test results in the performance of a psychological assessment (Foxcroft & Roodt, 2009). According to the Health Professions Act, 56, of 1974, Section 37 (2) (a), (b), (c), (d), and (e), a psychological act with respect to assessment is defined as being "the use of measures to assess mental, cognitive, or behavioural processes and functioning, intellectual or cognitive ability or

functioning, aptitude, interest, emotions, personality, psychophysiological functioning, or psychopathology (abnormal functioning)” (Foxcroft, Roodt & Abrahams, 2001).

Below is a discussion into the basic requirements for psychometric assessments.

2.2.1 Basic Requirements for psychometric assessments

The basic requirements for scientific psychometric assessments are that tools should be reliable, valid and standardised, in the context in which they are used (Employment Equity Act 55 of 1998). The extent that the cognitive admissions tests used in this study; namely the APIL instrument and the Critical Reasoning Test Battery (VCR2 and NCR2), meet these requirements will be discussed in Chapter Three.

2.2.1.1 Reliability

According to Foxcroft and Roodt (2009), the reliability of a measure refers to the consistency with which it measures whatever it measures. Simply stated, if a psychological test is repeatedly administered to the same person, it would yield the same results. Consistency always implies a certain amount of error in measurement (random error and systematic error) (Bryman, 2012). Random errors refer to the random fluctuations in performance, whilst systematic error refers to the non-random bias that impacts on the reliability of a measure.

In order to test the reliability of a measurement, there are various different techniques. Foxcroft and Roodt (2009), stated that the four primary methods of obtaining reliability coefficients are, test-retest reliability, alternate-form reliability, internal consistency reliability, and inter-scorer reliability.

2.2.1.1.1 Test-retest reliability

One of the easiest ways of showing that an assessment technique is consistent in what it does is to apply the same technique to the same group of people on two or more occasions (Bryman, 2012; Foxcroft & Roodt, 2009). The reliability coefficient in this case will be the correlation between the scores on the first test and the subsequent applications (Bryman, 2012; Foxcroft & Roodt, 2009). Such brief retest intervals are used when the construct being assessed is expected to vary across time (Weiner & Greene, 2011). This coefficient may also be referred to as the coefficient of stability (Foxcroft & Roodt, 2009).

2.2.1.1.2 Alternate-form reliability

In this method, two equivalent forms of the same measure are administered to the same group on two different occasions (Foxcroft & Roodt, 2009). The correlation obtained between the two sets of scores represents the reliability coefficient. This reliability coefficient may also be referred to as a coefficient of equivalence (Foxcroft & Roodt, 2009). It should be noted that the tests must be equivalent in all respects (number of items, item content, difficulty, administration etc.), and this method is both time consuming and expensive (Foxcroft & Roodt, 2009).

2.2.1.1.3 Internal consistency reliability

In this method, the most important question that needs to be answered is whether all parts of the assessment process measure the same thing (Weiner & Greene, 2011). Simply stated, does the assessment focus on a single phenomenon or is more than one property being assessed? In order to determine if an assessment method has a single focus, the different parts of the assessment are correlated (Weiner & Greene, 2011).

2.2.2.1.4 Inter-scoring reliability

This method focuses on the extent to which two or more raters, observers or judges agree about what has been observed (Foxcroft & Roodt, 2009). The basic strategy for determining inter-scoring reliability is to acquire a series of responses from a single client and to have the responses scored by two different individuals (Foxcroft & Roodt, 2009). Thereafter, the two scores can then be correlated to determine a reliability coefficient (Foxcroft & Roodt, 2009).

2.2.2.1 Validity

The validity of a measure concerns what the test measures and how well it does so (Babbie, 2013; Foxcroft & Roodt, 2009). In other words, does the psychometric instrument measure what it is supposed to measure. Validity does not refer to a specific property of a measure, but rather the specific purpose of an instrument. Validity can be determined in a number of different ways, each with a different meaning and use. However, Babbie (2013), states that there are three main forms of validity; construct validity, content validity and criterion-related validity.

2.2.2.1.2 Construct validity

The construct validity of a measure refers to the degree to which a measure relates to other variables as expected within a system of theoretical relationships (Babbie, 2013; Foxcroft & Roodt, 2009). The assessment of construct validity involves three general steps. Firstly by making a careful analysis of the trait, then by taking into consideration the way that the trait should relate to other variables, and finally, by testing the hypothesized relationships actually exist (Groth-Marnart, 2009). It should be noted that there is no single, best approach for determining construct validity.

2.2.2.1.3 Content validity

Content validity involves determining whether the content of the measure covers a representative sample of the behaviour domain/aspect to be measured (Babbie 2013; Foxcroft & Roodt, 2009). Content validity is a non-statistical type of validity and rather refers to a specific procedure in constructing a test measure. A frequently used procedure to ensure high content validity is the use of a panel of subject experts to evaluate the items during the test construction phase (Foxcroft & Roodt, 2009). Content validity has high relevance in evaluating achievement, educational and occupational measures.

2.2.2.1.4 Criterion-related validity

This method involves the calculation of a correlation coefficient between a predictor or more than one predictor, and a criterion (Babbie, 2013; Foxcroft & Roodt, 2009).

There are two main types of criterion-related validity, namely predictive validity and concurrent validity. Predictive validity refers to the accuracy with which a measure can predict the future behaviour or category status of an individual (Foxcroft & Roodt, 2009). Concurrent validity involves the accuracy with which a measure can identify or diagnose the current behaviour or status regarding specific skills or characteristics of an individual (Foxcroft & Roodt, 2009).

The subsequent discussion explores psychometric assessment in the South African context.

2.2.2 Psychometric Assessment in South Africa

Psychological assessment in South Africa provokes many strong opinions. It is highly controversial in South Africa due to past indiscriminate, unfair, and unbiased use of tests (Laher & Cockcroft, 2014). Since the first democratic elections in 1994, the country has a new constitution and stronger demands

for the cultural appropriateness of psychological tests (Laher & Cockcroft, 2014). The field has made an effort to shrug off the negative mantle and is grappling with attempts to form a new, positive identity that can contribute meaningfully to South African society (Laher & Cockcroft, 2014). Tests need to meet stringent psychometric standards and need to cater for all age groups in our multicultural society if psychological assessment practitioners are to succeed in employing fair, testing practices (Foxcroft, Paterson, le Roux & Herbst, 2004).

In order to ensure the cultural and fair use of assessments in South Africa, regardless of the context in which it is used, there are legal imperatives in place to regulate the profession.

The primary South African legislation governing psychometric assessment use is the Employment Equity Act (no. 55 of 1998), which has the dual objective of ensuring that only valid and reliable assessments are used and that assessments are used in a fair manner that is free from bias. The act specifically states:

“Psychological testing and other similar forms or assessments of an employee are prohibited unless the test or assessment being used:

- a) has been scientifically shown to be valid and reliable;
- b) can be applied fairly to all employees
- c) is not biased against any employee or group”

The Employment Equity Act has major implications for assessment practitioners in South Africa, because of the many measures currently in use (Foxcroft & Roodt, 2009; Laher & Cockcroft, 2014). Furthermore, the impact of this Act on the conceptualisation and professional practice of assessment in South Africa in general is far reaching as assessment practitioners and test publishers are increasingly being called upon to demonstrate, or prove in court, that a particular assessment measure does not discriminate against a certain group of people (Foxcroft & Roodt, 2009; Laher & Cockcroft, 2014).

According to the Health Professions Act (no. 56 of 1974), Section 37 (2) (a), (b), (c), (d) and (e), all instruments that measure psychological constructs must be used, interpreted and controlled by psychologists: only individuals who are registered with the Professional Board of Psychology may use psychological tests and instruments that are classified with the Board.

The investigated institution makes use of the services of trained, registered psychologists for the assessment of MBA applicants. Furthermore, the assessment battery used by the institution adheres to requirements mandated by the Employment Equity Act. Evidence lies in the APIL instrument being specifically designed for the South African population and in the specific development of South African norms for the Critical Reasoning Test Battery. The specific reliability and validity measures of the instruments will be discussed in Chapter 3.

2.3 ASSESSING INTELLIGENCE

Below is a brief literary review on the construct of intelligence. It is aimed at exploring intelligence by providing a definition for both intelligence and psychometric intelligence, and discussing the evolution of the theories underlying intelligence.

2.3.1 Defining intelligence

The concept of intelligence and the tests developed to measure it have been considered one of psychology's greatest contributions to society (Bray & Kehle, 2011). Intelligence is sometimes called intellectual ability or simply ability (Bray & Kehle, 2011). Theorists proposed, and researchers reported, that intelligence is a set of relatively stable abilities, which can change slowly over time (Fletcher & Hattie, 2011). Although intelligence can be seen as potential, it does appear to be inherently fixed or unalterable characteristic. Rather, it varies around a certain point (Fletcher & Hattie, 2011).

Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experience (Fletcher & Hattie, 2011). It reflects a broader and deeper capability for comprehending our surrounding (Fletcher & Hattie, 2011).

One of the central purposes of intelligence testing, dating back to Alfred Binet, is to predict educational achievement (Kaufman et al., 2012). In such instances, the aim is to gauge one's psychometric intelligence.

In the following section, the concept of psychometric intelligence is defined.

2.3.2 Defining psychometric intelligence

Psychometric intelligence implies that we use primarily standardised psychological tests to measure levels of functioning on psychologically defined constructs (Foxcroft & Roodt, 2009). This approach to intelligence focuses on understanding individuals' ability to reason, plan, solve problems, think abstractly, learn and adapt, and process and comprehend complex ideas and information (Kuncel & Hezlett, 2010). In the psychometric approach to intelligence, the emphasis is on the product rather than the process of learning (Fletcher & Hattie, 2011). Advocates of the psychometric approach consider intelligence to be: innate, objectively measurable, stable, and predictive of future behavior (Fletcher & Hattie, 2011).

Psychometric theories of intelligence are based upon the study of individual differences (Bray & Kehle, 2011); in particular, individual differences in performance on tests that involve some cognitive component. In a typical investigation using this approach, a large number of people are administered a number of different tests of cognitive ability (e.g. vocabulary, number series, perceptual speed, general knowledge, analogies, etc.). These test scores are then inter-correlated (Bray & Kehle, 2011). Thereafter, the resulting correlation matrix can be further analysed using mathematical techniques, such as factor analysis, to find underlying dimensions of cognitive ability.

These underlying dimensions usually form the basis of the resulting theory of psychometric intelligence (Bray & Kehle, 2011).

For the purposes of this literature review, it is necessary to explore the theories of intelligence that led to the development for the assessment of cognitive ability.

2.3.3 Evolution of theories on Intelligence

According to Nevid, Rathus and Greene (1997), psychological tests were originally developed for the purpose of assessing intelligence. The theories that attempt to explain intelligence are not all alike. They have emerged from different areas of psychology, and have emphasized different aspects of human performance (Gardner, 2011). The theories do not all agree with each other concerning the number of abilities that constitute intelligence, furthermore, the theories have evolved over time (Gardner, 2011).

2.3.3.1 Galton (1822-1911)

Galton, a cousin of Charles Darwin, is considered to be the first individual to attempt the scientific measurement of intelligence (Coaley, 2014). He was a prolific writer and zealous scientist (Coaley, 2014). As the cousin of Darwin, he attempted to apply the evolutionary theory to the study of human abilities.

Galton tried to explain why superior intelligence or genius ran in certain families (Coaley, 2014). He was the first to emphasise the importance of individual differences, created the first tests of mental ability, and was the first to use questionnaires (Coaley, 2014). He also discovered a number of statistical procedures to analyse data, many of which are still in use today; for example, normal distribution or the bell curve (Coaley, 2014).

2.3.3.2. Alfred Binet (1857-1911) and Theodore Simon (1873-1961)

Binet developed the first workable intelligence test. He argued that intelligence was a high level ability, to which mental judgement was key (Coaley, 2014; Hunt, 2010). It could be assessed using relatively complex thought patterns, usually displayed in everyday life and in the ability to learn within an academic setting (Hunt, 2010).

Simon, a doctoral student had approached Binet and asked him to supervise his research (Hunt, 2010). In 1903, both Binet and Simon were commissioned by the French government to improve the teaching methods for developmentally disabled children (Coaley 2014; Hunt, 2010). They set out to identify the individual differences that separated abnormal children from the normal and to measure them (Coaley, 2014).

They constructed a series of tests, including short, varied problems about daily life as well as tests of cognitive processes such as memory (Coaley; Hunt, 2010).

2.3.3.3 Charles Spearman (1863-1945)

After being thoroughly impressed with the work of Galton, Spearman began his work with village school children (Hergenhahn, 2005). He found that not only did measures of sensory acuity correlate highly among themselves, but more important, they also correlated highly with cleverness in school (Hergenhahn, 2005).

In his two-factor approach to intelligence, Spearman proposed that every mental test measured a general factor g and a specific factor s that was unique to specific test items (Hergenhahn, 2005; Hunt, 2010). Upon collating the scores from numerous tests, the s factor could be cancelled out, leaving an indicator of general intelligence. (Hergenhahn, 2005). Spearman described “general intelligence” or “ g ” as that which refers to the common variance shared by a battery of mental tests (Hergenhahn, 2005; Hunt, 2010)

2.3.3.4 Raymond B Cattell (1960s-1970s)

Cattell offered a higher-order theory, which distinguishes two forms of intelligence, fluid and crystallized (Taylor, 1994). According to Cattell, fluid intelligence is a basic inherited capacity as developed by an interaction with environmental characteristics, which are found in any society (Hunt 2010; Taylor, 1994). Crystallized intelligence involves specialized skills and knowledge promoted by and required in a given culture (Hunt, 2010; Taylor, 1994). This type of intelligence is based upon facts and rooted in experiences. Cattell believed that as we age, and accumulate new knowledge and understanding, crystallized intelligence becomes stronger (Taylor, 1994).

Cattell was one of the first to develop culture fair tests, which were designed to measure fluid intelligence (Taylor, 1994). A positive attribute of Cattell's model is that it is amenable to dynamic, learning or developmental interpretations (Taylor, 1994).

2.3.3.5 Anne Anastasi (1908-2001)

Anastasi was the first person to emphasise that different cultures have alternative concepts of what an "intelligent person" is, and that traditional tests measure only skills valued in academia and work in industrialised societies (Coaley, 2014). Anastasi undertook major studies in test construction, test misuse, misinterpretation, and cultural bias (Coaley, 2014)

Over the years, intelligence or cognitive ability evolved, along with the developing theories. This saw the birth of various different approaches to assessing cognitive ability.

2.4 COGNITIVE TESTS

2.4.1 Conceptualisation

Foxcroft and Roodt (2009) defined cognitive ability as the range of intellectual (or cognitive) skills that are available to a person at a given point in time. Kuncel and Hezlett (2010) concluded that tests of cognitive ability are seen as samples of this range of skills. Individuals who have acquired a wide range of such skills are seen to be more likely to perform well on the tests and subsequently perform well in academic tasks, as they already possess the needed knowledge (Foxcroft & Roodt, 2009).

According to Foxcroft and Roodt (2009) psychological assessment provides information that can be used to guide individuals, groups and organisations in understanding and making informed and appropriate decisions. Standardised tests of cognitive abilities are grounded in the psychological approach to intelligence, which has focused on understanding individuals' ability to reason, plan, solve problems, think abstractly, learn and adapt, and process and comprehend complex ideas and information (Kuncel & Hezlett, 2010).

Most tests of cognitive ability assess a combination of reasoning, verbal, and quantitative skills or discipline-specific knowledge, which are correlated and fit into a hierarchical structure with a single overarching general ability (Kuncel & Hezlett, 2010). As such, those who do well on one kind of content (e.g. mathematics) will tend to do well on tests with different content (e.g. verbal skills) (Kuncel & Hezlett, 2010). De Beer (2011) stated that results from cognitive ability assessments are often used in the educational context to determine school readiness, to obtain a comprehensive picture of specific aptitudes or to assist with decision-making (De Beer, 2011). Therefore, cognitive ability assessments are a way in which reliable and relevant information about an individual can be obtained.

2.4.2 Theoretical Model: Approaches to assessing cognitive ability

According to Taylor (1994), the three main traditions of cognitive assessment are:

- (1) the conventional or structural approach
- (2) the information processing approach
- (3) the dynamic or learning potential approach

Each of the traditions developed fairly independently of others, thus there is relatively little theory linking the three and relating their perspectives to one another (Taylor, 1994). The traditions will be discussed below.

2.4.2.1 The conventional or structural approach

The conventional or structural approach is referred to as the psychometric approach (Hamers & Resing, 1993). Assessments or tests that have been established in accordance with this approach, attempt to measure performance along dimensions, which are supposed to constitute the fundamental structure of the psychological domain in question (Hamers & Resing, 1993; Taylor, 1994). The domains include cognitive, personality, interests and others. Typically such approaches rely upon the statistical comparison between normalised groups and individuals (Murphy, 2002).

Almost all research and theory development in this tradition has been of the individual differences type (Taylor, 1994). For the cognitive domain, individual differences have been mainly measured through the power score (Taylor, 1994). A power score is a summation of the correct answers to problems of moderate to high difficulty. The individual differences research of the structural approach has also made extensive use of correlational and factor analytical techniques when resolving theoretical and empirical questions (Hamers & Resing, 1993; Taylor, 1994).

Spearman was the first researcher to use the factor analytic method in identifying underlying structures in the cognitive domain (Taylor, 1994). According to Taylor (1994), since then, researchers such as Ackerman

(1998), Cattell (1971), Guilford (1967), Horn (1986), Snow and Lohman (1984), and Vernon (1962) have all employed factor analytic techniques and developed Spearman's notions of g-factors, each producing a different structure of intellect.

The tests in this approach measure the products of prior learning (i.e. Cattell's Crystallized Intelligence). They therefore rely on the assumption that all individuals to be tested have had comparable opportunities to acquire what is being measured (Taylor, 1994).

The Critical Reasoning Test Battery (CRTB2) that is used in this study resides under the conventional or structural psychometric approach. The CRTB2 has been developed on data from undergraduates (Psytech SA, 2010). These are individuals who could be viewed as having above average intelligence, who are likely to find themselves in managerial positions as their career develops, and those who are thus likely to undertake the MBA programme (Psytech SA, 2010). The assessment tool is discussed in more detail in Chapter 3.

2.4.2.2 The information processing approach

Information processing began to establish itself as the basis of cognitive psychology in the 1960's (Taylor, 1994). Unlike the conventional or factorial grounded tests, these tests involve a great attention to detail (Taylor, 1994). They tap into one or a few specified cognition activities or approaches (Hamers & Resing, 1993; Taylor, 1994).

Central to the information-processing perspective is the view of intelligence as deriving from the ways in which people mentally represent and process information (Hamers & Resing, 1993). Essentially, this approach broadens the concept of intelligence by focusing on cognitive processes rather than end products of problem solving.

The approach was strongly influenced by the salience of computational thinking (Murphy, 2002). Two approaches developed from information

processing approach: the cognitive components approach and the cognitive correlates approach (Taylor, 1994). The aim of the cognitive components approach is to uncover the components of cognitive thought, such as the components that make up analogical problem solving (Taylor, 1994). The cognitive correlates approach, which was developed by Hunt, attempts to find the critical process, which underlie performance on a given conventional measure (Taylor, 1994).

The information processing approach promised a fruitful new era in assessment. According to Taylor (1994), with this approach, the problem of cultural bias is likely to be relatively small because the constructs are delineated and the measures are simple (although, this cannot be said for certainty since little cross-cultural research has been conducted). A possible disadvantage of this method is the necessity of computer administration, thereby limiting the number of people that can be tested at any given time (Taylor, 1994).

No assessments or tests used in this study are part of this approach.

2.4.2.3 The learning or dynamic approach

The dynamic approach is based on the work on Russian Psychologist Vygotsky's theory of the zone of proximal development (Taylor, 1994). The approach addresses the assessment of adaptation to novel tasks, as evidenced in mastery or increased speed and accuracy as a result of repeated exposure, instruction, examples or hints (Hamers & Resing, 1993; Taylor, 1994). With the emphasis of the approach lying with the training of cognitive processes, the approach focuses on speed and accuracy as a result of repeated mediation, in order to improve the measurement of intelligence (Hamers & Resing, 1993).

The approach views intelligence as the individual's capacity to adapt to the demands of the environment. Its aim therefore, lies in determining how sensitive, if at all, an individual is to instruction, and how efficient the

operations of cognitive processes are (Hamers & Resing, 1993; Taylor, 1994). The basic principle of learning potential assessments or the dynamic approach to testing is that a test should measure the ability of the individual to learn rather than only previously acquired knowledge or skill (Taylor, 1994).

According to Taylor (1994), Vygotsky acknowledged that individuals differ in their capacity to benefit from mediated learning experiences. Vygotsky therefore defined a concept, the Zone of Proximal Development, to indicate the difference between unassisted performance and performance attained through mediation (Taylor, 1994). Traditional static tests measure only unassisted performance whereas dynamic testing focuses on one's potential, thereby investigating an individual's ability to gain knowledge, and thereafter apply this knowledge to assist in problem solving (Taylor, 1994).

With the psychometric approach to dynamic testing, emphasis is placed on the measurement of change in performance (Taylor, 1994). The change in performance between pre- and post-test is an indication of Vygotsky's Zone of Proximal Development (Taylor, 1994).

The APIL assessment that is used in this study is an assessment of learning potential, therefore well suited to the dynamic approach. The aim of the assessment is to determine an individual's ability to learn new skills. The assessment tool is discussed in more detail in Chapter 3.

2.5 ACADEMIC PERFORMANCE

2.5.1 Conceptualisation

According to Hattie and Anderman (2013), student achievement is the basis of nearly every aspect of education. It gives direction to all education improvement efforts, provides the foundation for education accountability programmes, and serves as the primary outcome variable in most educational research studies (Hattie & Anderman, 2013). Furthermore, Albertini, Kelly and

Matchett (2011) stated that at a time of relatively high unemployment, and economic difficulty, a degree is important to help secure a job.

For academic performance to be determined, it first has to be measured. Formal educational institutions define and determine academic achievement using indicators such as course grades, accumulated grade point average (GPA) and the earning of diplomas or degrees, certificates, vocational licenses, or other such educational credentials (Hattie & Anderman, 2013; Albertini et al., 2011). In the South African context, student academic performance at university is expressed in terms of percentage points ranging from 0% to 100%, with higher percentages indicating better academic performance.

According to Ibrahim, Freeman and Shelly (2011), many factors can impact on a student's academic performance. The authors concluded that such factors include; demographic factors, age, family responsibilities, employment factors (whether the student is full-time or part-time) and whether the student is a traditional or non-traditional student (Ibrahim et al., 2011). A non-traditional student can be distinguished from a traditional student, as these students tend to be older, employed, have a family and seek the flexibility of a distance education (Carnoy, Rabling, Castano-Munoz, Durat Montoliu, & Sancho-Vinuesa, 2011).

Bischoff (2012) stated that the prediction of academic performance has many advantages for the academic context (Bischoff, 2012). Such benefits include: 1) efficiency of teaching resources as no time is wasted on students who are not coping on the programme, 2) better quality academic work and as a result also a better pass rate, 3) reduced student dropout, 4) enhancement of institutional reputation and funding (Bischoff, 2012). Additionally, Prevatt et al. (2011) stated that understanding the specific reasons for individual college student success would help in early identification and remediation of students with academic difficulties.

2.5.2 Variables of academic performance

Aside from cognitive ability, there are many additional factors that may influence academic performance (Beaujean, Firmin, Attai, Johnson, Firmin & Mena 2011; Kotze & Griessel, 2008; Sulaiman & Mohezar, 2006). Since the prediction of future behaviour is an important part of the selection process, it is important to identify all possible factors deemed important in influencing the eventual academic performance of a candidate (Tabsh, 2015). In addition, authors such as De Beer and Van der Merwe (2006) stated that in compiling a selection battery that satisfies all the aims of Higher Education and reflects high predictive validity, it is recommended that cognitive factors as well as non-cognitive factors be taken into consideration.

2.5.2.1 Personality

There is longstanding evidence that cognitive ability or intelligence is an important predictor of academic performance. However, in recent years, there is growing support for non-cognitive factors, mainly personality, as a significant predictor of academic success. Saville et al. (1996) stated that it is believed that a personality scale can provide information beyond that which is provided by cognitive ability tests alone (as cited in Kotze & Griessel, 2008). Both intelligence and personality include individual differences that influence performance: intelligence – “what can do a person” – facilitates understanding and learning, and personality – “what will do a person” – helps or hinders these abilities (Chamorro-Premuzic & Furnham, 2014, p.92).

Many studies, Chamorro-Premuzic and Furnham (2014); Kappe and van der Flier (2012); and Komarraju Schmeck and Advic., (2011) provide evidence that personality is an important factor when studied in relationship with academic performance.

Literature conceptualises personality through the Five-Factor Model of personality (Komarraju et al., 2011).

These Big Five traits (extraversions, agreeableness, conscientiousness, neuroticism and openness) have been related to a wide range of behaviours, including academic performance, job performance, leadership and well-being (Singh, 2012). Since Costa and McCrae first proposed the Big Five model, it has appeared prominently in many studies on educational performance (Singh, 2012). Such studies have showed that academic success is significantly correlated with Big Five traits such as conscientiousness and openness to experience (Komarraju et al., 2011).

Different studies have produced less consistent results. Most of them name conscientiousness as a major performance predictor, but the results have been diverse. For example, a study of Iranian university students looking at the relationships between personality traits and students' academic achievement, showed that neuroticism and extroversion were significantly and negatively related to academic achievement, whereas, agreeableness, and conscientiousness and openness to experience were positively related to academic achievement (Hakimi, Hejazi & Lavasani, 2011). The study by Duff, Boyle, Dunleavy & Ferguson (2004) into the relationship between personality, approach to learning and academic performance showed extraversion, conscientiousness and openness to experience produced statistically significant positive correlations with academic success, whilst the correlation coefficients for openness to experience and extraversion were negligible. Conscientiousness produced the largest correlation between personality traits and academic performance. Furnham, Monden & Ahmetoglu, (2009) on the other hand, found statistically significant positive correlations for conscientiousness, agreeableness and extraversion with academic performance.

Such discrepancies are conditioned by the cultural and institutional differences in the educational process.

2.5.2.2 Age

Some studies (Black, Devereux & Salvanes, 2011; Dobkin & Ferreira, 2010, as cited in Nam, 2014) have suggested that older students attain higher

academic achievement than younger students, and are more likely to graduate. According to Nam (2014) this is due to students' progress in their understanding of world and business affairs with maturity and professional experience. However, other studies have indicated that the effect of age either diminishes or disappears in high school and has little impact once the student enters the labour market (Nam, 2014). Research conducted by authors Sulaiman and Mohezar (2006) found that the role of age in predicting academic performance yielded conflicting results. Their research uncovered results for both negative and positive correlations for age as a predictor of academic performance.

2.5.2.3 Work experience

It has become a pre-requisite for MBA students in business schools, both locally and abroad, to have prior work experience. According to Dogan (2011) the experience and knowledge that students acquire in the business world provide them with a broader view of business functions, which puts them in an advantageous position over less experienced students. Students with previous work experience may more readily see the relevance and the potential applications of material (e.g., case studies, academic articles, class discussions they cover in the programme etc.) (Sulaiman & Mohezar, 2006).

2.6. THEORETICAL RELATIONSHIP BETWEEN COGNITIVE TESTS AND ACADEMIC PERFORMANCE

The focus of this section is on the integration of cognitive ability and academic performance in the context of MBA programmes.

Tests of cognitive abilities, such as college admissions tests, are some of the strongest and most consistent predictors of academic performance in educational settings (Kuncel & Hezlett, 2010). The use of cognitive ability has been of central importance in predicting factors such job performance, job type, wealth and socio-economic success, etc. (Kuncel & Hezlett, 2010). According to Ng and Feldman (2010), developmental psychologists and

educational researchers have observed that education is very closely related to individuals' cognitive ability.

General cognitive ability may be conceptualised as the “repertoire of intellectual (or cognitive) skills available to the person at a particular point in time” (Humphreys, 1989). Ng and Feldman (2013) stated that those who have high cognitive ability when they enter university are more likely to complete their formal qualification and earn further educational qualifications. In contrast, those with low cognitive abilities when they enter university are more likely to drop out along the way (Ng & Feldman, 2013).

In terms of the applicability of cognitive ability tests being used as a tool for selection into MBA programmes, Kass et al. (2012) stated that most MBA programmes have a selection process that involves an assessment of a candidate's ‘demonstrated and potential abilities’ to be a successful student and business leader. The most widely used test for this purpose is the General Management Aptitude Test (GMAT). The GMAT is a traditional measure of intelligence, or general cognitive ability. Over the years, evidence from studies such as those conducted by Kass, et al. (2012) and Siergert (2008), confirmed that the GMAT is a robust predictor for academic performance on an MBA programme.

With particular reference to the South African context, Kotze and Griessel (2008) conducted a study to identify valid predictors and measures of the academic performance of MBA students. They found a statistically significant positive correlation between students' aptitude test results (verbal and numerical abilities) and individual course results, as well as with their average academic performance. (Kotze & Griessel, 2008).

To my knowledge, no efforts have been made to determine how the cognitive ability tests investigated in this study directly/or indirectly impacts students' academic performance on an MBA programme.

2.7 IMPLICATION OF COGNITIVE ABILITY FOR ACADEMIC PERFORMANCE

A vast body of literature has shown that cognitive ability accounts for substantial variance in academic achievement (Kass et al., 2012; Kotze and Griessel; Siergert, 2008; Truitt, 2002). According to Watkins, Lei and Canivez (2007), as cited in Chen, Hwang & Lin, (2013) there is a casual relationship between cognitive ability and academic achievement. The authors presented evidence from a longitudinal study indicating that intelligence influences future achievement.

Hofer, Kuhnle, Killian & Fries (2012) stated that scores on diverse intelligence tests and subtests are usually highly correlated, with half or more of the variance often being accounted for by a single factor (called *g*), and more specific mental abilities loading on other factors such as memory, verbal comprehension, and numerical facility. These factors are often tested in cognitive tests, as is the case with the specific battery of cognitive tests used by the institution investigated in the present study. Furthermore, authors such as Deary et al, 2007; Furnham, Monsen and Ahmetoglu, 2009; Rhode and Thompson, 2007; Spinath, Spinath, Harlaar & Plomin 2006, as cited in Chen et al. (2013) emphasise cognitive ability as the primary predictor of academic success.

In a study conducted by Kuncel and Hezlett (2010), the authors found that theory and research indicate that cognitive tests are valuable tools because an assessment of current skill and knowledge is predictive of what a person can do right now as well as how a person is likely to learn and develop in the future.

2.8 CHAPTER SUMMARY

This chapter served as the literature review to the study. A discussion into psychometric assessments and assessing intelligence was provided. This was followed by conceptualisations into cognitive tests and academic

performance. The theoretical relationship between cognitive tests and academic performance was explained. Lastly, the implications for academic performance were discussed.

CHAPTER 3: RESEARCH ARTICLE

THE RELATIONSHIP BETWEEN COGNITIVE TESTS AND THE ACADEMIC PERFORMANCE OF STUDENTS ON AN MBA PROGRAMME

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ABSTRACT

Orientation: Student success is a major concern for institutions of higher education worldwide. In South Africa, graduation rates across all provider types of MBA qualifications are not very high. Against this background, it becomes imperative to admit students who have a greater chance to succeed into programmes.

Research purpose: The objective of this study was to determine if there is a relationship between cognitive tests (measured by APIL instrument and the Critical Reasoning Test Battery – VCR2 and NCR2) and the academic performance of students on a specific MBA programme.

Motivation for the study: The research aims to make a valuable contribution to institutions in terms of highlighting the usefulness of the selection battery in predicting academic performance. It further provides insight for further research in the area. It was anticipated that the findings from this research might also serve as a systematic evaluation of the selection procedures at the investigated tertiary institution.

Main findings: Statistically significant positive relationships were found between all cognitive tests and the academic performance of students on an MBA programme. Eta tests revealed that the APIL was the strongest predictor, followed by the VCR2 and NCR2 respectively.

Practical implications in terms of industrial and organisational psychology practices: Practitioners need to recognise how cognitive tests could be used to predict the academic performance of students when designing selection batteries.

Contribution/value-added: These findings contribute valuable new knowledge to the field of psychological assessment that can be applied in the selection of students for higher education.

Key words: Cognitive tests, MBA, academic performance, psychometrics, intelligence, students.

Please note: The guidelines provide by *the South African Journal of Industrial Psychology (SAJIP)* have been used as a broad and general guideline for the framework of the research article. The research article in this chapter is slightly more expanded than a typical article published in the SAJIP in order to adequately report and discuss the empirical study of the dissertation of limited scope.

INTRODUCTION

In the subsequent section, the focus and background of the study is explained. This is followed by general trends that emerged from the literature, and the objectives and potential value added by the study. The section concludes by offering insight into what follows in the rest of the chapter.

Key focus of the study

Masters in Business Administration (MBA) programmes are the cornerstone of many business schools' postgraduate delivery, with an exponential increase in both the number of programmes and students taking MBA's globally (Williams et al., 2013). In South Africa, MBA programmes are positioned within the broader landscape of postgraduate education (Kotze & Griessel, 2008). According to the Council on Higher Education (CHE), there have been low graduation rates across all provider types of MBA qualifications in South Africa (Kotze & Griessel, 2008). This is despite the fact that Business Schools strive to admit those students who are most likely to succeed. This research seeks to contribute to existing literature by focusing on the relationship between cognitive tests and the academic performance of students on an MBA programme.

Background to the study

Student success is a strategic priority for institutions of higher education in South Africa and abroad (Visser & Van Zyl, 2013). The production of university graduates, and especially postgraduate students is an essential component of the national system of innovation of modern industrialised societies (Council on Higher Education, 2010). According Davis & Venter (2011), student success rates not only enhance the reputation of an institution, but also increase government funding.

Applications to higher education have increased over the years, forcing Universities to select students based on their predicted academic performance (Bischoff, 2012). Graduate business schools have become no exception with the rapid popularity of an MBA programme (Bischoff, 2012).

The Master of Business Administration (MBA) programme has become a major component of the general credentials that business professionals must have to achieve success (Christensen, Nance & White, 2012). As such, the demand for MBA education has increased considerably. As previously stated, South African institutions offering MBA programmes do not have high graduation rates (Kotze & Grissel, 2008). Visser and Van Zyl (2013) stated that students are generally less prepared for higher education studies and are more at risk of dropping out, stopping out or taking longer to complete their qualifications. This is despite the fact that Business Schools strive to admit students that are most likely to succeed (Bischoff, 2012). The challenge with MBA admissions has thus been to select students who are appropriately qualified to enter the programme thereby improving student success (Christensen et al., 2012). According to Braxton et al. (2011), selection into MBA programmes is important not only to ensure that funding and accountability for the institution is maintained, but also because of the moral commitment that the institution has to students. Once a student drops out of higher education, they may never decide to return, and their life opportunities may be forever constrained. As such, student dropout is connected to human potential (Braxton et al., 2011).

According to Davis and Venter (2011), if drivers of student performance in a postgraduate business course are known, student performance can be driven more purposefully. Furthermore, knowledge of the differentiating factors between successful and unsuccessful students can lead to an identification of focus areas for potential development within institutions and courses (Davis & Venter, 2011). This knowledge could lead to an improvement in throughput, a reduction in student dropout and an enhancement of institutional reputation and funding (Davis & Venter, 2011). Safón (2012) stated that one of the most important intangible assets an organisation such as a business school can

possess is its reputation. The major determinant in the reputation and prestige of a business school is the outcome of its academic achievements, which signals high academic pass rates (Safón, 2012). Therefore, in order to ensure a good reputation, business schools need to ensure that they are selecting applicants who are most likely to succeed (Safón, 2012). Furthermore, according to Komarraju, Ramsey and Rinella (2013) identifying the best predictors of academic performance is extremely important as academic success is often used as a metric to evaluate the effectiveness of colleges and universities. Being able to identify accurate selection criteria that predict student success and persistence is therefore crucial for the survival of educational organisations (Komarraju et al., 2013). Beyond identifying reliable admission criteria, ensuring students' success through the first year, as well as their persistence through graduation is also vital to the existence of educational institutions (Komarraju et al., 2013). According to Smrthnik- Vitulić and Prosen (2012), further importance lies in predicting academic performance since known factors associated with academic achievement have important implications for educators in structuring educational processes aimed at improving academic performance.

Against such a background, assessments have become a valuable tool for selection purposes in education (De Beer, 2011). A widely used selection tool for admission into an MBA programme, worldwide is the Graduate Management Admissions Test – GMAT (Kass et al., 2012). The GMAT measures general verbal (GMAT-verbal) and mathematical skills (GMAT-quantitative), both of which are said to be associated with academic success in an MBA programme (Kass et al., 2012). In South Africa, universities and business schools use an array of different MBA admissions tests in their approach to the admissions process.

The investigated institution is unique in that it makes use of a battery of cognitive tests; namely the APIL (learning potential assessment), as well as the CRTB Numerical and Verbal Reasoning Tests. There has been no prior intuitional research offered on the use of the above tests in the context of MBA selection and success in South Africa.

It is clear from the above that student retention and success in higher education, with specific reference to MBA programmes is a major concern. As such, it becomes imperative that those involved in the administration of MBA programmes understand the likely outcome of graduate student performance (Sulaiman & Mohezar, 2006). Such a prediction could enable the institution to make quality admissions decisions, thereby improving their retention and graduation rates (Tabsh, 2015).

Trends from research literature

In the following section a brief outline of the trends in the research literature on the constructs of cognitive tests and academic performance is provided.

Cognitive tests

According to Foxcroft and Roodt (2009), psychological assessment provides information that is able to guide individuals, groups and organisations on how to understand and make informed and appropriate decisions. Standardised tests of cognitive abilities are grounded in the psychological approach to intelligence, which has focused on understanding individuals' ability to reason, plan, solve problems, think abstractly, learn and adapt, and process and comprehend complex ideas and information (Kuncel & Hezlett, 2010).

It is common practice for MBA programmes to have a selection process that involves an assessment of the potential candidate's demonstrated and potential abilities, which are required to be a successful student (Bischoff, 2012). According to Kuncel and Hezlett (2010), the vast body of accumulated knowledge about cognitive ability tests is clear. They are among the strongest and most consistent predictors of performance across academic settings (Kuncel & Hezlett, 2010).

Foxcroft and Roodt (2009) defined cognitive ability as the range of intellectual (or cognitive) skills that are available to a person at a given point in time.

Kuncel and Hezlett (2010) concluded that tests of cognitive ability are seen as samples of this range of skills, and individuals who have acquired a wide range of such skills are seen to be more likely to perform well on the tests and subsequently perform well on academic tasks, as they already possess the necessary knowledge.

Most tests of cognitive ability assess a combination of reasoning, verbal, and quantitative skills or discipline-specific knowledge, which are correlated and fit into a hierarchical structure with a single overarching general ability (Kuncel & Hezlett, 2010). What this means is that those who do well on one kind of content (e.g. mathematics) will tend to do well on tests with different content (e.g. verbal skills) (Kuncel & Hezlett, 2010). According to De Beer (2011), results from cognitive ability assessments are often used in the educational context to determine school readiness, to obtain a comprehensive picture of specific aptitudes or to assist with decision-making. As such, cognitive ability assessments are a way in which reliable and relevant information about an individual can be obtained.

Much research has been conducted on cognitive ability assessment in the academic context (Kass et al., 2012; Kotze and Griessel; Siergert, 2008; Truitt, 2002). Authors Watkins, Lei and Canivez (2007), as cited in Chen et al. (2013), concluded that there is a casual relationship between cognitive ability and academic achievement. The authors presented evidence from a longitudinal study indicating that intelligence influences future achievement.

Hofer et al. (2012) found that scores on diverse intelligence tests and subtests are usually highly correlated, with half or more of the variance often being accounted for by a single factor (called *g*), and more specific mental abilities loading on other factors such as memory, verbal comprehension, and numerical facility. Kuncel and Hezlett (2010) found that theory and research indicate that cognitive tests are valuable tools because an assessment of current skill and knowledge is predictive of what a person can do right now as well as how a person is likely to learn and develop in the future.

According to Schaap and Luwes (2013), the first consideration in electing assessment measures is that a measure should differentiate between those students who currently show academic excellence and those who display less significant accomplishments, but have the potential to develop academic excellence.

There are many cognitive ability tests available both in South Africa and abroad (Taylor, 1994). These tests measure some form of knowledge, which has been acquired up until the time that the candidate takes the assessment. According to Taylor (1994), majority of these tests are classified as crystallised ability measures.

Academic performance

The single most important and widely used indicator of student academic achievement or student success at university is their academic performance (Richardson, Abraham & Bond, 2012). According to Hattie and Anderman, (2013), student achievement is the basis of nearly every aspect of education. It gives direction to all education improvement efforts, provides the foundation for education accountability programmes, and serves as the primary outcome variable in most educational research studies (Hattie & Anderman, 2013).

In formal education institutions, academic achievement is typically defined and determined by indicators such as course grades, and accumulated grade point average (GPA), and the earning of diplomas or degrees, certificates, vocational licenses, or other such educational credentials (Hattie & Anderman, 2013). In South Africa, student academic performance at university is expressed in terms of percentage points ranging from 0% to 100%, with higher percentages indicating better academic performance.

In the academic context, the prediction of performance yields many advantages. Bischoff (2012) cited the following benefits: 1) efficiency of teaching resources as no time is wasted on students who are not coping on the programme, 2) better quality academic work and, as a result, also a better

pass rate, 3) reduced student dropout, 4) enhancement of institutional reputation and funding.

The academic performance of students at university not only indicates how well a student is performing academically, but also determines the likelihood or possibility of student retention and successful graduation (Allen & Robbins, 2010). Furthermore, Allen and Robbins (2010) state that predicting the academic performance of students at university is important, as academic performance has been found to be directly related to and indicative of student retention, to graduating on time, to degree persistence, and to university persistence in general. Davis and Venter (2011) concluded that if the drivers of student performance are known, then student performance could be driven more purposefully.

There is robust literature in support of the relationship between cognitive ability and educational achievement. According to Beaujean Firmin, Attai, Johnson, Firmin and Mena, (2011), academic success plays a vital role in predicting students' future opportunities and aspirations. Letseka et al. (2010) identified students' under-preparedness for tertiary education as a key factor of poor academic performance in South Africa (cited in van der Westhuizen, 2013). Bemeke and Beeming (2011) cited biographical characteristics, such as gender, race, language etc. as being influential to students' performance and Howell (2009) cited psychological well-being as a pre-entry variable that may influence students' academic performance (cited in van der Westhuizen, 2013).

The relationship between cognitive tests and academic performance of students on an MBA programme

According to the Council on Higher Education (CHE) graduation rates across all provider types of MBA qualifications in South Africa is not high (Kotze & Griessel, 2008). Similarly, Selaledi (2009) stated that there appears to be increasing concern about the throughput rate of postgraduate students, and according to the Department of Higher Education and Training (DHET, 2012),

there is an urgent imperative to increase the number of postgraduate students in South Africa (van der Westhuizen, 2013).

Against this background, it becomes essential for stringent selection for MBA programmes to be used (Bischoff, 2012). According to Hobbs and Gropper (2013), admissions decisions for MBA programmes are usually made up of processes that consider several indicators of the human capital, such as cognitive ability that prospective students possess. The reliance upon such results for MBA programmes is that they provide some indication of academic potential, at least for the first-year MBA courses (Hobbs & Gropper, 2013).

According to Komarraju et al. (2013), studies that have offered empirical evidence to support the role of cognitive ability as a valid predictor of college performance include; Schmitt et al., (2009); Kuncel and Hezlett, (2010); and Sackett et al. (2009). With specific reference to MBA programmes, the mostly widely researched cognitive admissions test for predicting performance has been the GMAT. The GMAT is a standardised test used internationally by over 4,500 graduate management programmes at 1,900 schools to make admissions decisions (Kass et al., 2012). The GMAT measures general verbal (GMAT-verbal) and mathematical skills (GMAT-quantitative) (Kass et al., 2012). According to Kass et al. (2012), there has been considerable support for the validity of the GMAT in predicting the academic performance of students on MBA programmes' (e.g., Kuncel, Crede & Thomas, 2007; Oh, Schmidt, Shaffer & Le, 2008).

In a study conducted by Cilan and Can (2014), the GMAT was found to be one of the most important instruments to successfully predict MBA academic success. Similarly, Kass et al. (2012) concluded that the GMAT (both quantitative and verbal sections), successfully predicted performance on an MBA programme. Hill et al., (2011) found that GMAT scores, particularly the composite scores of the GMAT verbal and quantitative, are reliable predictors of success on MBA programmes.

With particular reference to the South African context, Kotze and Griessel (2008) conducted a study to identify valid predictors and measures of the academic performance of MBA students. They found a statistically significant positive correlation between students' aptitude test results (verbal and numerical abilities) and individual course results, as well as with their average academic performance.

In light of the above, the value of studying the relationship between cognitive tests and the academic performance of students on an MBA programme is evident.

Stemming from the literature presented, the following hypotheses were empirically tested:

H₀1: There is no significant positive relationship between scores on the APIL and the academic performance of students selected for an MBA programme

H₁1: There is a statistically significant positive relationship between scores on the APIL and the academic performance of students selected for the MBA programme

In terms of the APIL, Du Plessis (2008), for example found that the results from the APIL demonstrated utility in predicting the future academic performance of university students at a South African university. De Beer (2006) found that learning potential assessments provide useful information in terms of indicating the level of general reasoning ability and learning potential shown by individuals. The assessment tool can indicate the academic level at which an individual is likely to be able to perform or the amount of effort required for an individual to achieve success at a certain level (De Beer, 2006).

H₀2: There is no significant positive relationship between scores on the CRTB2 Numerical Reasoning Test and the academic performance of students selected for an MBA programme

H₁₂: There is a statistically significant positive relationship between scores on the CRTB2 Numerical Reasoning Test and the academic performance of students selected for an MBA programme

With regard to the CRTB2 Numerical Reasoning Test, authors such as Kotze and Grissel (2008) concluded that a significantly positive correlation exists between students' aptitude test results (numerical) and individual course results, as well as with their average academic performance on an MBA programme. Hobbs and Gropper (2013) on the other hand, found that the quantitative assessment, whilst consistently positive, was not a statistically significant predictor of academic success.

Based on the literature presented above, the following hypotheses were empirically tested:

H₀₃: There is no significant positive relationship between scores on the CRTB2 Verbal Reasoning Test and the academic performance of students selected for an MBA programme

H₁₃: There is a statistically significant positive relationship between scores on the CRTB2 Verbal Reasoning Test and the academic performance of students selected for an MBA programme

In terms of the CRTB2 Verbal Reasoning Test, authors Fish and Wilson (2009) concluded that factors that successfully predicted success on a part-time MBA programme included a verbal skills test.

Research objectives

The objective of this study was to determine the relationship between cognitive tests and the academic performance of students on an MBA programme.

The potential value added by the study

The findings from the present research contribute valuable new knowledge by highlighting the usefulness of the investigated selection battery in predicting academic performance. Furthermore, the study provides insight for further research in the area.

What will follow

In the following section, a discussion is offered into the research design adopted in the study. This includes a description of the research approach and method used. Thereafter, the results are presented. A discussion of the significant findings is presented together with what has been found in previous studies. Lastly, conclusions are drawn, limitations presented and recommendations made for future research.

RESEARCH DESIGN

According to Terre Blanche et al., (2006), a research design is a strategic framework for action that serves as a bridge between research questions and the implementation of the research.

Research approach

This research design was ex post facto. According to Salkind (2010), an ex post facto study, or after-the-fact-research as it is sometimes referred to, is a category of research design in which the investigation begins after the fact has occurred without interference from the researcher. A quantitative research approach was believed to be best suited for the study as it involved a researcher converting data into numerical forms and then subjecting it to statistical analyses (Babbie, 2013). Furthermore, a quantitative approach makes it possible to conduct research in an unbiased and objective manner (Terre Blanche et al., 2006). Secondary data was utilised, as the data already

existed and could be used for purposes other than for which it was originally collected.

Research method

In this section, an explanation into the research method adopted in this study is offered. This includes the research participants, measuring instruments, research procedure, and statistical analysis.

Research participants

The population comprised of 946 students, over a three-year period from an MBA programme at an institution of higher learning in South Africa. Students were selected using non-probability, convenience, and purposive sampling (n=329) for the study.

The sample was non-probable, as it was known from the outset that the selected sample would not necessarily represent the wider population. Since this was an ex post facto study, data that already existed was used, and therefore, convenience sampling was deemed most appropriate. The selected sample was made up of students who had completed the selection battery to gain entry into the programme and subsequently completed their courses for the MBA.

The participants were mostly aged between 20 and 29 years (36,3%), 30 and 39 (52,9%), 40 and 49 years (10,3%), while only 0,3% were 50 and older.

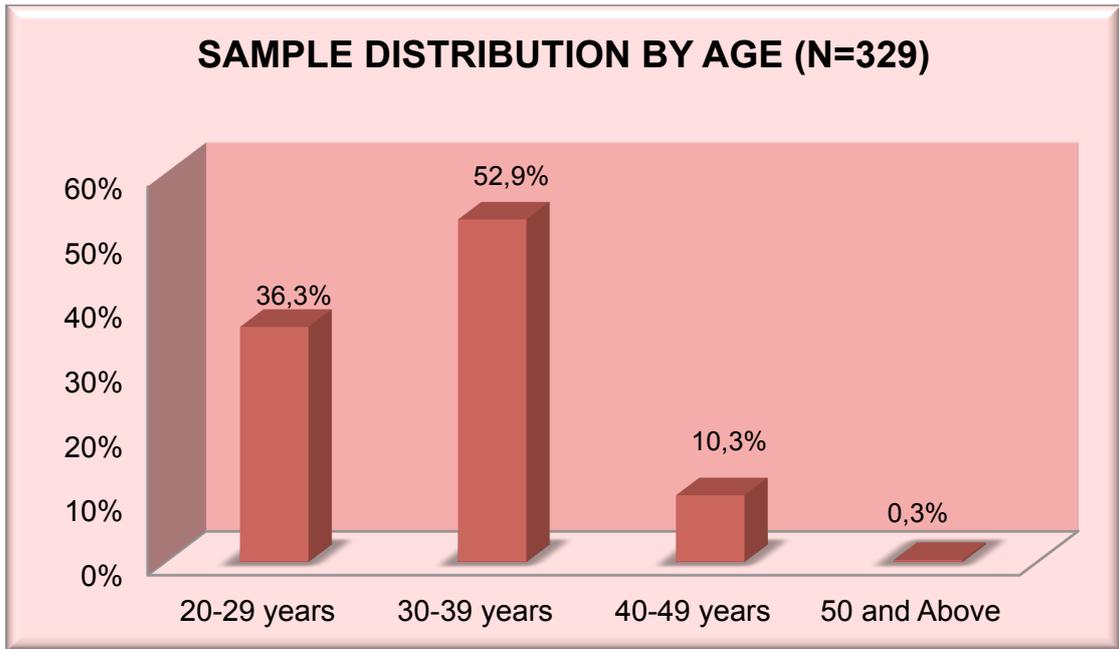


Figure 3.1: Sample distribution by age (N=329)

In terms of gender, the sample as shown in Table 3.1 and Figure 3.2 was skewed towards males (at 72.3%) with female representation of 27.7%

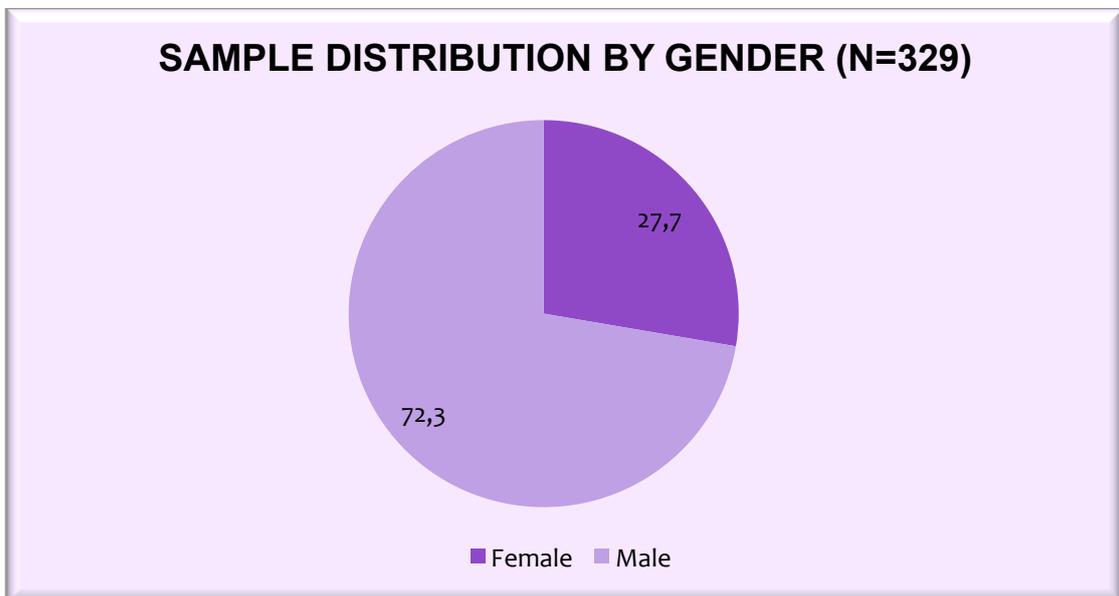


Figure 3.2: Sample distribution by gender (N=329)

In terms of race groups, Blacks represented 42,9%, Whites 32,5%, Indians 17%, Coloureds 6,4%, whilst 0,9% of the sample were from other race groups.

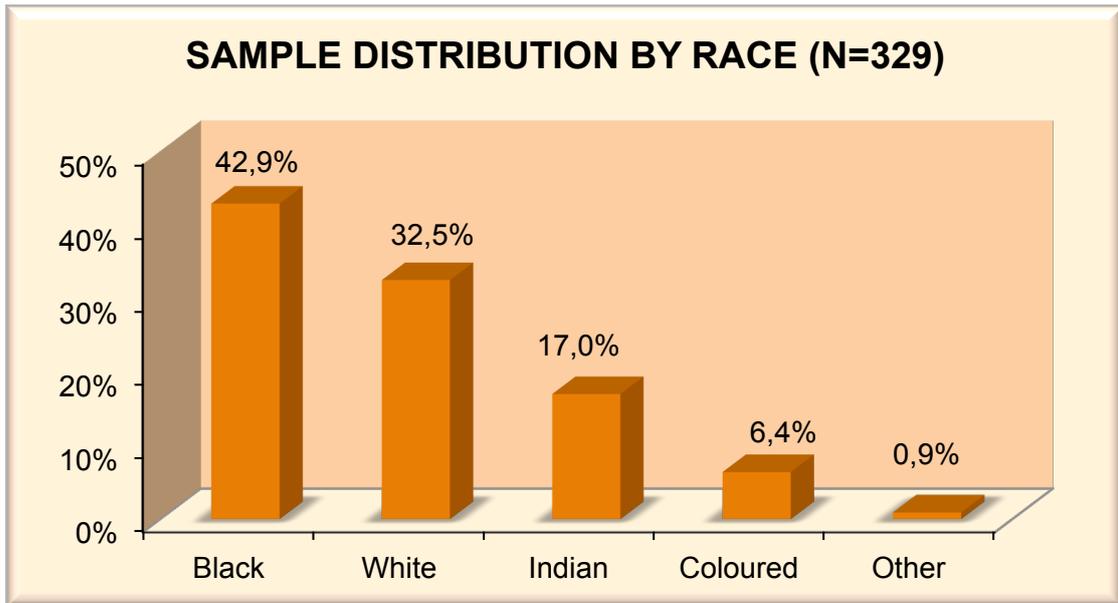


Figure 3.3: Sample distribution by race (N=329)

Finally, as shown in Figure 3.4, the majority of participants had a degree (71,4%), followed by 17,0% who had a masters, 4,6% had a diploma, 6,4% matric These individuals gained access into the MBA programme based on their experience and RPL (Recognition for Prior Learning), and 0,3% had a PhD. Higher qualification levels were expected owing to the selection criteria for an MBA programme requiring applicants to have a post-matric education.

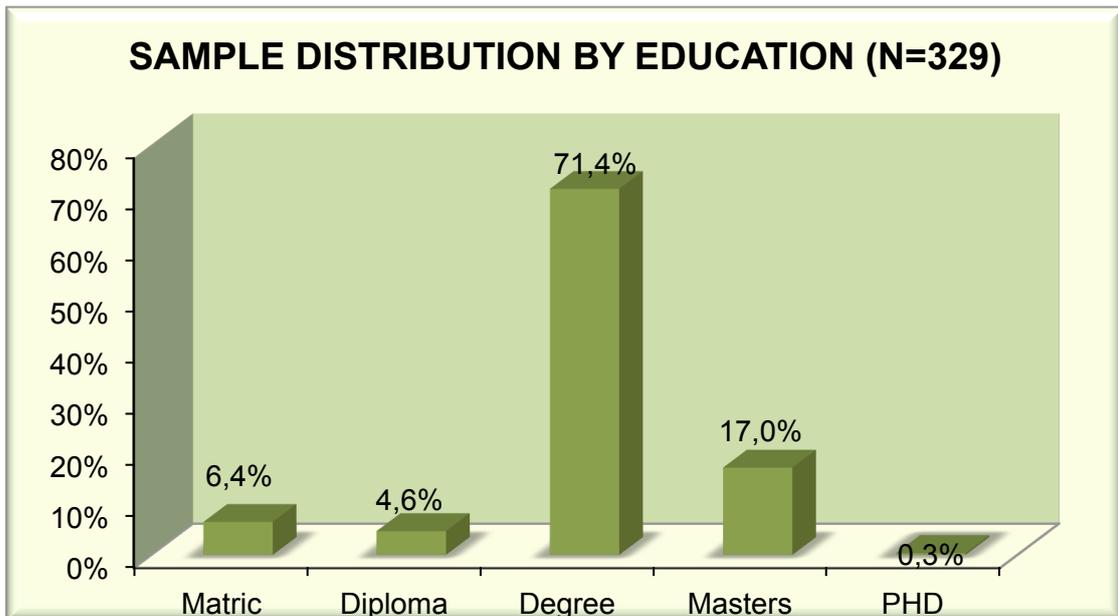


Figure 3.4: Sample distribution by education (N=329)

In summary, the biographical profile obtained from the sample shows that the sample characteristics are as follows:

Table 3.1: Biographical distribution of sample

Item	Category	Frequency	%
Age	20-29	119	36.3
	30-39	174	52.9
	40-49	34	10.3
	50 and above	1	.3
Gender	Female	91	27.7
	Male	238	72.3
Race	Black	142	42.9
	White	107	32.5
	Indian	56	17.0
	Coloured	21	6.4
	Other	3	.9
Education	Matric	21	6.4
	Diploma	15	4.6
	Degree	235	71.4
	Masters	56	17
	PhD	1	.3

Measuring instruments

The investigated institution makes use of the following cognitive ability tests: the APIL instrument, which measures learning potential (Taylor, 2007), and the Critical Reasoning Test Battery, which measures both Numerical Reasoning (NCR2) and Verbal Reasoning (VCR2) (Psytech SA, 2010).

APIL

This is a learning potential assessment that was developed by Terry Taylor. The APIL measures the capacity to acquire new knowledge and skills of an intellectually challenging nature (Taylor, 2007). According to Taylor (2007), the APIL has been specifically developed to be a culture-fair assessment tool

for use in multicultural contexts (South Africa). Therefore, it was designed to assess the individual's core cognitive abilities rather than specific skills that may depend on educational experience and life advantagement /dis-advantagement (Taylor, 2007). Taylor (1995) conducted reliability studies on six samples from relatively different backgrounds. In these reliability studies, the split-half reliability method was employed, which correlated 0.86, thereby illustrating the reliability of the instrument.

Numerous validity studies have been conducted in both education and industrial settings that have produced favourable results (Taylor, 2007). These results can be found in the instrument's Administrators Manual where studies emphasising predictive validity have yielded high coefficients for learning ability. One such study was to investigate the validity on the Concept Formation Test (CFT) section of the test. Taylor (1995) administered the CFT to a sample of 33 first-year university students. The CFT results were correlated with marks on a course they undertook which involved logical thinking and reasoning skills. The correlation was 0.44 (Taylor, 2007). In another validity study, which focused on the Curve of Learning and Memory and Understanding sections, correlated with performance ratings, 110 participants from a manufacturing company participated (Taylor, 2007). The correlation was 0.35 (Taylor, 2007). This supports the utility of the instrument as a measure of learning potential (Taylor, 2007).

CRTB2

CRTB is an acronym for the "Critical Reasoning Test Battery" that was developed by Psytech International (Psytech SA, 2010). The Critical Reasoning Test Battery assesses a combination of comprehension and critical thinking. Test items take the form of scenarios with either verbal or numerical content. Psytech SA (2010) reported alpha coefficients of .81 for the numerical reasoning test and .86 for the verbal reasoning test with regard to reliability for the South African general population.

Verbal Critical Reasoning (VCR2)

This test measures the ability to understand and accurately draw logical conclusions and inferences from complex reports (Psytech SA, 2010). It forms a key assessment for managerial and professional roles, which require accurate interpretation of written reports and rational decision-making.

Numerical Critical Reasoning (NCR2)

This test measures the ability to understand and critically evaluate a wide range of numerical data and draw logical conclusions from this (Psytech SA, 2010). It is a key assessment instrument for managerial and professional roles, which require the ability to understand financial, numerical and statistical information.

Psytech SA (2010) conducted studies to determine the reliability of the VCR2 and NCR2 for use on MBA applicants. Results from the study revealed that all the coefficients were above .8, indicating that the CRTB2 has good levels of internal consistency for the context of the study.

Psytech SA (2010) conducted a further study by correlating the VCR2 and NCR2 with the APIL on a sample of MBA students. The sample of (n=250) MBA students correlated statically significantly ($r = .57$ and $p < .001$) on the VCR2, and the sample (n=169) correlated statistically significantly ($r = .51$ and $p < .001$) on the NCR2. Both correlations were highly statistically significant, and substantial in size, thereby providing strong support for the concurrent validity of the instruments.

Research procedure

In order to obtain access to the data, permission was obtained from the institution and its relevant departments. An explanation about the purposes of the study and the confidential and anonymous use of the data was communicated to both the institution and the relevant departments. Having obtained permission to use the data, written, formal informed consent was

obtained from the institution prior to the researcher commencing with the study.

The first set of data included the psychometric selection results of students. The psychometric tests were administered by Industrial Psychologists. The psychometric test scores that were required included results from students who had completed the cognitive tests to gain entry into the MBA programme. The second set of data included the academic aggregate results of students on the MBA programme. Informed consent was obtained from students through the use of consent forms at the time of the assessments. Students received written and verbal, telephonic feedback.

All data was made available to the researcher in electronic form, which was coded. The raw data was captured and transferred to an SPSS data set.

Statistical analysis

The statistical analysis was conducted using the SPSS programme Version 20.0 (SPSS, 2011). Descriptive and inferential statistics were used to analyse the data. Descriptive statistics are values that describe the characteristics of a sample or population, whereas inferential statistics are used to test the research hypotheses (Babbie, 2013; Salkind, 2008).

Academic performance was quantified as a percentage out of a 100, which was the final average mark that students obtained in each subject.

It was decided to set the significance value for interpreting the results at the 95% confidence level ($p \leq .05$).

RESULTS

In this section, the results of the empirical study are presented and reported on. The objective of the research was to determine the relationship between

cognitive tests and the academic performance of students on an MBA programme.

Descriptive statistics

Descriptive statistics were used to describe the relationship among the variables in the sample (Babbie 2012; Salkind, 2008).

The mean, minimum and maximum values, standard deviations, skewness and kurtosis are reported below.

TABLE 3.2: Descriptive statistics of the variables

	APIL	VCR2	NCR2	Microeconomics	Financial Accounting	Marketing	Human Behaviour & Performance	Analytical Tools & Technology
N	330	330	330	329	329	329	329	329
Minimum	32.00	1.00	1.00	40.00	48.00	52.00	39.00	27.00
Maximum	89.00	9.00	9.00	94.00	92.00	92.00	92.00	92.00
Median	65.0000	6.0000	6.0000	66.0000	68.0000	68.0000	67.0000	68.0000
Mean	63.7788	5.6939	5.6182	66.8875	67.4711	68.2249	66.4498	66.7872
Std. Deviation	12.94797	1.73651	1.77100	9.16695	7.16359	5.22639	6.21108	9.59343
Skewness	-.222	-.114	.212	.371	.054	.188	-.241	-.449
Kurtosis	-.724	-.561	-.459	.583	-.084	1.245	1.512	1.060

Table 3.2 shows the descriptive statistics for the variables. In terms of the cognitive tests, scores are presented as global scores for the APIL and stanines for the VCR2 and NCR2. With regard to academic performance, scores are presented as percentages on the subjects. The minimum score is the smallest value of the variable, and the maximum score is the largest value of the variable. The mean is a central measure whilst the standard deviation indicates the measure of spread from the mean.

A comparison of the median and mean scores indicates that central measures are similar.

With regard to the APIL, the descriptive statistics show a minimum score of 32.00 and a maximum of 89.00, with a mean of 63.78 (sd = 12.95). This is greater than the mean of 50 (sd = 12) reported in the APIL manual (Taylor, 2007).

In terms of the VCR2, descriptive statistics show a minimum value of 1.00 and a maximum of 9.00 with a mean of 5.69 (sd = 1.74). This is less than the mean of 5 (sd = 2) reported in the CRTB2 manual (Psyctech SA, 2010).

In terms of the NCR2, descriptive statistics show a minimum value of 1.00 and a maximum of 9.00 with a mean of 5.62 (sd = 1.77). This is less than the mean of 5 (sd = 2) reported in the CRTB2 manual (Psyctech, SA, 2010).

Table 3.2 also reports on the skewness and kurtosis measures of the variables. Skewness is a measure of symmetry, or more precisely, the lack of symmetry (Pallant, 2007). Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. A skewness value of zero implies a normal distribution (Pallant, 2007). In order to calculate the significance of the skewness, the standard error of skewness is taken into account. This value may be determined by calculating the square root of 6, and then dividing it by the sample size. As an estimate, if the skewness result is less than two times its standard error, then symmetry is implied.

From table 3.2 it is clear that the distributions deviated from the normal distribution for Marketing (1.25), Human Behaviour and Performance (1.51) and Analytical Tools and Technology (1.06). The absolute values of the skewness and kurtosis were less than 1 in all other instances.

The average score for the 5 subjects was also obtained and is presented in Table 3.3 below.

Table 3.3: Average score for academic performance

N	Median	Mean	Std. Deviation
329	67.0000	67.1641	4.96473

It is noted from table 3.3 above that the median score is nearly the same as the mean. The small standard deviation also indicates small variability in the data.

To test for normality, a Kolmogorov Smirnov test was done. The results are shown in table 3.4 below.

Table 3.4: Kolmogorov Smirnov Results

	N	Normal Parameters ^{a,b}		Most Extreme Differences			Test Statistic	Asymp. Sig. (2-tailed)
		Mean	Std. Deviation	Absolute	Positive	Negative		
APIL	330	63.7788	12.94797	.056	.041	-.056	.056	.015 ^c
VCR2	330	5.6939	1.73651	.121	.106	-.121	.121	.000 ^c
NCR2	330	5.6182	1.77100	.130	.130	-.097	.130	.000 ^c
Microeconomics	329	66.8875	9.16695	.069	.069	-.036	.069	.001 ^c
Financial Accounting	329	67.4711	7.16359	.060	.038	-.060	.060	.006 ^c
Marketing	329	68.2249	5.22639	.071	.049	-.071	.071	.000 ^c
Human Behaviour & Performance	329	66.4498	6.21108	.070	.058	-.070	.070	.001 ^c
Analytical Tools & Technology	329	66.7872	9.59343	.055	.028	-.055	.055	.019 ^c

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

According to table 3.4, none of the variables have a normal distribution pattern as the p-values (highlighted) are less than the level of significance ($\alpha = 0.05$). This implies that comparative scores by year can only be done using non-parametric procedures. The skewed distribution patterns also suggest that the median is a better reflection of the centre (average) value as it is not prone to the effects of outliers.

Table 3.5: Comparative Scores by Year

	Chi-Square	df	Asymp. Sig.
APIL	3.792	2	.150
VCR2	7.895	2	.019
NCR2	5.166	2	.076
Microeconomics	1.312	2	.519
Financial Accounting	.689	2	.709
Marketing	2.513	2	.285
Human Behaviour & Performance	7.089	2	.029
Analytical Tools & Technology	2.003	2	.367
Academic Performance (Average Mark)	.654	2	.721

According to table 3.5 above, the p-values for VCR2 (.019) and Human Behaviour & Performance (.029) indicate that there are significant differences in the scores between the years.

Inferential statistics

Inferential statistics are used to make inferences about the population from which the sample was drawn (Babbie, 2013). In this way, inferential statistics tests the research hypotheses of the study (Salkind, 2008).

This section reports on the correlations, regression analysis of variance (ANOVA) and Eta tests of the variables.

A bivariate correlation was performed on the data. The results are found in table 3.6 below. The results indicate the following patterns: positive values indicate a directly proportional relationship between the variables, and a negative value indicates an inverse relationship. All significant relationships are indicated by a * or **.

Table 3.6: Bivariate correlation between variables

		APIL	VCR	NCR	Academic Performance (Average Mark)
APIL	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	330			
VCR2	Pearson Correlation	.424**	1		
	Sig. (2-tailed)	.000			
	N	330	330		
NCR2	Pearson Correlation	.414**	.460**	1	
	Sig. (2-tailed)	.000	.000		
	N	330	330	330	
Academic Performance (Average Mark)	Pearson Correlation	.302**	.359**	.311**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	329	329	329	329

** . Correlation is significant at the 0.01 level (2-tailed).

Based on the results from table 3.6 above, all of the interactions were statistically significant at the 0.01 level of significance. Since all of the coefficients are positive, it implies that the relationships are directly proportional. That is, as one variable increases, so does the other, and vice versa. For example, an increase in NCR2 would result in a corresponding increase in VCR2.

All three cognitive tests have a direct bearing on the marks achieved (academic performance), with the strongest being VCR2 ($r = .359$), followed by NCR2 ($r = .311$) and APIL ($.302$).

A bivariate correlation was also run on the variables using each subject of the MBA programme. The results are shown in table 3.7 below.

Table 3.7: Bivariate correlation between variables by subject

		APIL	VCR2	NCR2	Microeconomics	Financial Accounting	Marketing	Human Behaviour & Perf.	Analytical Tools & Technology
APIL	Pearson Correlation	1							
	Sig. (2-tailed)								
	N	330							
VCR2	Pearson Correlation	.424**	1						
	Sig. (2-tailed)	.000							
	N	330	330						
NCR2	Pearson Correlation	.414**	.460**	1					
	Sig. (2-tailed)	.000	.000						
	N	330	330	330					
Microeconomics	Pearson Correlation	.140*	.238**	.216**	1				
	Sig. (2-tailed)	.011	.000	.000					
	N	329	329	329	329				
Financial Accounting	Pearson Correlation	.215**	.273**	.258**	.347**	1			
	Sig. (2-tailed)	.000	.000	.000	.000				
	N	329	329	329	329	329			
Marketing	Pearson Correlation	.150**	.318**	.137*	.272**	.301**	1		
	Sig. (2-tailed)	.007	.000	.013	.000	.000			
	N	329	329	329	329	329	329		
Human Behaviour & Perf.	Pearson Correlation	.133*	.144**	.134*	.265**	.279**	.326**	1	
	Sig. (2-tailed)	.015	.009	.015	.000	.000	.000		
	N	329	329	329	329	329	329	329	
Analytical Tools & Technology	Pearson Correlation	.319**	.232**	.245**	.344**	.318**	.230**	.213**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	329	329	329	329	329	329	329	329

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 3.7 above shows that the cognitive tests, APIL, VCR2 and NCR2 effects all of the subjects on an MBA programme, as all interactions were statistically significant (** p<0.01, * p<0.05).

A multiple regression was run to predict Average (mark) from APIL, VCR2 and NCR2. The results are shown in table 3.8 below.

Table 3.8: Regression model summary of APIL, VCR2, NCR2 and academic performance (average mark)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.415 ^a	.172	.165	4.53709

a. Predictors: (Constant), APIL, VCR2, NCR2

Table 3.8 above provided the R , R^2 , adjusted R^2 and the standard error of the estimate, which can be used to determine how well a model fits the data,

The “R” column represents the value of R , the multiple correlation coefficient. The multiple correlation coefficient represents the effect size. Cohen (1988) provided the rule of thumb for interpreting the effect sizes, and suggested that an R value of .1 represents a ‘small’ effect size, .3 represents a ‘medium’ effect size and .5 represents a ‘large’ effect size. In this case, a value of .415, in table 3.8, indicates a ‘medium to large’.

The “R” square column represents the R^2 (also called the coefficient of determination), which is the proportion of variance in the dependent variable that can be explained by the independent variables. According to table 3.8, the result from this experiment was .172; meaning that the independent variables’ explains 17.2% of the variability in the dependent variable’s average.

The F -ratio in the ANOVA table below (table 3.8) was used to test whether the overall regression model was a good fit for the data.

Table 3.9: ANOVA summary between APIL, VCR2, NCR2 and academic performance (average mark)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1394.561	3	464.854	22.582	.000 ^b
	Residual	6690.176	325	20.585		
	Total	8084.737	328			

a. Dependent Variable: Academic Performance (Average Mark)

b. Predictors: (Constant), APIL, VCR2, NCR2

Table 3.9 above shows that the independent variables statistically do significantly predict the dependent variable, $F = 22.582$, $p < 0.0005$ (i.e., the regression model is the best fit of the data).

Table 3.10: Estimated model coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	57.508	1.324		43.431	.000
	APIL	.056	.022	.145	2.515	.012
	VCR2	.666	.170	.232	3.916	.000
	NCR2	.408	.165	.146	2.469	.014

a. Dependent Variable: Academic Performance (Average Mark)

The general form of the equation to predict average (score) from APIL, VCR2 and NCR2 is:

$$\text{Average (score)} = 57.508 + (0.056 \times \text{APIL}) + (0.666 \times \text{VCR2}) + (0.408 \times \text{NCR2})$$

This is obtained from the coefficients table above.

Unstandardised coefficients indicate how much of the dependent variable varies with an independent variable when all other independent variables are held constant. In table 3.10 above, the unstandardised coefficient, B_1 for APIL is equal to .056. This means that if APIL scores go up by 1, Average (score) is

predicted to go up by .056. For VCR2, the unstandardised coefficient B_1 , is .666. This means that if VCR2 scores go up by 1, Average (score) is predicted to go up by .666. Similarly, for NCR2, the unstandardised coefficient B_1 , is .408. This means that if NCR2 scores go up by 1, Average (score) is predicted to go up by .408.

A test of statistical significance for each of the independent variables is also found in table 3.10. This tests whether the unstandardised (or standardised) coefficients are equal to 0 (zero) in the population. If $p < .05$, it can be concluded that the coefficients are statistically significantly different to 0 (zero). The t -value and corresponding p -value are located in the “ t ” and Sig.” columns, respectively.

From table 3.10 above, it is noted that all independent variable coefficients are statistically significantly different from 0 (zero) ($p < .05$). That is, the coefficients for the independent variables cannot be treated as 0 (zero) and therefore, impact the model.

In summary, the following is worth noting:

- The APIL predicted the dependent variable ($p = .012$) and is statistically significant ($p < .05$).
- The VCR2 predicted the dependent variable ($p = .000$) and is statistically significant ($p < .05$).
- The NCR2 predicted the dependent variable ($p = .014$) and is statistically significant

Decision regarding the research hypothesis

Based on the above results, the following decisions in relation to the hypotheses were made. A **p-value** is generated from a **test statistic**. A significant result is indicated with " $p < 0.05$ ".

To test the research hypothesis that the academic performance (average mark) does depend on the cognitive tests, an eta test was performed. The average mark for academic performance was recoded as a symbol score. For example, marks greater than 75% were allocated an A symbol, etc.

The results are shown below.

Table 3.11: Eta test for APIL

Directional Measures			Value
Nominal by Interval	Eta	APIL Dependent	.307
		Academic Performance (Average Mark) Dependent	.489

Table 3.12: Eta test for VCR2

Directional Measures			Value
Nominal by Interval	Eta	VCR2 Dependent	.347
		Academic Performance (Average Mark) Dependent	.383

Table 3.13: Eta test for NCR2

Directional Measures			Value
Nominal by Interval	Eta	NCR2 Dependent	.325
		Academic Performance (Average Mark) Dependent	.334

Tables 3.11, 3.12 and 3.13 respectively, were used to determine what effect the APIL, VCR2 and NCR2 had on the dependent variable. According to table 3.11, the APIL (.489) has the strongest effect on the dependent variable, followed by the VCR2 (.383) in table 3.12 and NCR2 (.334) in table 3.13.

A summary of the decisions regarding the research hypotheses is presented in table 3.14 below.

Table 3.14: Decisions regarding research hypotheses

Research Hypotheses		Supportive Evidence
H₀1	There is no significant positive relationship between scores on the APIL and the academic performance of students selected for an MBA programme	No
H₁1	There is a statistically significant positive relationship between scores on the APIL and the academic performance of students selected for an MBA programme	Yes
H₀2	There is no significant positive relationship between scores on the CRTB2 Verbal Reasoning Test and the academic performance of students selected for an MBA programme	No
H₁2	There is a statistically significant positive relationship between scores on the CRTB2 Verbal Reasoning Test and the academic performance of students selected for an MBA programme	Yes
H₀3	There is no significant positive relationship between scores on the CRTB2 Numerical Reasoning Test and the academic performance of students selected for an MBA programme	No
H₁3	There is a statistically significant positive relationship between scores on the CRTB2 Numerical Reasoning Test and the academic performance of students selected for an MBA programme	Yes

DISCUSSION

The objective of this study was to explore the relationship between cognitive tests and the academic performance of students on an MBA programme.

Research aim 1: To investigate the statistical relationship between the APIL and the academic performance of students on an MBA programme

According to table 3.6, the correlation value (.302), indicates that APIL was a statistically significant predictor of academic performance on an MBA programme. According to the results of table 3.10, the APIL did yield a statistically significant prediction (.012) on academic performance, as the p -value was less than the significance level of 0.05. In addition, table 3.11; the eta score (.489) also indicates that APIL was a statistically significant predictor of academic performance on an MBA programme. The APIL effect in this investigation showed the largest effect on the dependent variable (.489). These findings are consistent with the literature review in that the APIL is a statistically significant predictor of academic performance.

This is consistent with Du Plessis's study (2008), which found that the results from the APIL instrument were able to demonstrate utility in predicting future academic performance of sampled South African university students, and consequently has utility as a selection method. Additionally, a study was conducted by Arolab, the test developer of the APIL instrument, amongst a sample of 52 MBA students at the Gordon Institute of Business Science (GIBS). The Critical Reasoning Test Battery (NCR2 and NCR2) was also administered. Results from the study indicated that the APIL was a significant predictor of MBA examination marks at GIBS (Taylor, 2012).

The results are also in line with those of De Beer (2006) who found that learning potential assessments provided useful information in terms of indicating the level of general reasoning ability and learning potential shown by individuals. The assessment tool can indicate the academic level at which

an individual is likely to be able to perform or the amount of effort required from an individual to achieve success at a certain level.

Schaap and Luwes (2013) provided further supporting evidence in their study where a cognitive ability test, the Learning Potential Computerised Adaptive Test (LPCAT), an assessment similar to that of the APIL, was found to be a statistically significant predictor of the future academic performance of students.

Research aim 2: To investigate the statistical relationship between the CTRB2 Verbal Reasoning Test (VCR2) and the academic performance of students on an MBA programme

According to table 3.6, the correlation value (.359), indicates that the VCR2 was a statistically significant predictor of academic performance on an MBA programme. From table 3.10, the *p*-value for VCR2 is .000, indicating that VCR2 did yield a statistically significant prediction on academic performance. In addition, table 3.12; the eta score (.383) also indicates that VCR2 was a statistically significant predictor of academic performance on an MBA programme.

These findings are consistent with the literature reviewed in that the VCR2 is a significant predictor of academic success. Supporting evidence was found in Fish and Wilson (2009) who concluded that that the factors that successfully predict success on a part-time MBA programme, included a Verbal skill test. Additionally, Christensen et al., (2012), found a strong positive relationship between written comprehension and performance and subsequent final MBA performance. The authors concluded that this is not surprising because most MBA programmes have rigorous written paper analysis components.

In terms of the VCR2 specifically, Psytech SA (2010) concluded that the VCR2 was predictive of academic performance after conducting a study on a group of MBA students.

Research aim 3: To investigate the statistical relationship between the CTRB2 Numerical Reasoning Test (NCR2) and the academic performance of students on an MBA programme

According to table 3.6, the correlation value (.311), indicates that NCR2 was a statistically significant predictor of academic performance on an MBA. In addition, according to the results of table 3.10, the NCR2 did yield a statistically significant prediction (.014) on academic performance, as the p -value was less than the significance level of 0.05. The results of table 3.13, the eta score (.334) also indicates that NCR2 was a statistically significant predictor of academic performance on an MBA programme. These findings are consistent with the literature review in that the NCR2 is a statistically significant predictor of academic performance.

Kotze and Griessel (2008) reported similar findings. They concluded that there is a statistically significant positive correlation between students' aptitude test results (numerical) and individual course results, as well as with their average academic performance on an MBA programme.

Additionally, Psytech SA (2010) conducted a study on a group of MBA students who completed the NCR2 prior to enrolling on the course. Their scores on the tests were then correlated with their subsequent performance across different MBA courses. The results revealed that the NCR2 is a statistically significant predictor of performance on an MBA programme. Further evidence was provided by Siergert (2008), who found that the GMAT Numerical section scores accounted for 36% of the variance in executive MBA programmes.

Research aim 4: To determine which one or more of the tests in the battery of tests used for admissions decision-making are the most significant predictors of MBA academic performance

According to table 3.10, and eta tables, 3.11, 3.12 and 3.13 respectively, the APIL, VCR2 and NCR2 are all statistically significant predictors of academic performance as all their p -values are less than the significance level of 0.05.

The eta table indicates that the APIL had the strongest effect, as it showed the largest effect (.489). Therefore, the APIL was the most significant predictor of academic performance. VCR2 however, had the strongest correlation (.359) with academic performance.

Watkins et al. (2007) concluded from a longitudinal study that intelligence influences future achievement. Furthermore, Rosander, Bäckström, and Stenberg (2011) showed that general intelligence had a statistically significant positive relationship both to overall academic performance and to the different subjects.

Conclusions: Implications for practice

Overall, it can be concluded that there is a statistically significant positive relationship between the cognitive tests (APIL, VCR2 and NCR2) and academic performance of students on an MBA programme. The APIL was the strongest predictor of academic performance on an MBA programme, whilst the VCR2 had the strongest correlation with academic performance.

The findings of the study contribute valuable new knowledge by highlighting the usefulness of the investigated selection battery in predicting academic performance. The conclusions from the findings further indicate that practitioners can benefit from understanding the relationship between cognitive tests and academic performance of students to inform selection procedures at higher institutions of education.

Limitations of the study

A major limitation of the study is that an ex post facto design was chosen. It is difficult to draw conclusions about the cause and effect with a cross sectional design as the measurement was taken at a specific point in time. The second limitation was that a non-probability purposive sampling technique was used. As a result, it is possible that the sample may not reflect the distribution of the broader population. Lastly, the results are not generalisable across other institutions since the study was conducted at one specific institution.

A comprehensive discussion into the major limitations of the study will follow in Chapter 4

Recommendations for future research

It is recommended that a more representative probability sample be used in the future to ensure that the sample reflects the true distribution of the broader population. It is also imperative to identify other possible predictors of MBA performance, as this could increase the percentage of the variation of academic performance that can be predicted.

A more comprehensive list of recommendations will follow in Chapter 4.

CHAPTER SUMMARY

In this chapter, a discussion into the essential aspects of the literature and empirical study was provided, the results of the study were interpreted through analysing the findings, conclusions were drawn, recommendations were made and the limitations of the study were highlighted.

CHAPTER 4: CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

This chapter concentrates on the conclusions drawn from this research study. The limitations of the literature review and empirical results are discussed, and recommendations are made for future research studies.

4.1 CONCLUSIONS

The research focused on investigating the relationship between cognitive tests and the academic performance of students on an MBA programme. Research conclusions stemming from the literature review and empirical study will be formulated below.

4.1.1 Conclusions regarding the literature review

There were three aims for this study. Firstly, the literature review aimed to conceptualise the constructs of cognitive tests from a theoretical perspective. The second aim was to conceptualise academic performance in the literature from a theoretical perspective. The third aim was to explain the theoretical relationship between cognitive tests and the academic performance of students on MBA programmes.

4.1.1.1 Aim 1: Conceptualisation of cognitive tests from a theoretical perspective

For the purposes of this study, cognitive ability was approached from the perspective of Foxcroft and Roodt (2009) who defined cognitive ability as the range of intellectual (or cognitive) skills that are available to a person at a given point in time. Standardised tests of cognitive abilities are grounded in the psychological approach to intelligence, which has focused on understanding individuals' ability to reason, plan, solve problems, think abstractly, learn and adapt, and process and comprehend complex ideas and information (Kuncel & Hezlett, 2010).

The literature review highlighted the fact that most tests of cognitive ability assess a combination of reasoning, verbal, and quantitative skills or discipline-specific knowledge, which are correlated and fit into a hierarchical structure with a single overarching general ability (Kuncel & Hezlett, 2010). It can thus be concluded that those who do well on tests with one kind of content (e.g. mathematics) will tend to do well on tests with different content (e.g. verbal skills).

According to de Beer (2011), results from cognitive ability assessments are often used in the educational context to determine school readiness, to obtain a comprehensive picture of specific aptitudes or to assist with decision-making (de Beer, 2011). In addition, Watkins, Lei and Canivez (2007), as cited in Chen et al., (2013) stated that there is a casual relationship between cognitive ability and academic achievement. The authors presented evidence from a longitudinal study indicating that intelligence influences future achievement. As such, cognitive ability assessments are one way in which reliable and relevant information about an individual can be obtained.

There are many cognitive ability tests that are available both in South Africa and abroad (Taylor, 1994). These tests measure some form of knowledge, which has been acquired up until the time that the candidate takes the assessment. According to Taylor (1994), the majority of these tests are classified as crystallised ability measures.

Research studies that have focused on the constructs of cognitive ability assessments concluded that there is a positive relationship between the construct and academic achievement (Chen, 2013; De Beer, 2011). Despite their potential value, it is not clear from the literature review how well the investigated constructs (APIL, CRTB2 Numerical and Verbal) are able to predict academic performance. This highlights the importance of the value added by this study.

4.1.1.2 Aim 2: Conceptualisation of academic performance from a theoretical perspective

The literature review emphasised that academic achievement is typically defined and determined by indicators such as course grades, and accumulated grade point average (GPA), and the earning of diplomas or degrees, certificates, vocational licenses, or other such educational credentials (Hattie & Anderman, 2013). It was determined that for the South African context, student academic performance at university is expressed in terms of percentage points ranging from 0% to 100%, with higher percentages indicating better academic performance.

Richardson et al. (2012) stated that the single most important and widely used indicator of student academic achievement or student success at university is their academic performance. Literature highlighted that student achievement is the basis of nearly every aspect of education. It gives direction to all education improvement efforts, provides the foundation for education accountability programmes, and serves as the primary outcome variable in most educational research studies (Hattie & Anderman, 2013).

It was found that the academic performance of students at university not only indicates how well a student is performing academically, but also determines the likelihood or possibility of student retention and successful graduation (Allen & Robbins, 2010). Davis and Venter (2011) concluded that if the drivers of student performance are known, then student performance could be driven more purposefully.

Furthermore, Allen and Robbins (2010) stated that predicting the academic performance of students at university is important as academic performance has been found to be directly related to and indicative of student retention, to graduating on time, to degree persistence, and to university persistence in general.

In conclusion, the literature highlighted that there was much value in predicting the academic performance of students, particularly for the higher education context.

4.1.1.3 Aim 3: Explanation into the theoretical relationship between cognitive tests and academic performance of students on an MBA programmes.

The literature detailed the way in which cognitive tests are able to predict academic success. According to Komarraju et al., (2013), several studies have offered empirical evidence to support the role of cognitive ability as a valid predictor of college performance (Schmitt et al., 2009; Kuncel and Hezlett, 2010 and Sackett et al., 2009).

With specific reference to MBA programmes, the mostly widely researched cognitive tests' for predicting performance has been the GMAT (Kass et al., 2012).

In a study conducted by Cilan and Can (2014), the GMAT was found to be one of the most important factors to successfully determining MBA academic success. Similarly, Kass et al., (2012) concluded that the GMAT (both quantitative and verbal sections), successfully predicted performance on an MBA programme. Hill et al., (2011) found that GMAT scores, particularly the composite scores of the GMAT verbal and quantitative, are reliable predictors of success on MBA programmes.

With particular reference to the South African context, Kotze and Griessel (2008) conducted a study to identify valid predictors and measures of the academic performance of MBA students. They found that there was a statistically positive correlation between students' aptitude test results (verbal and numerical abilities) and individual course results, as well as with their average academic performance.

Knowledge of the relationship between cognitive tests and the academic performance of students on an MBA programme can be useful in ensuring

that those students that have the greatest chance for success are admitted into the programme (Bischoff, 2012). It can further aid in ensuring student retention (Allen & Robbins, 2010), efficiency of teaching resources, better quality academic work, better pass rate and the enhancement of institutional reputation and funding (Bischoff, 2012).

In light of the above, it was concluded that there is great value in studying the relationship of cognitive tests and the academic performance of students on an MBA programme.

4.1.2 Conclusions regarding the empirical study

The specific aims of this study were as follows:

Research aim 1: To investigate the statistical relationship between the APIL and the academic performance of students on an MBA programme.

Research aim 2: To investigate the statistical relationship between the CTRB2 Numerical Reasoning Test (NCR2) and the academic performance of students on an MBA programme.

Research aim 3: To investigate the statistical relationship between the CRTB2 Verbal Reasoning Test (VCR2) and the academic performance of students on an MBA programme.

Research aim 4: To determine which one or more of the tests in the battery of tests used for admissions decision-making are the most significant predictors of MBA academic performance.

Research aim 5: To formulate recommendations for the discipline of industrial and organisational psychology, and for further research.

4.1.2.1 Aim 1: To investigate the statistical relationship between the APIL and the academic performance of students on an MBA programme

According to table 3.6, the APIL correlated statistically significantly (.302) with academic performance.

Based on the findings as shown in Table 3.10, the following conclusion was drawn:

The APIL added statistically significantly (.012) to the prediction of academic performance on the MBA programme.

According to De Beer (2006), learning potential assessments can indicate at what academic level an individual is likely to be able to perform or the amount of effort required from an individual to achieve success at a certain level.

4.1.2.2 Aim 2: To investigate the statistical relationship between the CTRB2 Verbal Reasoning Test (VCR2) and the academic performance of students on an MBA programme

According to table 3.6, the VCR2 had the strongest statistically significant correlation (.359) with academic performance,

Based on the findings as shown in Table 3.10, the following conclusion was drawn:

The VCR2 added statistically significantly (.000) to the prediction of academic performance on an MBA programme. In a study conducted by Psytech SA (2010) on a sample of MBA students, the VCR2 was found to be predictive of performance on an MBA programme.

4.1.2.3 Aim 3: To investigate the statistical relationship between the CTRB2 Numerical Reasoning Test (NCR2) and the academic performance of students on an MBA programme

According to table 3.6, the NCR2 correlated statistically significantly (.311) with academic performance.

Based on the findings as shown in Table 3.10, the following conclusion was drawn:

The NCR2 added statistically significantly (.014) to the academic performance of students on an MBA programme. In a study conducted by Psytech SA (2010) on a sample of MBA students, the NCR2 was found to be predictive of performance on an MBA programme.

4.1.2.4 Aim 4: To determine which one or more of the tests in the battery of tests used for admissions decision-making are the most significant predictors of MBA academic performance

The following conclusions were drawn:

Based on the findings of table 3.10, the APIL (.012), VCR2 (.000) and NCR2 (.014) were all statistically significant predictors of academic performance on an MBA programme.

Table 3.11 showed that the APIL had the largest effect (.489) on academic performance, and is thus the most statistically significant predictor of academic performance on an MBA programme. The APIL was followed by VCR2 (.383) (table 3.12) and NCR2 (.334) (table 3.13). This is consistent with Taylor (2012) who concluded that the APIL showed the strongest statistical significance in predicting academic performance on a sample of 52 MBA students who also completed the VCR2 and NCR2. Additionally, Gropper

(2007) and Watkins (2007) concluded that intelligence does have a positive relationship with academic performance.

Fish and Wilson (2009), Kotze and Griessel (2008), and Siergert (2008) concluded that there is a statistically positive relationship between results from Numerical and Verbal assessments and academic performance on MBA programmes. In addition, Hofer et al., (2012) stated that scores on diverse intelligence tests and subtests are usually highly correlated, with half or more of the variance often being accounted for by a single factor (called *g*), and more specific mental abilities loading on other factors such as memory, verbal comprehension, and numerical facility.

According to Fish and Wilson (2009), increased knowledge of the factors that predict academic performance has important implications for education. It allows educators to foresee who will perform better or worse in specific university programmes, and to understand better alternate ways to optimise study programmes.

4.1.3 Conclusions regarding the central hypothesis

With regard to the central hypothesis, it can be concluded that a positive relationship exists between the investigated cognitive tests and the academic performance of students on an MBA programme. The empirical study yielded statistically positive significant evidence to support the central hypothesis.

4.1.4 Conclusions regarding the contribution to the field of Industrial and Organisational Psychology

The findings from the literature review and empirical study have contributed new knowledge to the field of Industrial and Organisational Psychology. The literature review provided valuable insight into the variables of cognitive tests and academic performance to the study. The results from the empirical study provide valuable on the relationship between cognitive tests investigated in this study and academic performance on an MBA programme.

Conclusions drawn from the literature review indicate that practitioners should consider cognitive tests for the prediction of academic performance. The theoretical relationship between the variables brought to light that the prediction of academic performance is vital as academic institutions are often oversubscribed with applicants, and against this background, cognitive ability testing is often used as a selection tool.

Conclusions drawn from the empirical study; indicate that a significant positive relationship exists between the cognitive tests and an MBA programme. In addition, the results demonstrated which of the three cognitive tests used in the study was the strongest predictor of academic performance. Practitioners can benefit from understanding the relationship between the cognitive tests and the academic performance of students on an MBA programme as the knowledge could be used to inform selection procedures and decisions at higher institutions of education. The results from the empirical study have also provided insight for further research in the area.

4.2 LIMITATIONS

Many limitations with regard to the literature review and empirical study have been identified. The limitations of the study are discussed below.

4.2.1 Literature review

- As far as could be determined, little research has been done on the relationship between cognitive tests and the academic performance of students on MBA programmes in the South African context. It was therefore difficult to support and integrate findings from different researchers.
- Limited research studies were found which examined the relationship between the APIL, CRTB2 NCR2 and VCR2 assessments and the academic performance of students on an MBA programme.

- Limited literature could be found for cognitive testing in the specific context for admissions into MBA programmes, thereby making it difficult to conceptualise cognitive admissions tests in this study.

4.2.2 Empirical study

- A major limitation of the study is that *ex post facto* design was chosen for the study. It is difficult to draw conclusions about the cause and effect with a cross-sectional design as the measurement was taken at a specific point in time.
- The study was conducted at one institution, which means that the results of the study are not generalisable across other institutions offering an MBA programme in South Africa.
- There was a restriction of range in terms of the data since the data included only students that had completed the MBA programme
- The sample was limited in that it consisted of 72.3% men and only 27.7% women. As such, the biographical representation of the sample was skewed in terms of gender.
- Since the study was *ex-post facto* in nature, the researcher's role was limited in the research process. This could have placed limits upon how solid and reliable the results are.
- Due to the fact that a purposive sample was used, it is possible that the sample may not reflect the distribution of the broader population.

Notwithstanding these limitations, the results of this study offer a new explanation for the relationship between cognitive tests and the academic performance of students on an MBA programme. The study may be used as a foundation for understanding the relationship between the variables.

4.3 RECOMMENDATIONS

Based on the findings of this study, recommendations are made. These are discussed below.

- It is recommended that a more representative probability sample be used in the future to ensure that the sample reflects the true distribution of the broader population.
- Further research should be conducted on other cognitive ability tests that are used for selecting students into MBA programmes in the South African context.
- It is also imperative to identify other possible predictors of MBA academic performance, as this could increase the percentage of the variation of academic performance that can be predicted.
- Research should be done with a newer and larger sample size so as to increase the statistical influence of the results obtained.
- On going institutional research should be done to constantly evaluate the effectiveness of the selection battery used by the investigated institution

4.4 INTEGRATION OF THE RESEARCH

This study investigated the relationship between cognitive tests and the academic performance of students on an MBA programme. The results suggested that a relationship does indeed exist between these variables.

The literature review clearly illustrated that there is a relationship between the variables, whilst the empirical study provided statistically significant support for the central hypothesis. The findings therefore illustrate a relationship

between the APIL, VCR2 and NCR2 and the academic performance of students on an MBA programme.

In conclusion, the findings of this study reveal that insight into the relationship between cognitive tests, specifically the APIL, VCR2 and NCR2 and the academic performance of students on an MBA programme has practical significance. The knowledge of the relationship highlights the usefulness of the constructs, thereby enabling its adaptation. In addition, it provided insight for further research in the area.

4.5 CHAPTER SUMMARY

This chapter presented the conclusions, limitations and recommendations of the research. The literature aims and empirical aims of the study were addressed in terms of the conclusions drawn and limitations observed. Recommendations were made for further research on the basis of the findings.

REFERENCES

Ackerman, P.L. (1998). Determinants of individual differences during skill acquisition. *Journal of Experimental Psychology: General*, 117, 288-318.

Albertini, J. A., Kelly, R. R., & Matchett, M. K. (2012). Personal factors that influence deaf college students' academic success. *Journal of Deaf Studies and Deaf Education*, 17(1), 85-101.

Allen, J., & Robbins, S. (2010). Effects of interest-major congruence, motivation, and academic performance on timely degree attainment. *Journal of Counseling Psychology*, 57(1), 23-35.

Babbie, E., Mouton, J. (2001). *The practice of social research*. Belmont, CA: Wadsworth Thomson learning.

Babbie, E. (2013). *The basics of social research*. Belmont, CA: Wadsworth Cengage Learning.

Barnard, G., & Fourie, L. (2007). Exploring the roles and contributions of industrial psychologists in South Africa against a multi-dimensional conceptual framework (part 2). *SA Journal of Industrial Psychology*, 33(2), 45-53.

Beaujean, A., Firmin, M. W., Attai, S., Johnson, C. B., Firmin, R. L., & Mena, K. E. (2011). Using personality and cognitive ability to predict academic achievement in a young adult sample. *Personality and Individual Differences*, 51(6), 709-714.

Bisschoff, C. A. (2012). Empirical evaluation of a preliminary model to identify low-risk MBA applicants. *Managing Global Transitions*, 10(2), 189-204.

Bray, M. A., & Kehle, T. J. (2011). *The Oxford handbook of school psychology*. New York: Oxford University Press.

Braxton, J. M., Hirschy, A. S., & McClendon, S. A. (2011). *Understanding and reducing college student departure: ASHE-ERIC Higher Education Report, 30*, (3)-16. John Wiley & Sons.

Bryman, A. (2012). *Social research methods* (4th ed.). Oxford: Oxford University Press.

Carnoy, M., Rabling, B.J., Castano-Munoz, J., Durat Montoliu, J.M, & Sancho-Vinuesa, T. (2011). Who attends and completes virtual universities: the case of the Open University of Catalonia, (UOC). *Higher Education* 63(1), 53-82.

Cattell, R.B. (1971). *Abilities: their structure, growth and action*. Boston: Houghton Mifflin.

Chamorro-Premuzic, T., & Furnham, A. (2014). *Personality and intellectual competence*. Malden, MA: Wiley-Blackwell.

Chen, S. K., Yeh, Y. C., Hwang, F. M., & Lin, S. S. (2013). The relationship between academic self-concept and achievement: A multi cohort multi occasion study. *Learning and Individual Differences, 23*, 172-178.

Christensen, D. G., Nance, W. R., & White, D. W. (2012). Academic performance in MBA programs: do prerequisites really matter?. *Journal of Education for Business, 87*(1), 42-47.

Çilan, Ç. A., & Can, M. (2014). Measuring factors affecting MBA students' academic performance by using categorical regression analysis: A case study of institution of business economics, Istanbul University. *Procedia-Social and Behavioral Sciences, 122*, 405-409.

Coaley, K. (2014). *An introduction to psychological assessment and psychometrics*. London: Sage Publications Ltd.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. (2nd ed). Hillsdale: Lawrence Erlbaum.

Council on Higher Education. (2010). Access and throughput in South African Higher Education: Three case studies. *Higher Education Monitor*, 9, (1) 218.

Dash, N.K. (2005). Module: Selection of the research paradigm and methodology. *Online research methods resource for teachers and trainers*. Manchester: Manchester Metropolitan University.

Davis, A., & Venter, P. (2011). The performance and success of postgraduate business students. *Progressio*, 33(2), 72-90.

De Beer, M. (2011). The role of the Learning Potential Computerized Adaptive Test (LPCAT) in the vocational guidance assessment of adolescents. Unpublished manuscript. UNISA

De Beer, M., & Van der Merwe, D. (2006). Challenges of student selection: Predicting academic performance. *South African Journal of Higher Education*, 20(4), 547-562.

Dogan, R. (2011). Antecedents to students' performance in MBA programs. *In MPMC Conference-G. Junction, 1 -3 October 2011 (pp. 1-20)*. Colorado: University of Texas at El Paso.

Duff, A., Boyle, E., Dunleavy, K., & Ferguson, J. (2004). The relationship between personality, approach to learning and academic performance. *Personality and individual differences*, 36(8), 1907-1920.

Du Plessis, G.A. (2008). *Dynamic cognitive assessment: investigating learning potential within the context of an academic institution*. (Published Masters Thesis). University of Johannesburg, South Africa.

Fish, L.A., & Wilson, S. (2009). Predicting performance of MBA students: Comparing the part-time MBA programme and one-year programme. *College Student Journal*, 43 (1), 145-160.

Fletcher, R. B., & Hattie, J. (2011). *Intelligence and intelligence testing*. New York, MA: Routledge, Taylor & Francis Group.

Foxcroft, C., Paterson, H., Le Roux, N., & Herbst, D. (2004). Psychological assessment in South Africa: A needs analysis. The test usage patterns and needs of psychological assessment practitioners. *Final Report*, 1-202.

Foxcroft, C., Roodt, G., & Abrahams, F. (2001). Psychological assessment: A brief retrospective overview. *An introduction to psychological assessment in the South African context*, 11-33.

Foxcroft, C.D., & Roodt, G (2009). An introduction to psychological assessment in the South African context (3rd ed.). Oxford, UK: Oxford University Press.

Furnham, A., Monsen, J., & Ahmetoglu, G. (2009). Typical intellectual engagement, Big Five personality traits, approaches to learning and cognitive ability predictors of academic performance. *British Journal of Educational Psychology*, 79(4), 769-782.

Gardner, M. K. (2011). Theories of intelligence. *The Oxford handbook of school psychology*. New York: Oxford University Press Inc.

Gropper, R. (2007). *Working Memory and Academic Achievement in College Students with Attention-deficit/hyperactivity Disorder*. ProQuest.

Groth-Marnat, G. (2009). *Handbook of psychological assessment*. Hoboken, New Jersey: John Wiley & Sons Inc.

Guilford, J.P (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Hamers, J.H.M & Resing, W.C.M. (1993). Learning potential assessment: Introduction. In J.H.M. Hamers, K. Sijtsma A.J.J.M. Rujssenaars (Eds). *Learning potential assessment: Theoretical, methodological and practical issues* (pp. 24-41). Amsterdam: Swets & Zeitlinger.

Hakimi, S., Hejazi, E., Lavasani, M.G. (2011). The relationships between personality traits and students' academic achievement. *Procedia Social and Behavioural Sciences*, 29(1), 836-845.

Hattie, J., & Anderman, E. M. (Eds.). (2013). *International Guide to Student Achievement*. New York, NY: Routledge.

Health Professions Act, No.56. (1974).

Higher Education Act 101 of 1997, 2000 & 2001 Amendment Acts.

Hill, K. L., Hynes, G. E., Joyce, M. P., & Green, J. S. (2011). GMAT-AWA score as a predictor of success in a managerial communication course. *Business Communication Quarterly*, 74(2), 103-118.

Hobbs, B. K., & Gropper, D. M. (2013). Human capital indicators and academic success in executive MBA Programs: A multi-program study. *Journal of Executive Education*, 4(1), 3.

Hofer, M., Kuhnle, C., Kilian, B., & Fries, S. (2012). Cognitive ability and personality variables as predictors of school grades and test scores in adolescents. *Learning and Instruction*, 22(5), 368-375.

Horn, J.L. (1986). Intellectual ability concepts. In R.J Sternberg (Eds). *Advances in the psychology of human intelligence* (pp 35-77). Hillsdale (NJ): Lawrence Erlbaum.

Humphreys, L.G. (1989). The first factor extracted is an unreliable estimate of g: The case of discrimination reaction time. *Intelligence*, 13, 183-197.

Hunt, E. (2010). *Human intelligence*. Cambridge: University Press.

Ibrahim, N., Freeman, S. A., & Shelley, M. C. (2011). Identifying predictors of academic success for part-time students at polytechnic institutes in Malaysia. *International Journal of Adult Vocational Education and Technology*, 2(4), 1-16.

Kanfer, R., & Ackerman, P. L. (2004). Aging, adult development, and work motivation. *Academy of Management Review*, 29(3), 440-458.

Kaplan, R., & Saccuzzo, D. (2012). *Psychological testing: Principles, applications, and issues*. Wadsworth, CA: Cengage Learning.

Kappe, R., & van der Flier, H. (2012). Predicting academic success in higher education: what's more important than being smart?. *Journal of Psychology of Education*, 27(4), 605-619.

Kass, D., Grandzol, C., & Bommer, W. (2012). The GMAT as a predictor of MBA performance: less success than meets the eye. *Journal of Education for Business*, 87 (5), 290-295.

Kaufman, S. B., Reynolds, M. R., Liu, X., Kaufman, A. S., & McGrew, K. S. (2012). Are cognitive g and academic achievement g one and the same g? An exploration on the Woodcock–Johnson and Kaufman tests. *Intelligence*, 40(2), 123-138.

Komaraju, M., Karau, S. J., Schmeck, R. R., & Avdic, A. (2011). The Big Five personality traits, learning styles, and academic achievement. *Personality and Individual Differences*, 51(4), 472-477.

Komaraju, M., Ramsey, A., & Rinella, V. (2013). Cognitive and non-cognitive predictors of college readiness and performance: Role of academic discipline. *Learning and Individual Differences, 24*, 103-109.

Kotze, M., & Griessel, L. (2008). The prediction of the academic performance of MBA students by means of specific aptitudes and competencies. *Journal for New Generation Sciences, 6*(2), 60-79.

Krauss, S.E. (2005). Research paradigms and meaning making: A premier. *The Qualitative Report, 10*(4), 758-770.

Kuncel, N.R., Crede, M., & Thomas, L.L. (2007). A meta-analysis of the predictive validity of the Graduate Management Admissions Test (GMAT) and Undergraduate Grade Point Average (UGPA) for graduate student academic performance. *Academy of Management Learning and Education, 6*(1), 51-68.

Kuncel, N. R., & Hezlett, S. A. (2010). Fact and fiction in cognitive ability testing for admissions and hiring decisions. *Current Directions in Psychological Science, 19*(6), 339-345.

Leeson, P., Ciarrochi, J., & Heaven, P. C. (2008). Cognitive ability, personality, and academic performance in adolescence. *Personality and Individual Differences, 45*(7), 630-635.

Levitin, D. (2002). Preface. In Levitin, D. (Ed). *Foundations of cognitive psychology: core readings*. Cambridge, MA: The MIT Press.

Mouton, J., & Babbie, E. (2001). *The practice of social research*. Cape Town: Wadsworth Publishing Company.

Murphy, R. (2002). *A review of South African research in the field of dynamic assessment*. Unpublished M.A. dissertation: University of Pretoria.

Nam, K. (2014). Until when does the effect of age on academic achievement persist? Evidence from Korean data. *Economics of Education Review*, 40, 106-122.

Nevid, J.S., Rathus, S.A & Greene, B. (1997). *Abnormal psychology in a changing world*. Englewood Cliffs, NJ: Prentice-Hall.

Ng, T. W., & Feldman, D. C. (2010). Human capital and objective indicators of career success: The mediating effects of cognitive ability and conscientiousness. *Journal of Occupational and Organizational Psychology*, 83(1), 207-235.

Oh, I. S., Schmidt, F. L., Shaffer, J. A., & Le, H. (2008). The Graduate Management Admission Test (GMAT) is even more valid than we thought: A new development in meta-analysis and its implications for the validity of the GMAT. *Academy of Management Learning & Education*, 7(4), 563-570.

Ones, D. S., Viswesvaran, C., & Dilchert, S. (2005). Cognitive ability in selection decisions. *Handbook of Understanding and Measuring Intelligence*, 431-468.

Pallant, J. (2007). *SPSS survival manual : A step by step guide to data analysis using SPSS for Windows*. (3rd ed). London: McGraw-Hill.

Petit, F. (2013). An exploratory analysis of the impact of price on the search and selection process for executive MBA programs. *Journal of Executive Education*, 7(1), 1-3.

Prevatt, F., Li, H., Welles, T., Festa-Dreher, D., Yelland, S., & Lee, J. (2011). The academic success inventory for college students: scale development and practical implications for use with students. *Journal of College Admission*, 211, 26-31.

Psytech SA. (2010). Technical Manual for Critical Reasoning Battery. Psyctech International Limited.

Ramteke, A. Y., & Deshmukh, A. (2012). A study of factors impacting success of students in entrance examination for MBA program in Maharashtra. *Exploration-Indian Journal of Multidiscipline (Peer Reviewed Biannual Research Journal for Multi-Disciplinary Studies) Page, (27-35), 2249-2089.*

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: a systematic review and meta-analysis. *Psychological bulletin, 138(2), 353.*

Rohde, T. E., & Thompson, L. A. (2007). Predicting academic achievement with cognitive ability. *Intelligence, 35(1), 83-92.*

Rosander, P., Bäckström, M., & Stenberg, G. (2011). Personality traits and general intelligence as predictors of academic performance: A structural equation modelling approach. *Learning and individual Differences, 21(5), 590-596.*

Rust, J., & Golombok, S. (2014). *Modern psychometrics: The science of psychological assessment (3rd ed.)*: New York, NY: Routledge.

Sackett, P.R., Kuncel, N.R., Arneson, J., Cooper, S.R., & Waters, S. (2009). Socio-economic status and the relationship between admissions tests and post-secondary academic performance. *Psychological Bulletin, 135, 1-22*

Safón, V. (2012). Can the reputation of an established business school change?. *Management in Education, 26(4), 169-180.*

Salkind, N.J. (2008). *Exploring research. (7th ed.)* Upper Saddle River, NJ: Pearson Education.

Salkind, N. J. (Ed.). (2010). *Encyclopedia of research design* (Vol. 1). London, UK: Sage Publications Inc.

Schaap, P., & Luwes, M. (2013). Learning potential and academic literacy tests as predictors of academic performance for engineering students. *Acta Academia*, 45(3), 1-34.

Schreuder, D., & Coetzee, M. (2010). An overview of industrial and organisational psychology research in South Africa: A preliminary study. *SA Journal of Industrial Psychology*, 36(1), 1-11.

Selaledi, D. (2009). Building research capacity at Cut (professional growth and development). *Interim: Interdisciplinary Journal* 8(2), 80-88

Schmitt, N., Oswald, F.L., Kim, B.H., Imus, A., Meritt, S., Friede, A., et al. (2007). The use of background and ability profiles to predict college student outcomes. *Journal of Applied Psychology*, 92, 165-179.

Siegert, K. O. (2008). Executive education: Predicting student success in executive MBA programs. *Journal of Education for Business*, 83(4), 221-226.

Singh, A.K. (2012). Does trait predict psychological well-being among students of professional courses? *Journal of the Indian Academy of Applied Psychology*, 38(2), 234-241.

Smrtnik-Vitulić, H., & Prosen, S. (2012). Personality and cognitive abilities as predictors of university students' academic achievement. *Društvena istraživanja-Časopis za opća društvena pitanja*, 3, 715-732.

Snow, R.E., & Lohman. (1984). Toward a theory of cognitive aptitude for learning from instruction. *Journal of Educational Psychology*, 76, 347-376.

Sulaiman, A., & Mohezar, S. (2006). Student success factors: Identifying key predictors. *Journal of Education for Business*, 81(6), 328-333.

Tabsh, I. (2015). Admission criteria and performance predictors at a GCC executive MBA programme. *Journal for International Business and Entrepreneurship Development*, 8(1), 79-104.

Taher, A. M. M. H., Chen, J., & Yao, W. (2011). Key predictors of creative MBA students' performance: Personality type and learning approaches *Journal of Technology Management in China*, 6(1), 43-68.

Taylor, J. (n.d.). *MBA admissions testing—Who wins?* Unpublished manuscript.

Taylor, T.R. (1994). A Review of three approaches to cognitive assessment, and a proposed integrated approach based on a unifying theoretical framework. *South African Journal of Psychology*, 24(4), 184-194.

Taylor, T. R (1995). *Administrator and Technical Manual for APIL*. Auckland Park: AproLAB cc.

Taylor, T.R (2007) *Administrator and Technical Manual for APIL*. Johannesburg: AproLAB cc.

Taylor T.R (2012). (Revised Ed.) *Administrator and Technical Manual for APIL*. Johannesburg: AproLAB cc.

Terre Blanche, M., Durrheim, K., Painter, D. (2006). *Research in practice: Applied methods for the social sciences*. Cape Town: University of Cape Town Press.

Temtime, Z. T., & Mmereki, R. N. (2011). Challenges faced by graduate business education in Southern Africa: perceptions of MBA participants. *Quality Assurance in Education*, 19(2), 110-129.

Truitt, T. C. (2002). Validity of selection criteria in predicting MBA success. In *CBFA Conference, 2002* (pp. 1-18). (http://www.cbfa.org/Truitt_Paper)

Van der Westhuizen, S. (2013). Psychological well-being and postgraduate students' academic achievement in research methodology at an ODL institution. *South African Journal of Higher Education, 27*(5), 1324-1342.

Vernon, P.E. (1962). *The structure of human abilities*. London: Methuen

Visser, H., & Van Zyl, D. (2013). Assessment of academic readiness to achieve student success and retention. In *South African Journal of Higher Education: Special Issue: 2011 Forum of the Southern African Association of Institutional Research* (Vol. 27, No. 2, pp. 330-352). Sabinet Online.

Watkins, M. W., Lei, P. W., & Canivez, G. L. (2007). Psychometric intelligence and achievement: A cross-lagged panel analysis. *Intelligence, 35*(1), 59-68.

Williams, W., Parkes, E. L., & Davies, P. (2013). Wordle: A method for analysing MBA student induction experience. *The International Journal of Management Education, 11*(1), 44-53.

Weiner, I. B., & Greene, R. L. (2011). *Handbook of personality assessment*. Hoboken, N.J.: John Wiley & Sons.

Wright, A. J. (2010). *Conducting psychological assessment: A guide for practitioners*. Hoboken, N.J.: Wiley.

Yilmaz, K. (2011). The cognitive perspective on learning: Its theoretical underpinnings and implications for classroom practices. *Clearing House, 84*(5), 204-212.