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PREDICTING ACADEMIC SUCCESS: TOWARDS AN ADMISSIONS MODEL

by

CECILIA MYBURGH

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Supervisor: Professor A Nel
Co-Supervisor: Professor K Stanz

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I understand what plagiarism entails and am aware of the University's policy in this regard. I further declare that the Doctoral thesis, titled "*PREDICTING ACADEMIC SUCCESS: TOWARDS AN ADMISSIONS MODEL*", which I hereby submit for the degree PhD in Industrial and Organisational Psychology at the University of Pretoria, is my own work and has not been submitted by me for a degree at another university.

Cecilia Myburgh - April 2019

DEDICATION

To my two sons, Christian and Alexander,

Be curious in life, be brave and always keep on learning.

&

To my husband, Gregory,

I dedicate this work to you because of your unwavering support and continuous encouragement until the end. I would not have been able to complete this thesis without you.

Thank you so much for this incredible gift!

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ABSTRACT

PREDICTING ACADEMIC SUCCESS: TOWARDS AN ADMISSIONS MODEL

The study aimed to develop a model predictive of academic success based on variables assessed during the admission process and the relationships of the variables with academic progress and academic success at a South African university. To do this, the study investigated if school exiting results and admission tests were significant predictors of first-year grade point average and of final academic grade point average over a period of six years, taking into account different race and gender groups, as well as different school examination authorities. The relationship between first-year and final grade point average was also assessed in order to develop a comprehensive and integrated model predictive of academic success. The disaggregation of the dataset (*N*=3418) into different race and gender subgroups and different school examination authorities revealed to be useful and necessary as differences in mean scores of the predictor and criterion variables were observed and vastly different predictive models were presented, indicating that an overall model to predict academic success for all students is not appropriate. The results of this study highlighted the reality of significant inequalities in university outcomes for students of different race and gender subgroups in particular. The results of this study should be interpreted in the context of guiding admission decisions, and developing policies and rules that are fair, equitable, reliable and justifiable in terms of the ability and probability of students to succeed, bearing in mind individual differences in the prediction model with regard to race, gender and different school examination authorities.

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INTRODUCTION

"I have yet to see any problem, however complicated, which, when you look at it in the right way, did not become still more complicated."

- P. Anderson, in New Scientist 25 September 1969 (in Connolly & Martlew, 1999, p.187).

1.1 BACKGROUND

The higher education landscape has expanded exponentially in the 20th century, progressing from catering for only a small elite group of students in the past towards striving to provide opportunities and access to increasingly more people seeking higher education qualifications. Higher education institutions, both in South Africa and globally, are all experiencing the same pressures from government and regulatory bodies with regard to increasing participation and throughput, and providing more access and support. This is because governments recognise the return on investment and value that higher education qualifications add to a country as a major driver of economic competitiveness in the global economy (DHET, 2014a). Demand is further increased because higher education is seen as a vital tool for human resource development and critical to sustain economic growth, to enrich and restructure society and to build national unity, which in turn support peace and development and also contribute to national wealth (Jung, 2013; Misaro, Jonyo, & Kariuiki, 2013). Individual demand for access to higher education is increasing likewise as higher education qualifications, on a personal level, means "welfare" that could result in job opportunities, social status and prestige (Arikan, 2010).

This ever increasing demand for access to higher education and simultaneous decrease in student throughput rates placed a stronger emphasis on institutional selection and admission processes (Al-Hattami, 2012; Arikan, 2010). In fact, higher education institutions have a statutory responsibility to develop admissions policies that will ensure the admission of students with the potential to succeed (White Paper 3, DoE, 1997).

The secondary schooling system serves as the gateway into higher education, and higher education is in turn dependent on what the secondary schooling system provides in terms of academic

preparedness and quality of students. Both local and international research have linked poor throughput rates at universities directly to school exiting results (Al-Hattami, 2012; Fisher, 2011; Geiser & Santelices, 2007). Various studies in South Africa found the lack of academic preparedness of school leavers to be a key factor behind the poor throughput rates (Fisher & Scott, 2011; Maddock & Maroun, 2018; Scott & Yeld, 2008; Van Broekhuizen, Van der Berg, & Hofmeyr, 2017; Van der Westhuizen & Barlow-Jones, 2015; Wolmarans, Smit, Collier-Reed, & Leather, 2010). These studies concluded that students entering the university system seem underprepared and ill-equipped with the skills to be successful at university.

In light of the apartheid history of South Africa prior to democratisation in 1994, the education system was racially exclusive and divided, meaning that female and black African students were not likely to be admitted to universities in general (Badat, 2010). Hence, addressing racial inequalities by the transformation of the education system was a key priority for the first democratically elected government of South Africa (Badat, 2010).

One of the first major changes to the education system after 1994, was the introduction of the National Senior Certificate (NSC) as the new school exiting qualification. The new curriculum brought about the implementation of an outcomes-based approach to education, namely Outcomes-Based Education (OBE) from Grade 1 to Grade 12, and obtaining the NSC. The first cohort of Grade 12 learners to obtain the NSC qualification wrote the final school exiting examination in 2008, and successful students subsequently entered higher education in 2009. Higher Education South Africa (HESA) anticipated unpredictability, inconsistency and uncertainty related to the new NSC qualification, and thus commissioned the development of the National Benchmark Tests (NBTs). The purpose of the tests was to provide additional information about the academic preparedness of learners entering higher education (HESA, 2006).

1.2 PURPOSE OF THE STUDY

South African higher education is characterised as a system with low participation, high attrition, and low completion rates (Badsha & Cloete, 2011; DHET, 2016; USAf, 2015). Recent statistics on the throughput rate revealed that only about 50% of undergraduate students entering public universities in South Africa, actually graduate (DHET, 2017). The shocking throughput rate is a major concern

for South African universities and a problem that needs urgent attention. The persistent pressure on institutions in South Africa to increase access, participation and throughput emphasised the need for relevant local research related to predicting academic success. The Department of Higher Education and Training (DHET) also urged South African universities to continuously research and analyse institutional and national data in order to better understand factors that predict student success and influence student throughput (DHET, 2017).

Responding to this critical call for more South African research, this study focused on the predictive validity of both school exiting results, (the NSC) and the NBTs. The purpose of this study was to develop a model that is predictive of academic success, based on variables assessed during the admissions process and the relationships of these variables with academic progress and academic success measured over a period of six years.

1.3 RESEARCH QUESTIONS

In order to develop an admissions model, the study investigated if NSC school exiting results, measured as high school grade point average (HSGPA) and the National Benchmark Tests (NBTs) were significant predictors of academic success measured as first year grade point average (FYGPA) and as final academic grade point average (FinCumGPA) over a period of six years. Race, gender, and school examination authority were also taken into consideration. The relationship between FYGPA and FinCumGPA was also assessed in order to develop an integrated model predictive of academic success.

The research was guided by the following research questions:

Research Question 1: Assessing the Relationship between Input and Processing will be addressed by answering the following questions:

- What is the relationship between HSGPA, NBT results and FYGPA? What additional information or predictive variance do NBT results provide to HSGPA?
- How is the relationship between HSGPA, NBT results and FYGPA different for race and gender subgroups?

- How is the relationship between HSGPA, NBT results and FYGPA different for school examination authorities?
- How do the NBT benchmarks relate to dropout or exclusion after first-year?

Research Question 2: Assessing the Relationship between Processing and Output will be addressed by answering the following questions:

- What is the relationship between FYGPA and FinCumGPA?
- How is the relationship between FYGPA and FinCumGPA different for race and gender subgroups?
- How is the relationship between FYGPA and FinCumGPA different for different school examination authorities?

Research Question 3: Assessing the Relationship between Input and Output will be addressed by answering the following questions:

- What is the relationship between HSGPA, NBT results and FinCumGPA?
- How is the relationship between HSGPA, NBT results and FinCumGPA different for race and gender subgroups?
- How is the relationship between HSGPA, NBT results and FinCumGPA different for school examination authorities?
- How do the NBT benchmarks relate to Final Admission Status?

1.4 SIGNIFICANCE OF THE STUDY

This study is important because of the significance and contribution that this research provides to research theory, the field of industrial psychology and admission practices at universities, especially in the South African higher education context.

In terms of theory and research, the predictive validity of the NSC and NBT results have not yet been investigated longitudinally. There is a considerable lack of research on the significance of the NBTs in South African universities. Therefore, this study contributed to the limited South African research concerning the predictive validity of the school exiting results and admission tests. In a study on the NSC and NBT results, Rooney and Walbeek (2015) concluded “It would be useful to know whether

the increasing importance given to NBT results are justified in terms of a superior ability to predict whether a student will graduate or not, relative to Grade 12 marks". This study aimed to answer this question and to add to the field of research on predicting academic success.

Furthermore, this study aimed to validate the NBT benchmark levels by longitudinally tracking the progress of a cohort of students over a period of six years. The NBT benchmark levels refer to the level of support a student would require in order to be more likely to succeed in higher education. Thus, the benchmark levels of the NBTs recommend placement in certain programmes according to the level of support that would be required by the students. By validating these benchmark levels and the predictive validity of both the NBTs and NSC, this study contributed to the field of psychology in terms of psychometric test validation and test measurements.

The overarching goal of this study was to develop a model predictive of academic success that can be used in the admission processes to improve university system output and effectiveness. Such a model could guide institutional admissions policies and advise future regulatory developments related to student admissions that could be beneficial to universities. The focus on improving institutional effectiveness and efficiency is relevant to the field of organisational and industrial psychology. In addition, industrial psychologists may find value in the research results related to career advice and guidance to prospective students.

On a practical level, the results of this study could prove extremely valuable to institutions with regard to the admission and placement of students based on NSC and NBT results in order to improve throughput. Furthermore, the importance of first-year academic performance was emphasised in this study. Universities can apply the findings of this study to identify students at risk, as well as to develop support programmes to enhance and improve first-year academic performance. The practical value of the findings related to group differences in terms of race, gender and schooling authority can be used in developing fair and unbiased admissions policies and regulations, which in turn can have significant implications for institutional selection and admission practices.

1.5 DEFINITION OF TERMS AND ABBREVIATIONS

The following key terms are used throughout the study. This is followed by a table explaining the key abbreviations used in this study.

- Admission is a process whereby a university evaluates an applicant against the admission requirements and consider admitting or rejecting the applicant.
- Applicants refer to potential students, who have applied, but have not yet been admitted to a university.
- Cohort study is following and tracking a specific group of students from intake and registration to graduation, it is a longitudinal measure.
- Cohort completion rate refers to the percentage of the student intake that graduates.
- Curriculum refers to the structure of the degree programme such as mainstream, extended or foundational.
- Graduation rate is the percentage of students graduating in a particular year compared to the percentage of students registered for the programme in the same year.
- Higher Education in South Africa includes all types of post-secondary education providers and institutions.
- Institutions in this study refer to places of tertiary/higher education institutions such as colleges, institutes and can include universities.
- Output refers to graduates successfully exiting the system and can be measured in graduation rate and throughput rate.
- Participation rate is the proportion of the population aged between 20 and 24 in higher education.
- Placement is the process of registering a student into a specific degree programme or curricular routes in terms of mainstream (regular programmes) or extended programmes (programmes with additional time to complete) of foundational programmes (programmes that offer additional time and additional content).
- Scholars/learners refer to population currently in schools and secondary education.
- Students refer to the population currently registered and studying at a higher education institution.
- Success rate also refers to throughput rate, for a specific cohort of students being tracked over a period of time.
- Throughput rate is the proportion of a given student intake or cohort that graduates (this is not cohort specific) and complete their studies.

Table 1: Descriptions of abbreviations

ABBREVIATION	MEANING
HESA	Higher Education South Africa
CHE	Council for Higher Education
CHED	Centre for Higher Education Development
DHET	Department of Higher Education and Training
FYGPA	First-year Grade Point Average
FinCumGPA	Final Cumulative Grade Point Average
GPA	Grade Point Average
HE	Higher Education
HEIs	Higher Education Institutions
HSGPA	High School Grade Point Average
NBTs AL QL MATS	National Benchmark Tests Academic Literacy Quantitative Literacy Mathematical Literacy
NCHE	National Commission on Higher Education
NSC	National Senior Certificate
USAf	Universities South Africa

1.6 ORGANISATION OF THE STUDY

This study comprises five chapters. Chapter 1 provides the reader with background information about the study and introduces the statement of the problem, the research questions, and the significance of the study. Chapter 2 presents a review of the available literature and context related to the research study, working from a theoretical framework towards a conceptual model. Specifically, Chapter 2 sketches a brief overview of the South African higher education landscape, followed by contextualising university admissions, progress and throughput. Thereafter the focus is on defining and predicting academic success and concludes with the introduction of the conceptual framework for this study. The research methodology used in this study is discussed in Chapter 3, including the research design, the data sources, the sample, the data collection procedures, and the statistical analysis procedures employed. Chapter 4 presents the results and provides the findings of the study corresponding to and addressing each research question. The final chapter presents the interpretation of the research findings along with the limitations of the study, implications of the major findings, conclusions and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

The following chapter provides literature and context related to the research study working from a theoretical framework towards a conceptual model. Both local and international literature was consulted on university admissions processes, university progress and throughput, as well as defining and predicting academic success. A brief overview of the South African higher education landscape is also presented. The chapter concludes with the introduction of the conceptual model for this study.

2.1 INTRODUCTION

Recent statistics reveal that approximately half of the undergraduate cohort of students entering public universities in South Africa, actually graduate (DHET, 2017). The success rate, or throughput rate, has become a major concern for South African universities in recent years. Student success and throughput were listed as the first of five broad challenges facing universities in South Africa, according to the 2010 revised strategic plan of the Department of Higher Education and Training (DHET). In 2012, the DHET published the Green Paper for Post-School Education and Training, yet again identifying the increase of the throughput rate as a top strategic priority for tertiary education. Case, Marshall and Grayson (2013) highlighted that, in addition to a strategic priority, increasing the throughput rate must also become a national priority for South African universities.

Research has linked poor throughput rates at universities directly to school exiting results both globally (Al-Hattami, 2012; Geiser & Santelices, 2007) and locally (Fisher, 2011; Selesho, 2013). Various studies in South Africa found the lack of academic preparedness of school leavers to be a key factor behind the poor throughput rates (Fisher & Scott, 2011; Scott & Yeld, 2008; Wolmarans, Smit, Collier-Reed & Leather, 2010). Students entering university seem under-prepared and not equipped with the skills to be successful at university and consequently fail or drop out at university. Because the challenges with improving throughput rates are complex and multifaceted, the DHET encouraged South African universities to continuously scrutinise institutional and national data in order to gain a better understanding of the factors that predict student success and also to identity factors that influence student throughput (DHET, 2017).

The following section presents a brief summary of higher education in South Africa, sketching the history of education, and providing a general background of the transformation in education since the dawn of democracy.

2.2 HIGHER EDUCATION IN SOUTH AFRICA

> *"Our single most important challenge is therefore to help establish a social order in which the freedom of the individual will truly mean the freedom of the individual. We must construct that people-centred society of freedom in such a manner that it guarantees the political liberties and the human rights of all our citizens."*
>
> - Nelson Mandela, opening of the South African parliament, Cape Town, 25 May 1994.

Although it has been more than 25 years since the dawn of democracy in 1994, some remnants of apartheid remain visible in the current inequalities of race, class, gender and education within the social, political and economic environments of South Africa. During apartheid, institutionalised racism, marginalisation and deprivation were the order of the day in all services and social-economic spheres of the country. The practices of discrimination were legally enforced on all systems and services such as national healthcare, education systems and public service.

The Bantu Education Act or Native Education Act No. 47 of 1953 classified and separated education along racial lines to the extent that, without specific written permission, it was considered a criminal offense for "non-whites" (black people) to register at a white university (in Mdepa & Tshiwula, 2012). The non-white classification included all race groups other than white people, such as Indian, coloureds and black people. The blatant discrimination where students of colour could not register at white universities, led to the deprivation of quality basic and higher education for non-whites at institutions that were specifically for white people only. Consequently, the higher education system in South Africa was characterised as racially exclusive, fragmented and uncoordinated, with extremely low participation rates of female and black African students (Badat, 2010).

After democratisation in 1994, the South African government focused on repositioning the country for the future, in line with new social, economic and political imperatives and aspirations. The first initiative that specifically focused on addressing the inequality in the higher education system was

implemented in 1995 with the appointment of the National Commission on Higher Education (NCHE). One year later, in 1996, the Commission implemented a new policy for higher education titled "Overview of a new policy framework for higher education transformation" (NCHE, 1996). The policy identified the challenges and opportunities in the existing higher education system and proposed recommendations. The policy framework mainly focused on (1) increasing participation to address issues of equity, redress and development, while (2) increasing diversity with emphasis on greater responsiveness to social context, as well as (3) increasing partnerships and collaboration between higher education institutions, society and the state. The policy framework served as the basis for further policy directives in support of the national transformation agenda. This policy framework was followed by both the Higher Education Act of 1997, as well as the Education White Paper 3.

In 1997 the Minister of Education published the "Education White Paper 3: A Programme for the Transformation of Higher Education" (DoE, 1997). The document provided an agenda for change to overcome fragmentation, inequality and inefficiency, and to create a learning society. Soudien (2010) referred to Education White Paper 3 as one of the most important policy statements of the newly elected democratic government. The main objectives set for higher education, according to this Paper can be summarised as follows:

- Promoting equity of access and fair chances of success to all, while eradicating all forms of unfair discrimination and advancing redress for past inequities.
- Meeting national development needs, through well-planned and coordinated teaching, learning and research programmes for a growing economy operating in a global environment.
- Supporting a democratic ethos and culture of human rights.
- Contributing to the advancement of all forms of knowledge and scholarship, and in particular addressing the diverse problems and demands of the local, national, Southern African contexts and upholding rigorous standards of academic quality (DoE, 1997b p.14).

After Education White Paper 3, the promulgation of the Higher Education Act of 1997 (DoE, 1997) followed. This Act was considered to be a critical structural policy directive informing the operation of higher education institutions in South Africa. The Act created the South African Council of Higher Education (CHE) as an independent statutory body mandated to advise the Minister of Higher Education on issues pertaining to structure, planning and funding in higher education, as well as matters relating to quality through the Higher Education Quality Committee (HEQC). The function of

the HEQC is to perform quality promotion and quality assurance through institutional audits and academic programme approvals by the CHE (CHE, 2013b).

In 2001, the National Plan for Higher Education (NPHE) was released to set out a number of broad output-related goals aimed at addressing growth and widening of participation, output, efficiency and quality of higher education institutions (DoE, 2001). The NPHE further proposed a restructuring of the higher education sector by means of mergers and incorporations to reduce the then 36 universities to 23 tertiary institutions. Two new classifications of universities were simultaneously introduced, namely comprehensive universities and universities of technology. Badsha and Cloete (2011) explained that the classification was an attempt to soften the boundary between theoretical (academic) and vocational (technical) institutions, and to reshape the apartheid landscape of universities and higher education. In addition, the mergers and incorporations were attempts to create a more efficient higher education system and to reduce wastage and duplication of programmes (Le Grange, 2011).

The Department of Higher Education and Training (DHET), as it is currently known, was established in 2009 with the split between the Ministry of Education and the Ministry of Labour. The DHET brings together the main pillars of the post-school system and is responsible for all institutions that provide formal post-school education and training (colleges, FETs and universities), specific levy grant institutions such as the Sector Education and Training Authorities (SETAs), the National Skills Fund (NSF), as well as regulatory and other institutions such as the National Qualifications Framework (NQF), the South African Qualifications Authority (SAQA), the three Quality Councils, the National Skills Authority (NSA), and the National Student Financial Aid Scheme (NSFAS). The DHET addresses the higher education shape and output through steering mechanisms such as the funding framework, specifying programmes and the quality of teaching and learning for each institution, and engaging in the individual institutions' enrolment planning (Johl, von Solms, & Flowerday, 2014).

The National Development Plan 2030 was launched in 2012 by the National Planning Commission (NPC, 2012). The Plan acknowledged higher education institutions as key to developing the nation with three main functions in society, which include:

- To educate and train people with high-level skills for the employment needs of the public and private sectors.

- To produce new knowledge. Universities are the dominant producers of new knowledge. Universities set norms and standards, and determine the curriculum, languages, knowledge, ethics and philosophy underpinning a nation's knowledge-capital. South Africa needs knowledge that equips people for a society in constant change.
- Given the country's apartheid history, higher education should provide opportunities for social mobility and simultaneously strengthen equity, social justice and democracy. In today's knowledge society, higher education underpinned by a strong science and technology innovation system is increasingly important in opening up opportunities for the country's growth and development.

The White Paper for Post-School Education and Training (DHET, 2014b) was introduced in 2014, emphasising the importance of aligning higher education with the National Development Plan in order to respond to the needs of the country. The White Paper (2014), proposed policies to guide the DHET and the tertiary institutions to contribute to building a developmental state with a vibrant democracy and a flourishing economy with a vision of:

- A post-school system that can assist in building a fair, equitable, non-racial, non-sexist and democratic South Africa;
- A single, coordinated post-school education and training system;
- Expanded access, improved quality and increased diversity of provision;
- A stronger and more cooperative relationship between education and training institutions and the workplace;
- A post-school education and training system that is responsive to the needs of individual citizens and employers in public and private sectors, as well as broader societal and developmental objectives.

The vision for higher education in South Africa stated in the National Development Plan 2030 (NPC, 2012), is that: "Universities will be efficient institutions, characterised by increased knowledge productivity units, throughput rates and graduation and participation rates".

Striving towards the vision as set out above, higher education in South Africa has achieved some remarkable successes since 1994, including nearly doubling the number of students enrolled at universities (Mentz, 2012), significantly changing the racial composition of the students, the merging and restructuring of institutions, as well as a review of the funding mechanisms (DHET, 2014a).

Notwithstanding these achievements in higher education transformation, the current higher education system is still characterised by serious challenges and issues related to participation rates, access, success and funding.

The exponential expansion of higher education in the 20th century, where the focus shifted from initially catering for only an exclusive and elite group of students in the past, to striving to provide increased opportunities and access to more people in different countries all over the world (Case et al., 2013) has led to a stronger emphasis being placed on institutional selection and admission processes to ensure increased participation and success at universities (Al-Hattami, 2012; Arikan, 2010).

Education White Paper 3 placed the responsibility on higher education institutions in South Africa to develop admissions policies that will ensure that students with the potential to succeed are admitted, while at same time provide more opportunities by widening access to transform higher education (White Paper 3, DoE, 1997). Although access to higher education has been widened since 1994, current challenges with low throughput rates and student successes indicate a flaw in the admissions processes at universities. This implies that either the right students are not necessarily admitted, or that the required support structures are not in place for under-prepared students.

The next section discusses university admissions processes, and particularly the assessment measures on which admissions processes are generally based.

2.3 UNIVERSITY ADMISSIONS

With a view to contextualise the aim of this study, namely to develop a model for predicting academic success at a tertiary institution, the literature reviewed in the following section provides background and motivation for the development of such a model. The focus is on processes and context related to university admissions and university progress and throughput. Thereafter the focus moves to defining and predicting academic success and relevant research is presented.

Admission is a process whereby a university or tertiary institution considers admitting or rejecting an applicant, thus granting “permission to enter” (Collins English Dictionary, 2003), or allowing access

to the institution. Kirkup, Schagen, Wheater, Morrison, and Whetton (2007, p.3) explained that "universities and other higher education institutions have to assess the merit and potential of each applicant in order to decide who to admit".

Essack (2012) defined "access" as the responsibility to redress equity and transformation in universities through admissions processes. Thus, access is more than just an admission decision, as Belyakov, Cremonini, Mfusi and Rippner (2009, p.3) explained:

> "Access through participation is the policy of ensuring that students are able to enter and commence study at an institution of higher education. Access with success goes a step further, defining true access as completion of a degree or certificate program that prepares one for a vocation."

Providing "meaningful access" is not only about increasing participation but also about the performance and success of students (Casazza & Silverman, 2013). Universities must provide access, and at the same time increase student retention and graduation rates, whilst maintaining high quality academic programmes, and eventually produce well-educated graduates (Lenz, 2013). Access is therefore about admission decisions, applying policies and rules that are fair, equitable, reliable and justifiable in terms of the ability and probability of students to succeed.

The secondary schooling system is the conventional gateway into higher education, and higher education is in turn dependent on what the secondary schooling system provides with regard to academic preparedness and quality of students. Fisher and Scott (2011) mentioned a mismatch between admission requirements into higher education, the level of academic preparedness required in higher education, and the actual level of preparedness of students exiting the secondary schooling system.

Research conducted both globally (Al-Hattami, 2012; Geiser & Santelices, 2007) and locally (Fisher, 2011; Selesho, 2013), concluded that poor throughput rates at universities could be ascribed directly to school exiting results. Various studies in South Africa found the lack of academic preparedness of school leavers to be a key factor behind the poor throughput rates (Fisher & Scott, 2011; Scott & Yeld, 2008; Wolmarans et al., 2010). Students entering university seemed under-prepared and not equipped with the skills to be successful at university.

Sewry and Mokilane (2014) stated that the South African higher education system was severely constrained by the conditions of the schooling system. The Department of Higher Education and Training also admitted to serious challenges with the secondary schooling system (DHET, 2011, p. 37):

> "…the poor performance of the schooling system is a major systemic constraint to success in the university system. Access to programmes with specialised entry requirements is a major concern to universities, as is the under-preparedness of students and the consequent high dropout and poor completion rates. This is wasteful of private and institutional resources and energies."

This is supported by the findings of a study conducted by Spaull (2013), who found that South Africa's education system was ranked the worst of all middle-income countries that participated in cross-national assessments of educational achievement on Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS) and Southern and East African Consortium for Monitoring Educational Quality (SACMEQ). Prior to this, Timeslive (2012) reported that South Africa ranked lowest in Mathematics and Science education in a survey of 62 countries commissioned by the World Economic Forum.

In addition to poor performance, the South African schooling system was found to be highly imbalanced due to differences in the quality of education and the socio-economic status of schools (Wangenge-Ouma, 2012). According to Butler-Adam (2013) top schools achieved pass rates of near 100%, while schools in rural areas obtained lower pass rates of between 50% and 60%. Only 1% of African schools were in the top performing sphere in final school results (NPC, 2011, in Wangenge-Ouma, 2012). Subsequently, the majority of schools performed poorly in terms of quality of education and throughput. Furthermore, this poor school throughput was reflected in a study that found that nearly a third of pupils starting school in the Grade 1 will not progress to Grade 12, and only half of the students at Grade 10 level will progress to writing the final Grade 12 examination or qualify for the National Senior Certificate (Butler-Adam, 2013).

2.3.1 School Results: National Senior Certificate (NSC)

Similar to the restructuring in higher education from 2001 onwards, the secondary education system in South Africa also had to undergo huge changes and restructuring after 1994. One of the many

changes was the introduction of a new curriculum in an attempt to address the shortcomings of the previous education system (Nel & Kistner, 2009). The new curriculum brought about the implementation of an outcomes-based approach to education from Grade 1 to Grade 12 and the achievement of the National Senior Certificate (Mentz, 2012). The first cohort of Grade 12 learners wrote the NSC examination in 2008 and entered higher education in 2009.

The aim of the NSC was to enrich the learner with a combination of learning outcomes that would provide applied competence and a basis for further learning, as well as provide a benefit to society and the economy that is internationally comparable with other assessments (PMG, 2012). The NSC is a three-year qualification, obtained after completing Grades 10, 11 and 12. The curriculum offers subjects without distinction between levels of difficulty (higher and lower grades), and prescribes four compulsory subjects namely two South African languages, Mathematics or Mathematical Literacy, and Life Orientation, with a choice of three other elective school subjects.

Based on a student's final Grade 12 results, the NSC is awarded and certified by the quality assurance body Umalusi. A student qualifies for further studies based on the statutory minimum requirements for the Higher Certificate, Diploma and Bachelor's Degree Programmes (DoE, 2005). Initially, the statutory minimum requirement for university entrance was a 50% pass in four NSC subjects. In a further effort to increase university access, and to ensure that even more students have an opportunity to enter university, the requirements for university entrance were amended in 2018 to at least 40% in the student's Home Language, 40% in two other subjects and at least 30% for four other subjects (DHET, 2018). The final NSC results must comply with both the statutory minimum requirements for degree study as well as the specific institutional admission requirements in order to register at a tertiary institution.

All state and public schools offer the NSC (or variations thereof) as the official school exiting qualification. Some private schools in South Africa offer an equivalent examination by the Independent Examinations Board (IEB) that is based on the National Curriculum Statement (NCS).

Although the IEB is an independent assessment agency that is separate from state and provincial examination boards, the IEB is bound within the constraints of national legislation and provisions of national quality assurance (Oberholzer, 2018).

Selesho (2013) explained that institutional admission requirements, as set in school exiting results, were based on the extent to which academic success could be predicted or dictated. The central principle was that school exiting results were indicative of acquired knowledge and readiness for higher education (Essack, Wedekind, & Naidoo, 2012). Thus, school exiting results should be predictive of academic performance in higher education, notwithstanding the fact that various other factors impacted on academic performance such as quality of schooling, funding, and accommodation, among others (Richards, 2012; Wolmarans et al., 2010).

Nel and Kistner (2009) found the validity of the NSC as a school exiting measure and an entry measure into higher education to be uncertain, due the NSC being a relatively new qualification and the availability of research on the longitudinal relationship between school exiting results and academic performance at university is still sparse. Marnewick (2012) found no correlation between the NSC and academic performance on a tertiary level. Other studies investigating the predictive ability of the NSC on first-year performance, found varying results (Müller, 2013; Oosthuizen & Eiselen, 2012; Potgieter & Davidowitz, 2010; Schoer, Ntuli, Rankin, & Sebastiao, 2010; Wilson-Strydom, 2012). The poor correlation and issues related to predictive validity have been attributed to standardisation processes and grade inflation of the NSC results (Govender & Moodley, 2012; Hunt, Ntuli, Rankin, Schöer, & Sebastiao, 2011; Nel & Kistner, 2009; Simkins, 2011). Hunt et al. (2011) reported NSC marks inflated by up to 25%, where Dennis and Murray (2012) found NSC mathematics marks inflated by 20%. Fisher asserted that grade inflation casted serious doubt and uncertainty on the standards and validity of NSC results (Fisher, 2011).

Reacting to the NSC grade inflation, Jansen (2012) publicly criticised the process, emphasising that the psychological problem resulting from grade inflation created false expectations for students who will struggle to pass at university, which in turn will affect the throughput rate. Fisher (2011) confirmed that grade inflation led to students having an inflated sense of their own abilities and very little sense of the hard work that will be required at university. Simkins (2011) warned that if grade inflation continued, universities will counter-react by inflating admission requirements for NSC applicants, eventually devaluing the South African public education system.

Despite the concerns related to the validity of the NSC results, most universities still use these results exclusively for admission purposes, although some institutions use additional measures, such as the

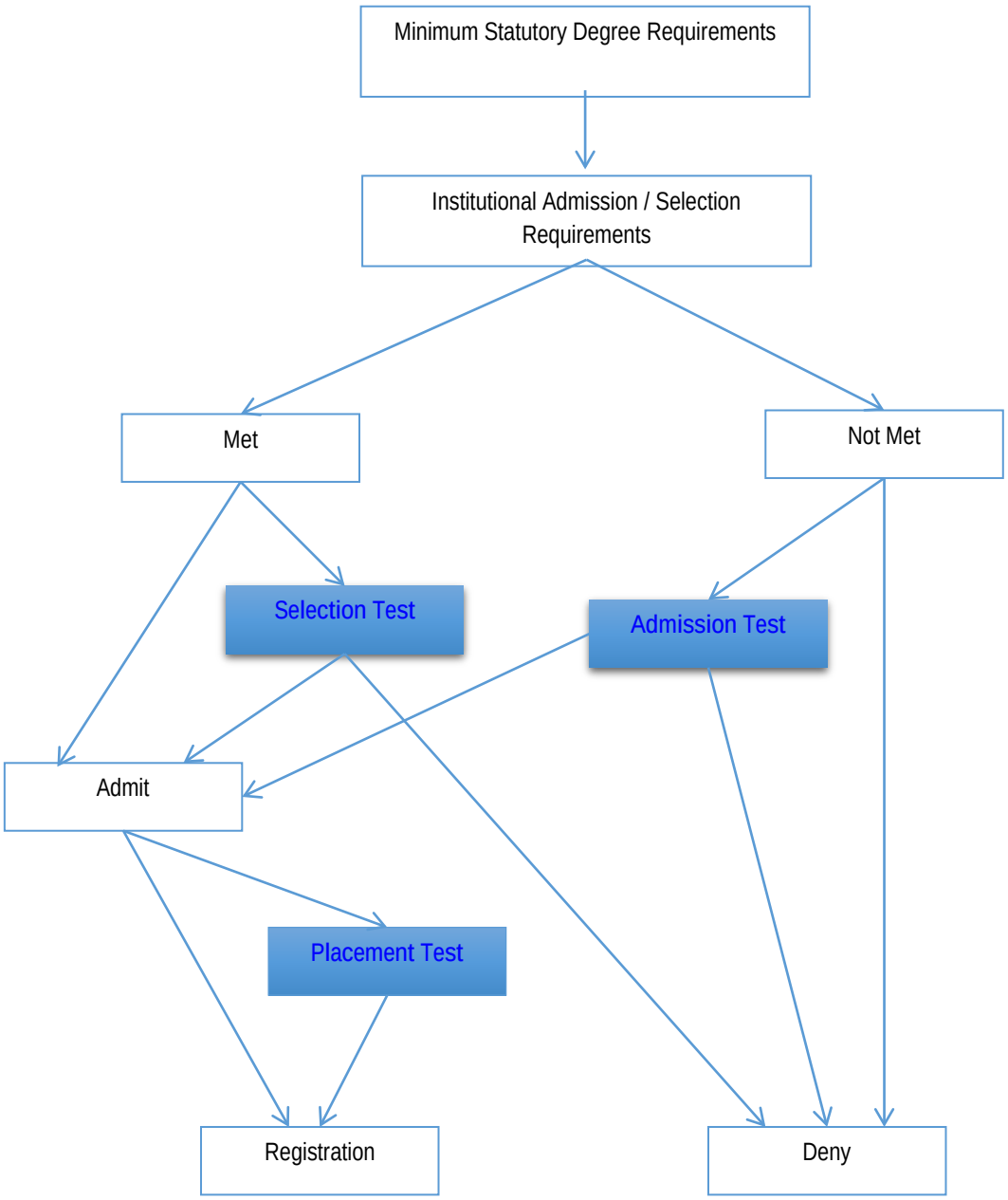
NBTs. The Department of Basic Education supports the use and implementation of additional measures stating:

> "As at present, institutional admissions policies must allow for alternative routes of entry that are equivalent to the National Senior Certificate standard, including the assessment of an adult learner's capacity to benefit from a particular programme by the Recognition of Prior Learning (RPL) or other means" (DoE, 2005, p.3).

The following section provides more information on alternative measures and assessments. The purpose of the section is to explain alternative measures and information that are used in the admission or placement processes for input into the university system.

2.3.2 Alternative Measures and Assessments

The aim of alternative measures and tests is to provide additional information about applicants that may be relevant to the requirements of higher education. Furthermore, alternative measures can assist with interpreting school results, or provide further information about academic preparedness and the level of support learners will require at institutions. According to Wilson-Strydom (2010) institutions explored the use of additional admission tests to complement the school exiting results in an attempt to understand and manage the gap between *'eligibility and readiness'* for university. Alternative measures and tests can be categorised according to the purpose of the test, be it admission, selection or placement. Figure 1 below provides a schematic diagram of the different tests and its purposes, followed by a brief description of each test.



Source: Author's own illustration

Figure 1: *Selection, Admission and Placement Tests*

Admission tests provide additional information for admission purposes to assist with admitting applicants into the system. According to Koch and Foxcroft (2003), in the South African context, admission tests have been used to address issues of equity, unequal schooling and cultural differences as a result of the political regime of apartheid. Most of the tests focus on the identification of learners with the potential to succeed at higher education institutions (such as learning potential assessments).

Selection tests are used to select specific students out of a competing pool of applicants. Arikan (2010) states that the great demand for higher education makes "selection" necessary. The purpose of selection tests is to provide additional information related to variance and performance measures in order to distinguish between students and select the best students for a particular programme. Selection tests are mostly used when there is an oversupply and high demand for places, for example applications for medical studies (Poole, Shulruf, Rudland, & Wilkinson, 2012). Schaap and Luwes (2013) found that additional measures, other than school exiting results, were relevant in selecting and identifying specific students because of the unique contribution the tests offer.

Typically, placement tests are used after admission or selection as an indicator of academic preparedness and the level of support that would be required in a specific curriculum. Placement is a post-admission process that refers to registering students into specific programmes, such as extended, foundation or mainstream programmes according to the level of support required by the student. Belfield and Crosta (2012) explained placement tests as a binary indicator of (a) yes, the student would need development support or (b) no, the student is ready. Subsequently, the student is then 'placed' into a programme based on the test result.

Alternative assessments are used for the different purposes above, be it admission, selection or placement. However, in the United States of America, standardised test scores are often used for all three purposes in an attempt to address the challenges of bridging the divide between secondary school and university and to predict academic success in higher education (Scholtz, 2012). Santelices and Wilson (2012) explained that standardised tests allow applicants an environment with the same testing conditions, instructions and time-constraints, opportunities to ask questions and procedures for scoring, therefore the scores are comparable among students.

Annually, millions of prospective students in the USA write one or more of the following tests for admission, selection or placement purposes: the Scholastic Aptitude Test (SAT), the American College Testing (ACT), the Graduate Record Examination (GRE), the Law School Admission Test (LSAT), the Medical College Admission Test (MCAT), and the Graduate Management Admission Test (GMAT) (in Sackett, Kuncel, Arneson, Cooper, & Waters, 2009).

In South Africa, higher education institutions use additional measures and proficiency tests for admission, selection or placement purposes. Scholtz (2012) reported that the most prominent tests used were the Placement Test in English for Educational Purposes (PTEEP), the Standardised Test for Access and Placement (SATAP), the English Literacy Skills Assessment for Higher Education and Training (ELSA Plus), the Test of Academic Literacy Levels (TALL), the Assessment Access Battery (AAB), and more recently the National Benchmark Test (NBT).

2.3.3 National Benchmark Tests (NBTs)

In 2005, HESA commissioned the development of the National Benchmark Test (NBT). The purpose of this large scale testing on a national level was to provide additional information to the NSC results and standards. The additional information could assist institutions with the placement of students into appropriate curricular programmes, such as extended programmes, tutorial programmes or language support programmes (Scholtz, 2012). The NBT project was outsourced to the Centre for Higher Education Development at the University of Cape Town with the following four objectives (HESA, 2006):

1) to assess entry-level academic and quantitative literacy and mathematics proficiency of students;
2) to assess the relationship between higher education entry-level requirements and school-level exit outcomes;
3) to provide a service to higher education institutions requiring additional information to assist in placement of students in appropriate curricular routes; and
4) to assist with curriculum development, particularly in relation to foundation courses.

Prince (2012) stated that, in addition to the four objectives above, the NBTs also provided additional information to assist the higher education sector to interpret the school exiting NSC results.

The NBTs measure the ability to transfer understanding of Academic Literacy, Quantitative Literacy and Mathematical Literacy to the demands of higher education. Prince (2016) defined the different tests as follows:

- The Academic Literacy test assesses an applicant's capacity to engage successfully with the language demands of academic study and is an assessment of the generic academic reading and reasoning ability.
- The Quantitative Literacy test assesses an applicant's ability to manage situations or solve problems of a quantitative (mathematical and statistical) nature in real contexts relevant to quantitative disciplines.
- The Mathematical Literacy test assesses an applicant's manifest ability related to mathematical concepts that form part of the school Mathematics curriculum and is also related to mathematical disciplines such as Physics and Chemistry. The Mathematical Literacy test basically assesses the degree to which applicants have achieved the ability to manipulate and synthesise a number of different mathematical concepts, and to draw strictly logical conclusions in abstract symbolic contexts (Prince, 2016).

The test results categorise applicants into three benchmark achievement levels, set as basic, intermediate and proficient. The benchmarks inform applicants and universities about the level of academic support that would be required for the successful completion of programmes. Basic performance indicates serious learning challenges and that the applicant would need extensive long-term support in terms of a bridging programme. Intermediate performance indicates that the applicant is likely to experience difficulty in regular degree programmes, unless specific support is provided such as extended programmes. Proficient performance indicates that applicants are likely to cope with mainstream study at university. The benchmark levels in each domain were set by national panels led by psychometricians from the Educational Testing Service in Princeton, New Jersey (Prince, 2012).

Yeld (2009) reports that during 2009, more than 13 000 learners across universities in South Africa wrote the NBTs in the pilot study. The results of the pilot study were very concerning, as only 43% of the students who wrote the pilot test proved "proficient" in Academic Literacy, 25% in Quantitative Literacy and a mere 8% in Mathematics (Wilson-Strydom, 2012). Commenting on the alarming results, Yeld (2010) stated that differences between the NSC and NBT results were to be expected because of different skills being assessed for the NSC and NBT respectively.

The essential difference is that the NSC is an assessment tool for school exiting; whereas the NBT serves as a tool for entry-level benchmarking into higher education.

2.3.4 Non-Academic, Personal and Biographical Attributes

School results or admission tests are not the only factors that have an effect on a student's success. Other factors, such as additional personal characteristics, experiences and biographical attributes also impact on a student's performance and throughput. Although these factors are not necessarily assessed or measured as part of the admissions process, they form part of what is considered as input characteristics. Gender, race, socio-economic status (SES) and family history are all characteristics that can affect behaviour and success at university.

Nel, Kistner, and Van der Merwe (2013) investigated enrolment trends at a South African university in relation to a student's personal and biographical attributes such as race, language, school performance, geographical area of the school, socio-economic status and access and use of information sources. Their results indicated a significant correlation between socio-economic circumstances and actual registration at university. They found that "the higher the school classification, the perception of the parents' ability to pay the study fees without additional help, and the parents' academic qualifications, the greater the likelihood of students enrolling at the university" (Nel, Kistner, & Van der Merwe, 2013, p.92).

In 2012, the United Kingdom commissioned a steering team to enhance fairness in university admissions. They presented principles for the use of 'contextual data' in admission decisions that included (a) academic performance of the applicant's school, (b) the proportion of pupils in the school living in relative poverty (measured by entitlement to free school meals); and (c) the relative rate of participation in higher education in the area in which the applicant lives - which is closely associated with indices of multiple deprivation (Hall, 2012). The steering team presented the contextual data as non-academic factors defined as the socio-economic status of applicants.

The National Center for Education Statistics (NCES, 2012, p.4) defined Socio-Economic Status (SES) as follows:

> "SES can be defined broadly as one's access to financial, social, cultural, and human capital resources. Traditionally a student's SES has included, as components, parental educational

attainment, parental occupational status, and household or family income, with appropriate adjustment for household or family composition. An expanded SES measure could include measures of additional household, neighbourhood, and school resources."

In the USA, the use of SES has been presented as a possible solution to widening access in the admissions process. Young and Johnson (2004) found that admission decisions based on an SES model could serve as an alternative to those admission decisions only based on affirmative action policies and may increase educational opportunities, provide greater student diversity, and be legally defensible.

One dimension of SES is parent educational attainment. The widening of access to higher education institutions, specifically in South Africa, has resulted in more educational opportunities available to more students and subsequently an increase in first-generation students and graduates (Mdepa & Tshiwula, 2012; Oosthuizen & Eiselen, 2012; Puukka, Dubarle, Mckiernan, Reddy, & Wade, 2012). Nel, Kistner, and Van der Merwe (2013) reported that the majority of coloured students (71%) and black African students (63%) who registered at Stellenbosch University were first-generation students. Identifying these students during admissions processes are important, as research by Engle (2007) found that most first-generation students were faced with challenges such as poor academic preparation, inadequate finances, and lack of support from peers or family members.

In addition to socio-economic factors, research also emphasised psychosocial variables that impacted on academic success, such as achievement motivation, educational commitment, academic self-efficacy and affective reaction (Olani, 2009; Saltonstall, 2013). The Student Readiness Inventory (SRI) assessed three major psychosocial factors predictive of college performance and retention, namely motivation and skills, social engagement and self-management (Komarraju, Ramsey, & Rinella, 2013).

Institutions must proactively respond to the needs of admitted students by providing meaningful access. Casazza and Silverman (2013, p13) summarised this responsibility as follows:

"When students are admitted through the doors of higher education, institutions have a responsibility to assess students' strengths and challenges and provide appropriate support systems. Students admitted to an institution's programs must have the opportunity to earn the

credentials they seek. The new demographics are the present and future of higher education: ignoring these students is not an option."

Applications are considered during admissions processes, and permission to enter is granted based on certain admission requirements or additional and alternative measures of assessment. Such tests and measures must be valid, and the use of the tests must be justified. As Ali and Ali (2010) stated, the predictive validity of the test must be established by determining the relationship between the test and a measure of academic success.

Furthermore, applicants all have various non-academic input characteristics, such as SES, that may impact their performance at university. These factors should also be identified during the admissions processes in order to provide the necessary support to students once they are in the university system. Universities have a responsibility to ensure students who are admitted have a fair chance to succeed. Engstrom and Tinto (2008) asserted, "*access without support is not opportunity!"*

2.4 UNIVERSITY PROGRESS AND THROUGHPUT

This section will present the literature on throughput rates at universities and the factors that might influence the progress of students.

In 2013, the Council for Higher Education reported that only 27% of undergraduate students in South Africa completed their studies in the minimum prescribed time. Furthermore, only half of the students who entered higher education eventually graduate (CHE, 2013). However, poor student throughput and success is not unique to South Africa. In fact, during the same year, the DHET reported an even worse international graduation rate at 25% throughput for a three-year degree programme (DHET, 2013). Such poor throughput is a huge problem for any system in terms of sustainability and efficiency, which negatively affects both the system, the student and the external environment.

In a critical review of access to higher education institutions in South Africa, Machingambi (2011) emphasised the responsibility of institutions to create student engagement through the learning environment and to provide support services to ensure progress and success. He concluded by recommending:

> "The South African government and universities should ensure that all students who enrol with institutions of higher education are provided with conditions that are conducive to their success. That is to say, it is high time the government and all those concerned with the provision of higher education realise that merely offering access to students without putting in place mechanisms to ensure student success is not only an act of irresponsibility but also a waste of acute resources" (Machingambi, 2011).

There is vast local and international literature and research on student retention, throughput, engagement, dropout and attrition. Local research include the following: Breier, 2010; CHED, 2012; Cosser & Letseka, 2010; DHET, 2017; Fisher, 2011; Fraser, Case, Heydenrych, & Steen, 2011; Govender & Moodley, 2012; Lewin & Mawoyo, 2014; Mashige, Rampersad, & Venkatas, 2014; Mkhize, 2013; Muller, 2014; Ogude, Kilfoil, & Du Plessis, 2012; Prince, 2016; Schaap & Luwes, 2013; Sewry & Mokilane, 2014; Van Broekhuizen et al., 2017, whereas international research include: Adamson, 2016; Al-Hattami, 2014; Ameri, Fard, Chinnam, & Reddy, 2016; Blanchet, 2016; Chen, 2012; Engle & Tinto, 2008; Gupta, Gupta, & Vijay, 2013; Kovanic, 2012; McGilvray, 2014; Oreški, Hajdin, & Kliček, 2016; Radcliffe, Huesman, & Kellogg, 2006; Schneider, Kitmitto, Muhisani, & Zhu, 2015; Tinto, 2009; Trowler, 2010. Dropout was pointed out as a major problem for university systems, and early identification of students at risk of dropout is critical. Research conducted by Kruzicevic et al. (2012) emphasised this challenge, as it indicated that 50% of attrition occurred during a student's first year.

The academic under-preparedness for higher education of South African students was highlighted as a major contributor to the poor throughput. (Bozalek & Boughey, 2012; Bradbury & Miller, 2011; Du Plessis & Gerber, 2012; Oosthuizen & Eiselen, 2011; Shandler, 2010; Smit, 2012; Van Schoor, 2010). The CHE (2013, p.57) reported "what the students know and can do – attainments that were good enough to gain them entry to higher education – does not match the expectations of the institution". In other words, there is a discrepancy between eligibility and readiness for higher education, commonly referred to as the "articulation gap". Lewin and Mawoyo (2014, p.6) explained the articulation gap as the "disparity between the learning requirements of higher education programmes and the knowledge and competencies of students entering universities. This disparity is caused by differences in teaching and learning between high school and university."

Fisher and Scott (2011) recommended, among other strategies, addressing the articulation gap by improving the effectiveness of teaching and learning in higher education itself, particularly adjusting the curriculum at entry level to the capacities of incoming students. Some higher education institutions in South Africa have been responding to the articulation gap through institutionalising major educational interventions such as foundation or extended programmes as well as placement and curriculum development strategies (Yeld, 2010).

The DHET acknowledged the fact that students entering higher education institutions are under-prepared, but rightfully urges universities to address this problem. The DHET (2012) specifically stated that funding would be earmarked for support initiatives such as foundation or support programmes in order to increase throughput in higher education institutions. Furthermore, the National Development Plan advised institutions to develop strategies and structures to increase throughput and output, and specifically to "…offer extra support to underprepared learners to help them cope with the demands of higher education… Support programmes should be offered and funded at all institutions" (NPC, 2012, p320).

Against the backdrop of poor throughput rates at higher education institutions in South Africa, the CHE appointed a task team to investigate the obstacles experienced with regard to throughput and student success, and to propose a possible intervention. The task team focused on the existing undergraduate curriculum structure as a key element of the teaching and learning process and considered the desirability and feasibility of amending the curriculum as a means of substantially improving graduate output and success.

In August 2013, the task team presented the report "A proposal for undergraduate curriculum reform in South Africa: The case for a flexible curriculum structure" (CHE, 2013a). The report pointed out major deficiencies in overall graduate numbers, both in equity and in the proportion of the student body that succeeded in higher education, and presented the following statistics (CHE, 2013, p.15):

- one in four students in contact institutions graduated in the minimum time;
- 35% of the total intake, and 48% of contact students, graduated within five years;
- 55% of all students will never graduate, even when allowed to take longer than five years and allowed to return after dropping out;
- racially skewed, completion rates for white students was on average 50% higher than that for black African completion rates;

- fewer than 5% of black African and coloured youth were succeeding in any form of higher education.

The report finally proposed “curriculum reform” in higher education in terms of duration, flexibility and standards. In summary, it suggested that the minimum completion time of most degrees be extended by one year, but still allowed flexibility for some students to complete the programme in less than the allocated time. The additional curriculum space could then be used to enhance the curriculum to ensure realistic starting points and progression paths. The recommendations of this report focused on the processing component and on improving output by supporting students once they were in the system. However, the solutions presented also highlighted the importance of admission and placement in higher education. Higher education must have strategies and innovative approaches to diagnostic assessment, as the information becomes critical, not only for admission, but also for placement within the flexible curricula (Scott, Yeld, & Hendry, 2007).

Various studies supported the need for innovative admission and placement strategies in order to identify the support that a student might require from the onset. Jacobs (2010) proposed a placement model for universities in order to improve throughput. In her research, she emphasised that universities should collect as much knowledge and information as possible about entering students to be able to provide them with the necessary support. Essack (2012) concluded that innovative strategies were necessary in both pre-admission and post-admission processes, to provide comprehensive holistic student support and curriculum interventions that would address both access and success. Grayson (2011) and Yeld (2010) highlighted the need for reliable assessments and measures for selecting and placing students in programmes according to their ability and level of preparedness in an effort to increase throughput.

In addition to providing an environment that is conducive to academic success, institutions must also assess the academic needs and preparedness of admitted students. Aspects such as the relevance of the curriculum, the placement of students, the preparedness of students, financial support available to students, and other strategies aimed at ensuring progression, are all critical to increasing throughput.

The goal of higher education is to ensure student success and also that the overall system functions optimally and works according to the principles of effectiveness and efficiency, as defined in Education White Paper 3 (DoE, 1997 p.12):

> "An effective system or institution functions in such a way that it leads to desired outcomes or achieves desired objectives. An efficient system or institution is one which works well, without unnecessary duplication or waste, and within the bounds of affordability and sustainability. It does things correctly in terms of making optimal use of available means."

To achieve this goal, the university system as a whole must work optimally. In other words, the admissions processes must provide access to suitable applicants; admitted students must be placed in the appropriate programmes according to their requirements and abilities; the institution must ensure support by means of providing support, quality teaching and learning, as well as relevant curriculum reform and design that include extended and foundation programmes. Success is achieved when students graduate and exit the system, enabled to enter the labour market and contribute to the broader economic development of the country, or enter the postgraduate education system for further studies.

This section discussed factors that relate to progress and throughput. Defining and measuring academic success will be discussed in the next section, and context and relevant research findings on predicting academic success will be provided. This information is pertinent to the overarching goal of this study, namely to develop a model that will predict academic success.

2.5 DEFINING ACADEMIC SUCCESS

Defining academic success has been a topic for educational research and discussions for many years (Hartnett & Willingham, 1980; York, Gibson, & Rankin, 2015). Hartnett and Willingham (1980) reviewed numerous potential indicators of student success and found that the definitions and measurements of student success vary across institutions, disciplines and programmes. They referred to the 'criterion problem' as the principle question of how to define academic success in relation to validating admission measures.

More than three decades later, another analytical literature review on defining and measuring academic success found that the "criterion problem" was still prominent. York, Gibson, and Rankin, asserted that, "Ambiguity associated with the definition of academic success is partially attributed to its inherently perspectival nature. Varying constituents view success, and thereby academic success, differently" (York, Gibson, & Rankin, 2015, p.1).

The broad definition of academic success in literature generally varied between perspectives (systemic, institutional and student) as measurable and immeasurable variables that were either observable or subjective outcomes. For example, some studies focused on predicting academic success where success was measured as grade point average for first-year performance (Du Plessis & Gerber, 2012; McDonald, Newton, Whetton, & Benefield, 2001; Müller, 2013; Stemler, 2012), as opposed to measuring academic success as an overall cumulative grade point average for degree completion (Adebayo & Dorcas, 2014; Al-Hattami, 2012; Al Alwan, Al Kushi, Tamim, Magzoub, & Elzubeir, 2013; Geiser & Santelices, 2007; Spruill, 2011). Other studies focused on student persistence and retention as measures of success in identifying contributors of student attrition and dropout (Case et al., 2013; Essack, 2012; Pocock, 2012; Rooney & Van Walbeek, 2015; Zewotir, North, & Murray, 2011). A study by Sandberg (2015) proposed combining both performance and persistence in defining academic success by measuring grade point average as well as retention.

From a student's perspective, academic success is more than a score, grade point average, metric or degree certificate. Research by Singh, Jack, and Schapper (2014) on defining academic success for students included outcomes as the "development of soft skills such as networking, communication, teamwork, presentation, and writing, research skills, improvement of academic knowledge, contributions to home country or society, and exploration of international life" (Singh, Jack, & Schapper, 2014).

Singh et al. (2014) concluded that academic success must include indicators of academic excellence as well as unquantifiable attributes and capabilities that led to academic success. In an analytical literature review, York et al. (2015) summarised the categorical outcomes mostly measured as "academic success", as *academic achievement* (GPA, grades); *career success* (extrinsic and intrinsic); *satisfaction* (degree and course experience); *persistence* (degree completion and retention); *acquisition of skills and competencies* (critical thinking, academic skills and affective outcomes); and *attaining learning objectives* (engagement and institutional objectives).

With the complexity of defining academic success as a single measure in research, various elements and factors associated with academic success have been identified that enabled researchers to investigate different aspects of success as measurable dimensions of both cognitive and non-cognitive elements of academic success (Briggs, 2012; Sommer, 2013; Stemler, 2012).

As mentioned previously, it is the responsibility of higher education institutions to develop admissions policies that will ensure the admission of students with the potential to succeed (DoE, 1997). The policy on statutory minimum requirements for students entering university, pertinently stated that "institutions have to admit applicants likely to succeed in degree studies based on admission requirements that predict student success in degree programmes" (DoE, 2005, p.5). This implies that institutions have the responsibility to establish the predictive validity of admission measures in predicting student success.

2.6 PREDICTING ACADEMIC SUCCESS

Bakker, Mindadze, and Ziegler (2012) referred to predictive validation of admission measures as a '*conditio sine qua non*' - meaning an indispensable necessity, stating that "without proper predictive abilities it is irresponsible to make decisions on access to higher education from an ethical and fairness perspective but also from an economic and political perspective".

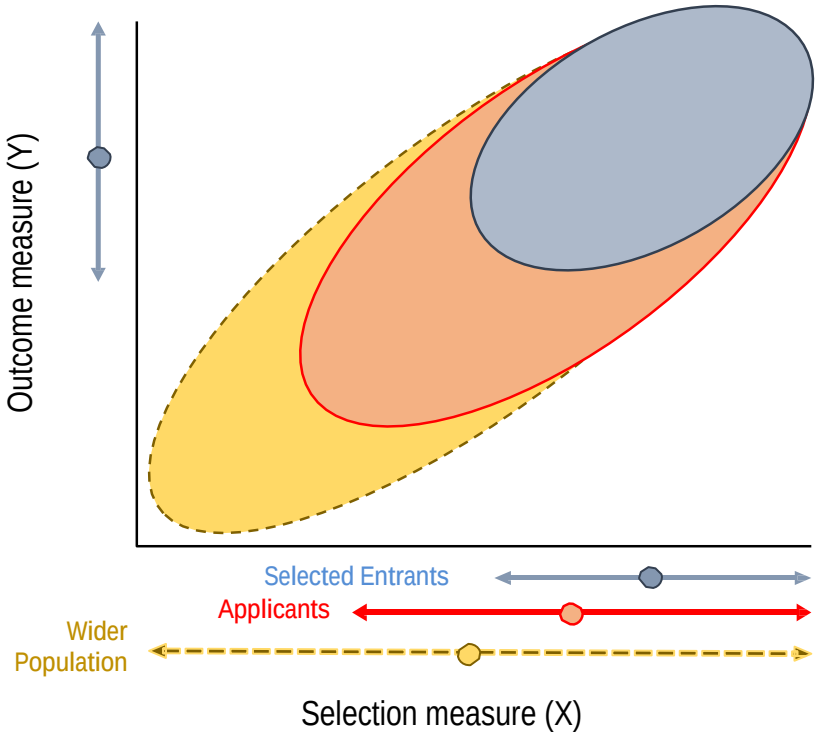
Admission validity studies assess the accuracy, relevance and fairness of admission measures and are generally used by institutions to review, validate or refine criteria for admission purposes (NACAC, 2016). Edmunds (2010) summarised the importance of predictive validity and concluded that the ability to predict student persistence at the point of admission was critical to improve an institution's ability to admit students likely to succeed. Well-founded research based on predicting success must form the basis for improving admissions policies and procedures (Bakker et al., 2012).

Predictive validity studies in higher education are not without limitations and problems. Studies found that research on predicting academic success was surrounded by issues such as restriction of range (sample), criterion unreliability (measurement) and test bias that affected the relationship between variables (Coates, Edwards, & Friedman, 2010; Moore et al., 2013; Wiberg & Sundström, 2009). Furthermore, one limitation of predictive studies was that causality could not be inferred from the findings, only the strength and direction of the relationships between variables.

Wiberg and Sundström (2009) explained restriction of range as a common problem in predictive validity research where the purpose of the study was to examine the correlation between variables, but subjects were selected on the one variable whereas information on the other variable was only available for the selected subjects. In other words, the sample was restricted. Iddrisu (2009) elaborated on the restriction of range stating that "students select universities and universities select students which means the range of scores used in the prediction model are much narrower than the larger pool of applicants".

The result of restriction of range was weaker validity coefficients and an underestimation of the true relationship between the predictor and criterion variables (Kyei-Blankson, 2005). Visser and Hanslo (2006) asserted that restriction of range as a truncated sample tended to have a different correlation coefficient as to when a sample was randomly selected.

See Figure 2 below for a depiction of restriction of range. On the X axis, from the wider population (yellow) only applicants participated in the selection process, the applicant mean score is indicated with a circle, of these applicants some students were selected and indicated with the blue line. The entrants have a higher mean score on the selection measure. Results on the outcome measure is only available for the selected entrants indicated on the Y axis, consequently the relationship between the selection and outcome measure can only be investigated for the selected entrants.



Source: Adapted from McManus et al. (2013, p.3).

Figure 2: Restriction of Range

In addition to restriction of range, criterion unreliability also weakens correlations in predictive validity studies. Problems associated with defining academic success are realised through the criterion measure of success and result in criterion unreliability. Not only is success measured differently, the measure of success may not take into account dropouts due to non-academic reasons, for example when graduation is measured as the criterion of success (Moore et al., 2013). Subjective assessments and evaluations used as measures of academic success also add to criterion unreliability (Emery, 2007).

Researchers have proposed a number of procedures to adjust for restriction of range and criterion unreliability. The literature consistently indicated that, after adjusting for restriction of range and criterion unreliability, validity coefficients increased (Kuncel, Hezlett, & Ones, 2001; Kyei-Blankson, 2005; Sackett, Lievens, Berry, & Landers, 2007; Schwager, Hülsheger, Bridgeman, & Lang, 2015; Shen et al., 2012; Wiberg & Sundström, 2009). However, when correlations were not adjusted for

restriction of range or criterion unreliability, generally low correlation coefficients (r = 0.3) were considered beneficial for predictive validity studies (Emery, 2007).

To counter some of the challenges associated with studies that predicted academic success, some researchers made use of survival analysis as opposed to correlational studies (see for example Ameri, 2015; Ameri, Fard, Chinnam, & Reddy, 2016; Deike, 2003; Finch, Lapsley, & Baker-Boudissa, 2009; Kartal, 2015; Murtaugh, Burns, & Schuster, 1999; Nicholls, 2013; Nicholls, Wolfe, Besterfield-Sacre, & Shuman, 2009; Radcliffe, Huesman, & Kellogg, 2006; Vallejos & Steel, 2016; Viitanen, 2016; Visser & Hanslo, 2005). Survival analysis as a statistical technique was initially developed for biostatistics and research on human lifetimes and event occurrences such as deaths and the timing of events (Deike, 2003). Time is a critical variable in survival analysis. Eshighi et al. (2011), explained that including time-dependent variables in the analysis, it was possible to determine whether an event occurred as well as when the event occurred. Using survival analysis in the educational research domain, the focus moved to student retention and graduations as key events (Visser & Hanslo, 2006). Thus, the technique was useful in estimating the risk of dropout out at any particular time during the student's studies.

Another shortcoming generally associated with assessments is test bias. Although the definition of bias refers to fairness and/or unfairness, these concepts are not interchangeable (Bryant, 2004; Oche, 2012). Jensen, (1984) explained that bias referred to an objective statistical property of a measure or instrument in relation to two or more subgroups, whereas fairness related to the philosophical value judgement concerning procedures and purposes of tests (Jensen, 1984). Fairness was also associated with transparency, equality and access as broader educational themes. According to Meiring (2007, p.7), "fairness is the total of all the variables that play a role or influence the final decision based on an assessment procedure". Thus, analysing bias in testing was evaluating only one aspect of fairness (Bakker et al., 2012).

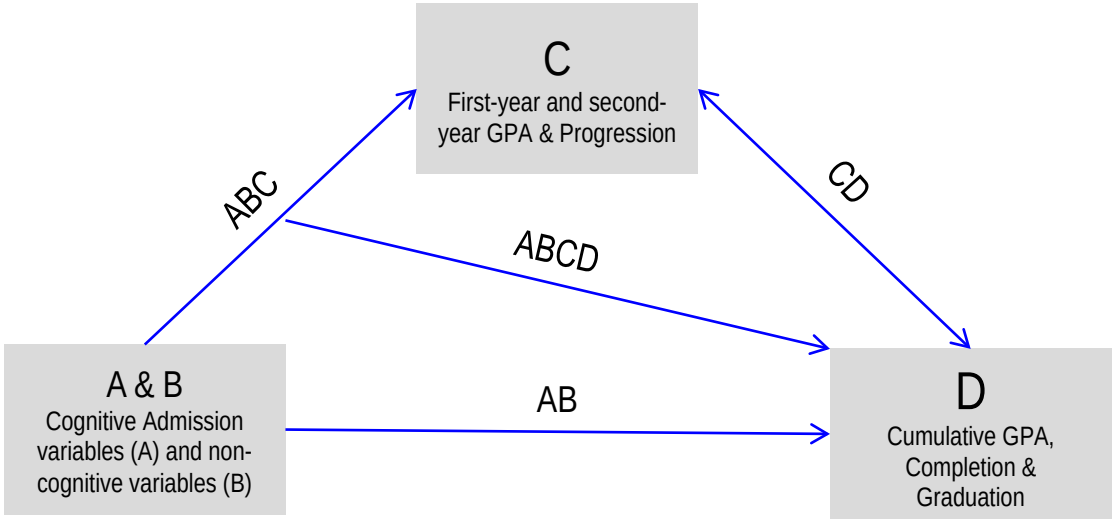
Kyei-Blankson (2005) considered test bias as consisting of two aspects, differential validity and differential prediction. Differential validity examined whether a test was equally predictive across different subgroups, whereas differential prediction involved determining whether a similar prediction equation could be used to equally predict subsequent performance for all subgroups. Race, gender, and socio-economic status were the three most commonly researched student subgroups for differential prediction and differential validity of admission measures (Edmunds, 2010).

The following section presents research on predicting academic success, followed by South African research relevant to this study.

2.7 RESEARCH PREDICTING ACADEMIC SUCCESS

Research available on various factors, variables and characteristics related to measuring, defining and predicting academic success is on the increase. However, the purpose of this literature review was not to provide a synthesis on all the research available on academic success and the prediction thereof. This literature review rather aimed to provide an overview of the relevant research on these factors, in support of the main purpose of this study, which is to develop a model for predicting academic success.

Figure 3 below depicts common variables and measures related to academic success and the possible and potential relationships identified in the literature on predicting academic success in higher education.



Source: Author's own illustration

Figure 3: Variables and Measures of Academic Success

- Cognitive Admission variables (A):

  Cognitive or academic pre-admission variables refer to prior academic achievement that is usually measured as high school grade point averages (HSGPA), school exiting examinations, standardised tests, or placement tests as measures of acquired knowledge and academic readiness for higher education (Essack et al., 2012; Saltonstall, 2013).

- Non-cognitive variables (B):

  Non-cognitive variables that affect measures of academic success include inter alia biographical variables such as race, gender and language, as well as socio-demographic variables, including first-generation students, parents' educational level and family income (see for example Ali, Haider, Munir, Khan, & Ahmed, 2013; Burrus et al., 2013; McDaniel, 2016; Spruill, 2011; Therriault & Krivoshey, 2014; Zekarias, Aba-Milki, & Mikre, 2015). Furthermore, research also emphasised psychosocial variables that impacted on academic success, such as achievement motivation, educational commitment, academic self-efficacy and affective reaction (Olani, 2009; Saltonstall, 2013). The Student Readiness Inventory (SRI) for example, assesses three major psychosocial factors predictive of college performance and retention, namely motivation and skills, social engagement and self-management (Komarraju et al., 2013). There is growing interest in the impact of non-cognitive variables on student success.

  For example, 'Grit' defined as passion and perseverance for long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007) and perceived as the ability of students to persevere when faced with challenges and adversity (Chang, 2014; Hochanadel & Finamore, 2015; Robertson et al., 2012; Strayhorn, 2014). Other examples of non-cognitive tests used in higher education included the SuccessNavigator (by the Education Testing Service), Engage (by ACT), the Learning and Study Strategies Inventory (by H&H publishing), and the College Student Inventory (by Noel Levitz) (listed in Barnett and Reddy 2017).

- First-year academic performance and academic progression variables (C):

  First-year GPA (FYGPA) and second-year GPA (SYGPA) are sometimes used in studies as both predictor and outcome variables. Some studies focused on student persistence and retention as measures of success in identifying contributors of student attrition and dropout (Case et al., 2013; Essack, 2012; Pocock, 2012; Rooney & Van Walbeek, 2015; Zewotir et al., 2011). A recent study by Sandberg (2015) proposed combining both performance and persistence in defining academic success by measuring 'in-studies' GPA as well as retention.

- Cumulative academic performance and degree completion variables (D):
  Academic success as an outcome variable is often measured as cumulative grade point average (CGPA), or as overall degree completion (Adebayo & Dorcas, 2014; Al-Hattami, 2012; Al Alwan et al., 2013; Du Plessis & Gerber, 2012; Geiser & Santelices, 2007; McDonald et al., 2001; Müller, 2013; Spruill, 2011; Stemler, 2012).

The focus of many studies on academic success was more on predicting first-year grade point averages (FYGPA) (refer to ABC in Figure 3), as opposed to measuring success as degree completion, cumulative grade point average (CGPA) or overall degree attainment (ABD in Figure 3 above) (Atkinson & Geiser, 2009). Great emphasis was placed on FYGPA (as an outcome variable) and the importance of the first-year experience in student retention and persistence research (Alkhasawneh, 2011; Garza & Bowden, 2014). These studies found that students are most vulnerable for dropout during their first year at a higher education institution. Kruzicevic et al., (2012) report that 50% of attrition occurs during a student's first year (see also research by Ameri, 2015). The FYGPA also proved to be predictive of further academic success in terms of CGPA and overall degree completion (Curtis, Lind, Plesh, & Finzen, 2007; Iddrisu, 2009; Mudric, 2012; Nadasen & List, 2016) (refer to CD in Figure 3). According to Zwick (2007), few studies focused on correlations between admission data and performance beyond the first year, because many other factors affect success during a student's studies. Longitudinal research by Al Alwan et al. (2013) found that the correlational strength of HSGPA declined after the third year of studies (see also Wikström & Wikström, 2012). Santelices and Wilson (2012) contended that lower correlations between pre-admission characteristics and persistence can be ascribed to the influences of non-academic factors on retention such as finances, motivation, social adjustment, family and health problems, and an institution's selectivity and size.

However, some studies found cognitive pre-admission variables such as HSGPA to be the strongest predictor of success not only for first-year success but also for graduation (refer to ABCD in Figure 3), see for example research conducted by Adebayo and Dorcas, 2014; Al Alwan et al., 2013; Briggs, 2012; Tesema, 2013; Wasielewski, 2014; Zwick and Sklar, 2005 in support of this statement. A study conducted by Geiser and Santelices (2007) reported three key findings on predicting success (refer to ABCD in Figure 3). Firstly, the HSGPA was consistently the strongest predictor of four-year college outcomes. Secondly, the predictive weight of the HSGPA increased after the first year, accounting for a greater proportion of variance in cumulative fourth-year GPA (This finding is contrary

to the findings of Al Alwan et al. (2013)). Lastly, the HSGPA had a less adverse impact than standardised tests on disadvantaged and underrepresented minority students.

Many studies examined the validity of the HSGPA in combination with standardised tests in predicting academic performance. Research by Zwick and Sklar (2005) investigated the predictive validity of HSGPA and standardised SAT tests on both FYGPA and graduation (refer to ABCD in Figure 3). The study found the HSGPA to be a stronger predictor than the SAT score but concluded that both HSGPA and SAT were associated with a higher probability of graduation. The HSGPA had a statistically significant influence on the White / English group, whereas the SAT had a significant effect on the Hispanic / English and White / English groups. Despite the group differences, the overall recommendation was that both the HSGPA and SAT be used for admission purposes. A similar study in the United Kingdom investigating school results (A-Levels and GCSE) and the SAT in predicting higher education outcomes, found that the SAT did not add any value to school results and did not identify students with potential (Kirkup, Wheater, Morrison, Durbin, & Pomati, 2010). This finding is problematic since the main purpose of the SAT is to measure a student's potential for academic success. Conversely, and in support of the purpose of the SAT, Bakker et al. (2012), found that the SAT provided additional information to add value to admissions processes, concluding that the combination of SAT and HSGPA proved to be the best predictor of FYGPA.

A similar study by Briggs (2012) focusing on pre-admission variables, (both cognitive and non-cognitive variables) (refer to ABD in Figure 3), in predicting graduation found that HSGPA significantly predicted retention and graduation, whereas the standardised ACT test was found to be not significantly predictive. The findings indicated that the two most important variables in predicting graduation were HSGPA and socio-economic status (SES), specifically the financial aspects.

There is a growing body of research on academic success and the influence of non-cognitive variables in predicting academic success (refer to ABD in Figure 3). These studies typically investigate the effects of non-cognitive variables in relation to cognitive pre-admission variables on academic success (see for example Ali & Ali, 2010; Komarraju et al., 2013; Sackett et al., 2012; Sackett, Kuncel, Arneson, Cooper, & Waters, 2009; Smith, 2014; Wasielewski, 2014). Some studies found no correlations between non-cognitive variables and academic success (Galleher et al., 2012; Keller, 2011; Powell, 2003). Other studies indicated that non-cognitive factors complement or add to

cognitive predictors of academic success as opposed to replacing cognitive predictors (Ali & Ali, 2010; Komarraju et al., 2013; Murray, 2006; Wasielewski, 2014).

Focusing on personality as a non-cognitive variable, research by Kaufman, Agars, and Lopez-Wagner (2008) pointed out the importance of high levels of conscientiousness for academic success (see also Durso-Finley, 2016). Supporting this finding, Kappe and Van der Flier (2012) found conscientiousness as the strongest predictor of success and concluded that academic success, measured as degree completion, can be explained by combining intelligence, personality, and motivational predictors (refer to ABD in Figure 3). Komarraju et al., (2013) stated "although cognitive ability might inform us about what an individual student is capable of achieving, personality and motivational factors help explain what the student might actually achieve". Research on non-cognitive variables and academic success was strengthened with the development of the Grit Scale that measures "perseverance and passion for long term goals" (Duckworth, Peterson, Matthews, & Kelly, 2007, p.1087) and was found to be positively correlated with undergraduate GPA. Cooper (2014) also found a strengthened predictive validity when the SAT was incorporated with Grit and academic self-efficacy as non-cognitive variables related to academic success.

Some studies measured the effectiveness and impact of institutional characteristics, programmes and interventions on student success or persistence (refer to CD in Figure 3). For example, Garza and Bowden (2014) found that students participating in a development course during their first year of study were more likely to persist and had higher grade point averages during their studies (see also Hosch, 2008; Kovacic, 2012; Letkiewicz et al., 2014; Pusztai, 2014).

The literature examined in the section above is evidence of the ever-growing body of research available on the factors, variables and characteristics related to measuring, defining and predicting academic success globally. However, there is a significant lack of research in South Africa on these variables and characteristics. The following section presents relevant South African research conducted on factors that predict academic success.

2.8 SOUTH AFRICAN RESEARCH

South African higher education is characterised as a system with low participation, high attrition and low completion rates (Badsha & Cloete, 2011; DHET, 2016; USAf, 2015). Despite the focus and pressure on HE institutions in South Africa to increase access, participation and throughput, relevant local research related to academic success remains sparse. Mentz (2012, p.28) reported:

> "This relative lack of published research on a critical area highlights the need for research conducted on the topic of student success in South Africa, particularly in the context of the national imperative to increase enrolments, the high dropout rates and the low success rates (particularly for diverse groups). It must also be noted that studies related to the factors that lead to student success in SA are not as extensive in nature or quantity as in the US and very few national or multi-institutional studies exist. This lack of comprehensive, systemic research in the South African context further highlights the necessity of studies [such as the current research project] to understand student success more comprehensively from a South African perspective."

The reasons for the poor throughput and academic performance in higher education are multifaceted and complex, but the DHET (2016, p.17) listed some of the main reasons as the poor schooling system, staff to student ratios, lack of student support, and the lack of early identification of students at risk of dropout. Unsurprisingly, in line with some of the above reasons associated with poor throughput, two main themes emerged from the limited South African research available on student success. Firstly, some studies focused on access to higher education that included the validity of admission measures such as schooling, standardised tests and admissions criteria (see Müller, 2013; Oosthuizen & Eiselen, 2012; Potgieter & Davidowitz, 2010; Schoer, Ntuli, Rankin, & Sebastiao, 2010; Wilson-Strydom, 2012). Secondly, other studies focused specifically on identifying underlying reasons or factors related to student dropout, retention and persistence (see Lemmens, 2010; Van Zyl, 2010).

A study by Nel et al. (2013) on enrolment trends at a South African university, also mentioned earlier in this chapter, concluded that there was a significant correlation between socio-economic circumstances and actual registration at university. This study took the students' personal and biographical attributes into account in determining the likelihood of the students registering at the institution. They found that, where parents were able to pay study fees without having to obtain student loans, and where parents also had academic qualifications, the likelihood of such students

enrolling at the specific institution was greater. (Nel et al, 2013, p.92). Although this study did not focus on academic success, the results of the study identified critical variables related to student participation, retention and dropout.

The NSC is a relatively new qualification, and the first successful student cohort entered the higher education system in 2009. Research on predicting future academic success is thus not yet available or published, especially research in longitudinal studies. However, some of the first studies on the NSC reported concerns with the level of quality, validity and grade inflation (Govender & Moodley, 2012; Nel & Kistner, 2009). According to Simkins (2011, p.11),"The 2008 NSC results were a mixed bag, reflecting real progress, grade inflation, and some worrying chaos in the middle of the schooling system". Hunt et al. (2011) reported NSC marks that were inflated by up to 25%, where Dennis and Murray (2012) found NSC Mathematics marks inflated by 20%.

Furthermore, a recent review on the NSC examination marking process in the Northern Cape found that the perceived quality of the process is not acceptable, and clouded with controversy (Van Wyk, 2016). These problems cast serious doubt and uncertainty on the standards and validity of the NSC results (Fisher, 2011). Subsequently, there is a critical need for more validity studies on the NSC and academic success in higher education.

The current research available on the NSC and the predictive value thereof, focused mostly on first-year academic success (refer to ABC in Figure 3, p.35) (see Müller, 2013; Oosthuizen & Eiselen, 2012; Potgieter & Davidowitz, 2010; Schoer et al., 2010; Visser & Van Zyl, 2013; Wilson-Strydom, 2012). Although the results from these studies varied, most studies recommended further investigation on the predictive value over a longer period of time in order to establish the validity of the NSC longitudinally (Govender & Moodley, 2012; Wilson-Strydom, 2012).

Marnewick (2012) examined the correlation between NSC performance and first-year academic performance to determine the validity of selection criteria used for university admissions. The results indicated no correlation between NSC and first-year performance. Other research on the predictive validity of the NSC results and first-year academic success in Optometry found weak correlations and concluded that the NSC cannot be used as the sole predictor of academic success in the first year of the Optometry programme (Mashige et al., 2014). Supporting this finding, another study conducted by Van der Westhuizen and Barlow-Jones investigated the relationship of the NSC

(specifically the subject Mathematics) and two programming courses at a university, and found only marginal correlations that were not statistically significant and concluded that the NSC Mathematics result was not a valid admission measure for programming courses in South Africa (Van der Westhuizen & Barlow-Jones, 2015).

In contrast to the above findings, Visser and Van Zyl (2013) reported overall strong correlations between the NSC and first-year performance. Tewari (2014) found the NSC Mathematics results predictive of academic performance in first-year courses, reporting a unit increase in the NSC Mathematics added between 12-14% pass rate in first-year courses in Management studies. Kridiotis, Bezuidenhout and Raubenheimer (2016) investigated whether the selection criteria (as NSC scores) were predictive of academic success in the first year of studying Radiography. The results indicated that the NSC core subjects (Mathematics, Physical Sciences, Life Sciences and English) were adequate predictors for first-year academic success. These reported inconsistencies in the predictive validity of the NSC created a need for institutions to make use of alternative admission measures and tests such as the NBTs (Rooney & Van Walbeek, 2015). The purpose of the National Benchmark Tests (NBTs) was to assess the academic readiness of first-time entry students to South African universities (Le Roux & Sebolai, 2017). Although most universities still use the NSC as the main admissions criteria, the NBTs provide additional information on student preparedness for higher education (CHE, 2016).

The longitudinal relationship between the NSC and the NBTs as admission variables has not been researched before. Based on her analysis of the NSC and NBTs, Jacobs (2010) presented a framework for the placement of students after admission in order to increase first-year success and concluded that future research should build on her framework, as the results were limited to first-year success only. Du Plessis and Gerber (2012) evaluated both the NSC and the NBTs in order to determine the best indicator of academic preparedness measured as first-year performance. They found that, while the NBTs proved useful in classification according to the benchmarks, the results indicated that the NSC was the best measure of academic preparedness.

Wilson-Strydom (2012) conducted another study that investigated under-preparedness of students by evaluating NBTs as a predictor of first-year performance. Although weak correlations were found, she recommended that the NBTs scores be further investigated and proposed combining the results into a composite score. Le Roux and Sebolai (2017) studied the linearity of the relationship between

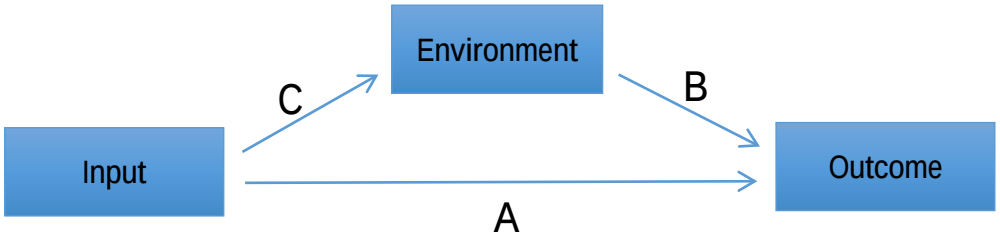
the NSC and NBTs and found that they were related but not identical. They recommended that both be used as complementary in the admission and placement processes.

It is clear that available scientific research on the validity of the NSC and NBTs in admissions processes is lacking. This literature review concludes with the observation by Rooney and Walbeek (2015):“It would be useful to know whether the increasing importance given to NBT results are justified in terms of a superior ability to predict whether a student will graduate or not, relative to Grade 12 marks.” Higher education institutions in South Africa urgently need a framework to guide admission decisions that will result in admitting students who are more likely to succeed.

2.9 CONCEPTUAL FRAMEWORK: TOWARDS PREDICTING ACADEMIC SUCCESS

This section presents the conceptual framework for this study. A conceptual framework stems from theoretical principles and is focused on attending to the identified research problem (Kumar, 2011). The selected conceptual framework, namely Astin's I-E-O model, is relevant to this study because the ultimate goal of this research was to develop a model that can be predictive of academic success.

The conceptual framework for this study departed from Astin's (1991) I-E-O model. Based on his research in higher education and incorporating elements of the General Systems Theory (Von Bertalanffy, 1968), Astin (1991) developed the Input-Environment-Outcome (I-E-O) model. The purpose of this model was to demonstrate the relationship between the different elements and the impact thereof on student outcomes. In his model, input (I) referred to all personal characteristics of students when entering the system; the environment (E) addressed the educational, curricular and teaching experiences the student was exposed to during and whilst in the system, and outcome (O) referred to the characteristics, or results, after the student experienced the environment. The I-E-O model denotes that input has a direct relationship with outcome (A), the environment has a direct relationship with output (B), and input has an indirect relationship with outcome through the environment (C). These relationships are depicted in Figure 4 below.



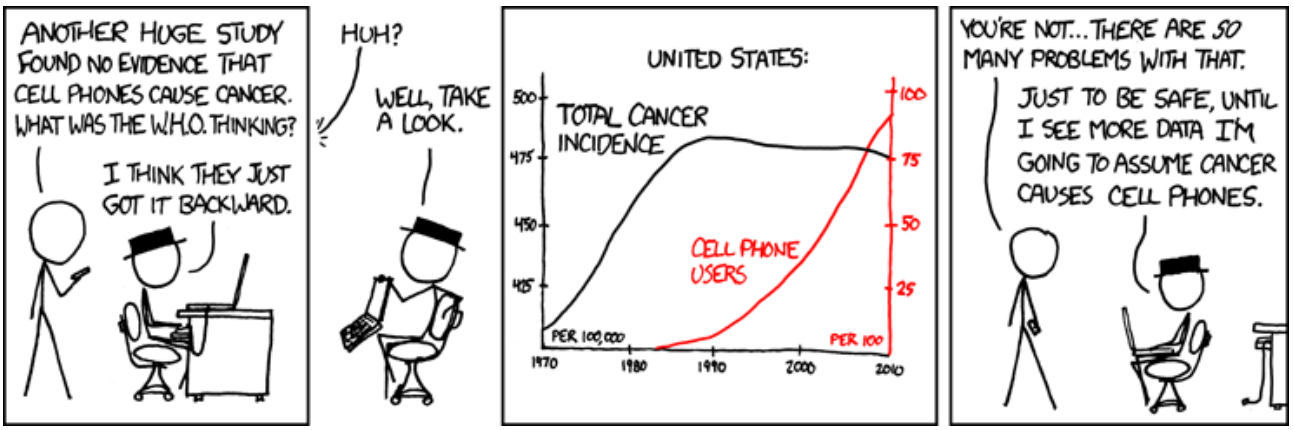
Source: Adapted from Astin (1991)

Figure 4: Astin's I-E-O Model

Astin's model (1991) provides a framework for investigating relationships between variables and has also been used for numerous studies related to student success and outcomes (see for example Bergeron, 2013; Campbell, 2012; Edmunds, 2010; Harner, 2014; Irlbeck, Adams, Akers, Burris, & Jones, 2014; Korobova, 2012; Miller, 2013; Moore, 2013; Murray, 2006; Murray, 2014; Niehaus, 2012; Yanto, Mula, & Kavanagh, 2011; York, Gibson, & Rankin, 2015).

Inputs can be used to predict outcomes, however, the effect of the environment on outcomes can also impact on the predicted results (Poggendorf, 2013). Therefore, different input variables can have different relationships with the environment variables and could produce different outcomes (Miller, 2013). Astin's (1991) model is useful and popular in educational research because it promotes the study of several variables simultaneously and lends towards multivariate analysis of complex relationships (Blair, 2014) and because the model takes into account the environmental variables that impact on the relationship between input and output (Wasielewski, 2014).

Osano (2013) however, warned that the difficulty in applying the I-E-O model lies in establishing and defining the variables and measurements before any of the relationships can be investigated and measured. Furthermore, measuring relationships between variables does not inherently imply causality (Alex, 2014). To determine whether there is an actual cause-and-effect relationship between the variables requires specific statistical analysis and investigation. Prematurely supposing causality, is a logical fallacy referred to as '*post hoc ergo propter hoc*' meaning 'after this, therefore, because of this' that wrongly assumes that, because two variables are related, one causes the other (Adeleye & Acquah-Dadzie, 1999). See Figure 5 below for an example of a logical fallacy.

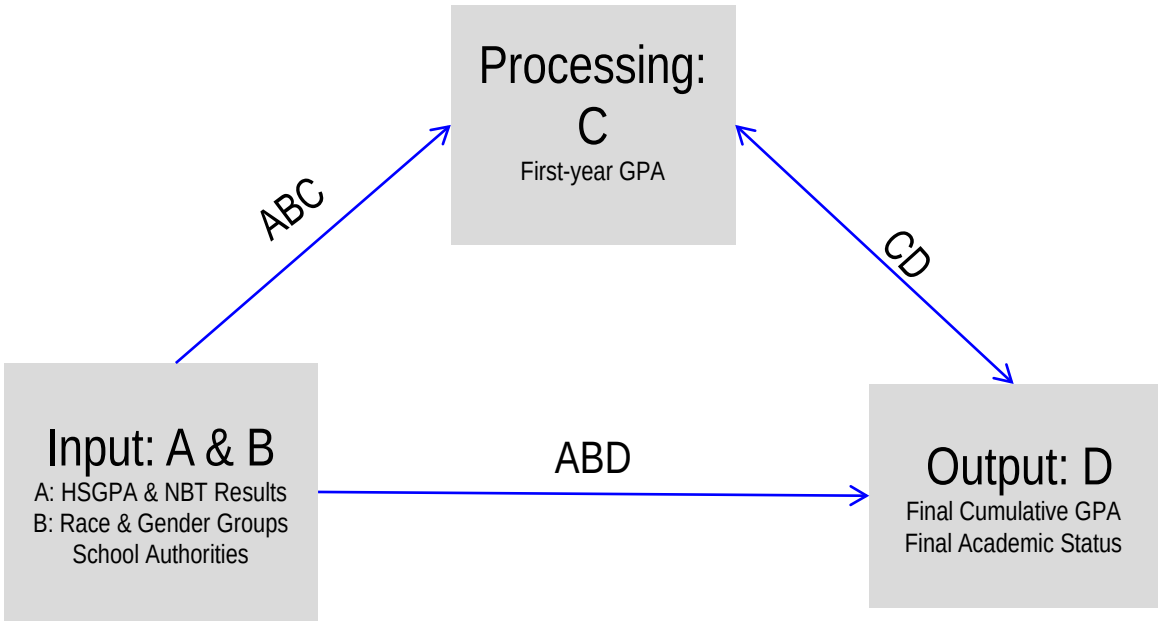


Source: XKCD (2014)

Figure 5: Logical Fallacy

This study responded to the critical need for more relevant South African research related to the predictability of the NSC and NBTs on student success. Thus, using Astin's (1991) Input-Environment-Outcome (I-E-O) model, the relationships between Input, Processing and Output were investigated in this study.

The purpose of this study was to provide a model that is predictive of academic success, based on the input variables (AB) assessed during the admissions process and the relationships of these variables with progress (C) and academic success (D) measured over a period of six years. Figure 6 below illustrates the three relationships between the different variables that were investigated in this study. ABC illustrates the direct relationship between Input and Processing, the relationship between Processing and Output is depicted by CD and the relationship between Input and Output is represented by ABD.



Source: Author's own illustration

Figure 6: Conceptual framework

In order to develop the model, the study investigated if school exiting results (HSGPA) and the National Benchmark Tests (NBTs) were significant predictors of academic success after the first year (FYGPA) and final academic grade point average (FinCumGPA), measured over a period of six years. Race, gender, and school examination authority were taken into consideration in this investigation. The relationship between FYGPA and FinCumGPA was also assessed in order to develop an integrated model predictive of academic success, and to ultimately achieve the goal of this study.

The following chapter presents the research methodology used in this study.

CHAPTER 3

RESEARCH METHODOLOGY

The research methodology presents a framework to conduct research within the context of a specific research design (Wahyuni, 2012). The research design refers to a strategic framework that specifies a series of activities to ensure that valid conclusions can be drawn from the research. This chapter provides a detailed description of the research methodology that was used in this quantitative empirical study and includes the research paradigm (positivism), research design (predictive correlational design), sample and data collection procedures, as well as variables and data analysis techniques for the study. The chapter concludes with the ethical considerations relevant to this study.

The purpose of this study was to provide a model that is predictive of academic success, based on the input variables assessed during the admissions process and the relationships of these variables with progress and academic success measured over a period of six years. In order to develop an admissions model, the study investigated if school exiting results (HSGPA) and the National Benchmark Tests (NBTs) were significant predictors of academic success after the first year (FYGPA) and final academic grade point average (FinCumGPA) measured over a period of six years, also taking into account race and gender as well as school examination authorities. The relationship between FYGPA and FinCumGPA was also investigated in order to develop an integrated model predictive of academic success.

3.1 RESEARCH PARADIGM

A research paradigm refers to the accepted tradition or framework that guides all aspects of the research; its laws, beliefs, procedures, methods, the analysis and the interpretation of the data collected (Babbie & Mouton, 2011). Research paradigms are based on philosophical groundings or belief systems of researchers that is generally categorised as epistemology, ontology, axiology and methodology.

From a philosophical perspective, a research paradigm is comprised firstly of a view of the nature of reality, what it is and the assumptions of reality (i.e. ontology). Secondly, how the researcher knows about the reality and assumptions about how knowledge can be acquired and accepted (i.e. epistemology) and lastly, the research paradigm reveals assumptions about the value system (i.e. axiology). Pathirage, Amaratunga and Haigh (2008) explain that together, "the epistemological undertakings, ontological assumptions and axiological purposes about the nature of the world complement the formulation of research philosophy, thereby influencing the selection of appropriate research approach and methods."

In social science research, four broad approaches are generally identified based on the ontological and epistemological issues. However, Porta and Keating (2008) clarified that these broad approaches were not hard categories, but in fact presented positions on a spectrum from most positivistic to most humanistic. Table 2 below provides a summary of the approaches.

Table 2: Common Research Approaches in Social Sciences

	Positivist	Post-Positivist	Interpretivist	Humanistic
Does reality exist?	Objective; realism	Objective; critical realism	Objective and subjective as intrinsically linked	Subjective science of the spirit
Is reality knowable?	Yes, and easy to capture	Yes, but not easy to capture	Somewhat, but not as separate from human subjectivity	No; focus on human subjectivity
What is the relationship between scholar and object?	Dualism, scholar and object are separate; inductive procedures	Knowledge is influenced by scholar; deductive procedures	Aims at understanding subjective knowledge	No objective knowledge is possible
Forms of knowledge	Natural laws (causal)	Probabilistic law	Contextual knowledge	Empathetic knowledge
Which methodology?	Empiricists, aiming at knowing the reality	Mainly empiricists, recognising context	Relative focus on meanings, context	Focus on values, meaning and purpose
Which methods?	Imitating the natural method (experiments, mathematical models, statistical analysis)	Based upon approximations to the natural method (experiments, statistical analysis, quantitative interviews)	Seeking meaning (textual analysis, discourse analysis)	Empathetic interactions between researchers and object of research

Source: Adapted from Porta and Keating (2008)

This research study was conducted within the paradigm of positivism, employing a predictive research approach. The research intent of this study was to predict. Wellard and Ordin (2011) asserted that research with a predictive approach focused on careful and controlled measurement as the basis of knowledge, and with the researcher detached and independent of the situation, the knowledge obtained is considered objective. Table 3 presents the main assumptions underlying the current predictive research approach.

Table 3: Research Paradigm for Current Research Study

PARADIGM	Positivism
ASSUMPTIONS OF REALITY	Objectivism, reality is one. By studying different parts and relationships the whole can be understood
ASSUMPTIONS OF KNOWLEDGE	The knower is outside of what is to be known
GOAL OF PARADIGM	Uncover truth and facts as quantitatively specified relations among variables
KEY FOCUS or IDEAS	Relationship between variables; Descriptive and Causal questions
FORM OF THEORY	Verified hypotheses involving valid, reliable and precisely measured variables
CRITERIA FOR ASSESSING RESEARCH	Prediction; Rigor; Internal and External validity; Reliability
RESEARCH METHODOLOGY	Quantitative empirical research
RESEARCH DESIGN	Predictive correlational design
DATA ANALYSIS	Descriptive and inferential statistics
UNIT OF ANALYSIS	Students
TYPE(S) OF ANALYSIS	Quantitative: frequencies, descriptive statistics, product-moment correlations, multiple regression analysis.

In line with the positivist research paradigm that follows deductive reasoning to test theoretical proposals, a quantitative method was considered to be appropriate for this study. Departing from the theoretical principles of systems theory and building on Astin's (1991) I-E-O model, the overarching goal of this study was to develop a model predictive of academic success that can be used in the admissions processes (input) to improve university system (E) output (O) and effectiveness. For the purpose of this study, Astin's I-E-O model provided a logical framework to assess relationships as the model promotes the study of several variables simultaneously through multivariate analysis of complex relationships. A quantitative method was further considered appropriate because of the

statistical tests and analyses employed to measure and investigate the relationships between the independent and dependent variables.

The following section describes the research design and includes the methods of data collection, the sample, the variables relevant to this study, as well as the statistical analysis of the data.

3.2 RESEARCH DESIGN

This study followed a non-experimental correlational ex post facto research design to examine archived student data collected from 2011 to 2016. In order to address the research questions and investigate the relationships between the variables, correlational analyses and various regression analyses formed part of the statistical methodology followed in this study.

In ex post facto designs, the researcher retrospectively investigates relationships between variables. Researchers have no control over the variables and data cannot be altered during the research process, as the event has already occurred (Cohen, Manion, & Morrison, 2007). In correlational studies, the researcher focuses on determining how measures on one variable are related to measures on another variable through statistical analyses of the data. In order to determine the extent of the relationship between variables, the correlational analysis is used as a statistical procedure. Correlational research designs are often considered to be inferior to experimental designs as it does not permit inferences about causality. However, correlational research designs can provide valuable information about relationships between variables and associations (Thompson, Diamond, McWilliam, Snyder, & Snyder, 2005).

Furthermore, this study investigated the academic performance of students over a period of six years. Longitudinal cohort studies are based on following the same sample over a period of time with repeated observations. Because longitudinal cohort analysis allows researchers to track students as a group or cohort over a specified period of time, it is often used in educational psychology and research (Euser, Zoccali, Jager, & Dekker, 2009). De Villiers and Van Wyk (2013) elaborated on this by explaining that, through longitudinal cohort studies, researchers can determine exactly how many students of a specific cohort dropped out, completed their qualifications or are still in the system.

In addition to this data, researchers are able to profile successful students, or students who are more likely to drop out, with the individual student data available. By aiming to develop a model to predict academic success, the longitudinal cohort analysis will aid in achieving the goal of this study.

Some of the disadvantages of cohort studies include confounding variables and selection bias. Because the researcher has no control over the variables, relationships may be affected by confounding variables not accounted for in a particular study. Due to a lack of randomisation in cohort studies, selection bias is also possible and may affect the external validity of the overall research design. Another disadvantage is that causal effects cannot be established through cohort studies. Other threats to the validity of this study relate to the ex post facto correlational research design and include measurement errors in variables and omitted variables that should be noted.

3.3 POPULATION AND SAMPLE

The data used in this study was obtained exclusively from the selected institution's database and was extracted from the Student System (PeopleSoft Campus Solution) for the purpose of secondary data analysis. The extracted data were collated into a single dataset including biographical information, school data, admission data as well as academic performance data collected from 2011 to 2016.

Through purposive non-probability sampling, the participants for this study were selected from the population of registered first-year students in 2011, at a South African public university. The sample consisted of 3418 new first-year students who registered in 2011. The sample was drawn from an academic cohort who completed their secondary school education (obtained the NSC) in 2010 and who also wrote the NBTs prior to registration at the University and already had results in the student system.

In terms of the race and gender distribution, the sample comprised 59.9% white students and 40.1% black students (including all non-white race groups i.e. Asian, coloured, black African and Indian students). Female students accounted for 59.7% of the sample. For the purpose of analysis, the sample was grouped into four categories, namely white, black, male and female.

The official white and black race classification used in this study is in line with the Black Economic Empowerment Act 53 of 2003 as amended by Act 46 of 2013.

3.4 VARIABLES

Variables refer to any characteristics, number, or quantity that can be measured or counted, or that is subject to variation (Colman, 2009). In this study, the conceptual framework departed from Astin's I-E-O model (refer to Figure 4 on p.43 in this study) and specified various Input, Processing and Output variables. Specifically, the Input variables included the cognitive admission variables namely high school grade point average (HSGPA) and NBT results, as well as non-cognitive variables such as gender, race, and education authority. The processing variable (C) was the first-year grade point average (FYGPA). The Output variables (D) included the final cumulative grade point average (FinCumGPA) and final academic status over the period of six years, and also the criterion variables.

3.4.1 Predictor Variables: HSGPA and NBT Results

HSGPA was calculated as an average percentage score of six final National Senior Certificate subjects. The NBT results were presented as percentage scores and benchmark levels (Basic, Intermediate, or Proficient) in the different tests. Academic Literacy (AL) and Quantitative Literacy (QL) were assessed in one test, which was compulsory for all students. However, only students admitted into programmes that required Mathematics as a school subject were required to write the Mathematical Literacy (MATS) test. Both HSGPA and NBT results are percentages on a scale of 1-100, therefore the results and mean scores represent percentage scores.

The purpose the NBTs was to provide additional information to the NSC results and standards in order to assist institutions with the placement of students into appropriate curricular programmes such as extended programmes, tutorial programmes or language support programmes (Scholtz, 2012). The benchmark levels inform learners and universities about the level of academic support that would be required for the successful completion of programmes as follows:

- Basic performance indicates serious learning challenges, and that the student would need extensive long-term support in terms of a bridging programme.

- Intermediate performance indicates that the student is likely to experience difficulty in regular degree programmes, unless specific support is provided such as extended programmes.
- Students performing proficient are likely to cope with mainstream study at university.

The benchmark levels in each domain were set by national panels led by psychometricians from the Educational Testing Service in Princeton, New Jersey (Prince, 2012). Prince (2010) reported the internal consistency of the NBTs using Cronbach's alpha with coefficients varying from 0.884 to 0.937.

3.4.2 Dependent Variables

For the purposes of this study, the two dependent variables were first-year grade point average (FYGPA) and final cumulative grade point average (FinCumGPA). The FYGPA was calculated according to the institutional regulation as a weighted average of all registered modules in relation to the credit value of modules taken in the student's first academic year. The FYGPA was therefore the GPA for all the students in the sample at the end of 2011.

The FinCumGPA was the final weighted average across all the years a student was registered at the institution between 2012 and 2016, as the last or final cumulative GPA on a student's record, irrespective of their academic status. The FinCumGPA was therefore not sequential, but nominal, as the last cumulative grade point average of all students in the sample, including students who had dropped out, were academically excluded or students who completed their degrees between 2012 and 2016. The reason for using the FinCumGPA was to ensure that most students were included in analysing the data and relationships between the variables. Only students that dropped out or were academically excluded after their first year that had the same FYGPA and FinCumGPA scores, since their FYGPA is also their last or final cumulative GPA on their student records, were excluded from FinCumGPA (n=392).

The Final Academic Status is the last academic status on a student's record and the corresponding cumulative grade point average was used to calculate the FinCumGPA. Dropouts refer to students who discontinued their studies and who did not return to the institution at all. Students who did not perform academically according to the various faculty rules, were excluded and not allowed to return

to the institution. Students who completed their degrees had a Completed status, and students who were still studying at the end of 2016, had an Active status.

Table 4 below provides an outline of all the variables considered in this study, how they were identified, and how they were measured.

Table 4: Research Variables, Description, and Measurements

Variable	Description and Measurement	Type of Data
1. HSGPA	• Final Grade 12 results, as released by the Department of Education for the NSC and uploaded onto the system • HSGPA – the calculated average of the final mark % in six registered subjects. Life Orientation as a subject is excluded from the HSGPA	Interval
2. NBTs	• All students have Academic (AL) and Quantitative Literacy (QL) Scores, but only students registered in programmes with a Mathematics subject requirement, have Mathematical Literacy (MATS) test scores • Test scores and benchmarks levels per test uploaded directly onto student records	Score: Interval Benchmarks: Nominal B = Basic I = Intermediate P = Proficient
3. Gender	• Applicants indicate male or female in the application process (self-reported)	Nominal: Male Female
4. Race & Gender Coding	• For statistical analysis, race and gender subgroups were coded as • Black Females (BF) • Black Males (BM) • White Females (WF) • White Males (WM)	Nominal: BF BM WF WM
5. School Examination Authority	• Final Grade 12 NSC examinations can only be written at one of the nine South African provincial examination authorities (public schools), or alternatively at a registered private authority (private schools). The examination authority field is obtained from the official data load received from the Department of Basic Education.	Nominal: Public Schools Private Schools
6. FYGPA	• FYGPA was calculated according to the institutional regulation, as a weighted average of all registered modules in relation to credit value of modules at the end of the first year – 2011.	Interval
7. FinCumGPA	• FinCumGPA is calculated according to the institutional regulation, as a weighted average of all registered modules in relation to credit value of modules as the final grade point average on a student's record between 2012 to 2016	Interval
8. Final Academic Status	• Last academic status on students' records as: • Completed • Active • Dropout • Excluded	Nominal

3.5 DATA ANALYSIS

This study followed a non-experimental correlational ex post facto research design to examine archived student data collected from 2011 to 2016. In order to answer the research questions and investigate the relationships between the variables, correlational analyses and various regression analyses were part of the statistical methodology followed in this study.

The data analysis for this study included both descriptive and inferential statistics. The descriptive statistics were computed for the predictor variables (HSGPA and NBT results) and for the criterion variables (FYGPA and FinCumGPA), and frequencies for demographic variables (race, gender and school examination authority) were also tabulated. All analyses were conducted using SPSS version 25, statistical software.

Correlational analyses and various regression analyses were part of the statistical methodology followed to answer the research questions. Pearson's correlation coefficients were computed among the variables. In this study the correlation coefficients were interpreted according to Cohen's (1988) guideline for research in social sciences, as weak ($r = 0.1$), moderate ($r = 0.3$), and strong ($r = 0.5$). To answer the research questions related to predictive variances stepwise regression analyses were used. The focus of stepwise regression analysis is on finding the best combination of variables to predict the dependent variable. Thus, the stepwise regression analyses evaluated all the predictors and only predictors that contributed significantly were included in the regression equations. Stepwise regression analysis is different from other regression analysis where the variables are entered in blocks in an order that is predetermined by past research and expectations. With stepwise multiple regression analysis all variables are entered into the prediction model and independent variables are removed if not statistically significant ($p > 0.05$) remaining with only significant independent variables. The order of entering the variables into the model was not important since the removal of variables was automatic in the stepwise regression processes.

Prior to performing the regression analyses, the data was evaluated against the assumptions of regression namely normality, linearity, homoscedasticity, and absence of multicollinearity. This was necessary because assumption violations can result in biased estimates and untrustworthy confidence intervals, as well as untrustworthy significant tests (Williams, Grajales, & Kurkiewicz, 2013). Normality was assessed through a P-P plot. If there were no drastic deviation visible on the

P-P plot the assumption of normality was accepted. The linearity of the relationship between the predictor variables was assessed through the examination of scatterplots. Residual plots were also examined for the linear relationship between the residual values and the predicted scores. The absence of multicollinearity was confirmed with VIF values below 10, as well as correlation coefficients below 0.8 in order for the data to meet the assumptions of regression analysis.

The research questions are set out below, followed by the methodology that was applied to each question in order to attend to the questions:

Research Question 1: Assessing the Relationship between Input and Processing

- What is the relationship between HSGPA, NBT results and FYGPA? What additional information or predictive variance do NBT results provide to HSGPA?
- How is the relationship between HSGPA, NBT results and FYGPA different for race and gender subgroups?
- How is the relationship between HSGPA, NBT results and FYGPA different for school examination authorities?
- How do the NBT benchmarks relate to dropout or exclusion after first-year?

The relationship between HSGPA, NBT results and FYGPA was investigated through correlational analysis and stepwise linear regression analysis. The predictive validity of HSGPA and NBT results was examined across four race and gender subgroups and for public and private schools respectively. Lastly the NBT benchmark levels were compared with first-year academic status to determine if the levels were indicative of dropout or exclusion after the first-year.

Research Question 2: Assessing the Relationship between Processing and Output

- What is the relationship between FYGPA and FinCumGPA?
- How is the relationship between FYGPA and FinCumGPA different for race and gender subgroups?
- How is the relationship between FYGPA and FinCumGPA different for different school examination authorities?

The relationship between FYGPA and FinCumGPA was examined through correlational analysis and a linear regression analysis. The predictive validity of FYGPA was examined across four race and

gender subgroups and then separately for public and private schools, to establish the predicted variance in FinCumGPA that can be explained by FYGPA.

Research Question 3: Assessing the Relationship between Input and Output

- What is the relationship between HSGPA, NBT results and FinCumGPA?
- How is the relationship between HSGPA, NBT results and FinCumGPA different for race and gender subgroups?
- How is the relationship between HSGPA, NBT results and FinCumGPA different for school examination authorities? How do the NBT benchmarks relate to Final Admission Status?

The relationship between HSGPA, NBT results and FinCumGPA was investigated through correlational analysis and stepwise linear regression analysis. The predictive validity of HSGPA and NBT results was examined across four race and gender subgroups and for public and private schools respectively. Finally, the NBT benchmark levels were compared with final academic status to determine if the levels were indicative of degree completion, or dropout and exclusion.

3.5.1 Assessing the Quality and Rigour of the Study

A serious risk and threat related to correlational research is the misinterpretation of results. The researcher must interpret the relationship in terms of statistical significance, the size of effect, practical significance and meaning in light of theoretical significance. Shuttleworth (2008) identified the following errors related to misinterpretation of research:

- Confirmation bias occurs where a researcher looks at the results from their research and tries to fit them around pre-existing expectations and hypotheses. It is similar to deliberate bias where the researcher chooses information to support a preconceived idea.
- Polarisation occurs when researchers select information supporting their own pre-existing beliefs, and drift further from the middle ground.
- Verification error involves manipulating results to fit preconceived ideas.
- Post hoc reasoning is the fallacy of believing that because one event follows another, the first must have been a cause of the second.

Rigour in data analysis requires the meticulous adherence to standard processes (Zelik Patterson & Woods, 2007). According to Thompson et al. (2005), to maintain quality in correlational research,

standard practices must be followed in terms of (a) measurement, (b) quantifying effects, (c) avoiding common analysis errors, and (d) using confidence intervals to portray the range of possible effects and the precisions of the effect estimates.

A non-experimental correlational ex post facto research design was used in this study to examine archived student data collected from 2011 to 2016. Being mindful of the risk of misinterpreting the results, and also being aware of other threats to the validity of this study, certain limitations were taken into consideration when interpreting the results. The restriction of range was one limitation, as the sample consisted of only students who registered or enrolled at the institution from a larger population of applicants. Furthermore, given that the sample was collected from only one institution, the results may not be generalisable to other higher education institutions, which constitutes another limitation.

3.6 ETHICAL CONSIDERATIONS

The researcher made use of data extracted from the University's database. The data was extracted for the purpose of secondary analysis, and consisted of information relevant to the study. The participants remained anonymous throughout the study, and are not identifiable by their results or any other information used in this study. Institutional consent and approval were vital to obtain access to the data and files. Prior to obtaining the data, ethical approval for the research was sought from, and granted by the Faculty's Ethics Committee. The researcher ensured confidentiality and anonymity of the selected participants and there was no interaction between the participants and the researcher throughout the entire research study.

This chapter provided a comprehensive explanation of the research methodology applied in this study. The research paradigm, design, sample and the variables were discussed in detail. The results are presented in Chapter 4.

CHAPTER 4

RESULTS

Chapter 4 presents the results of the data analysis. The descriptive statistics are presented first and is followed by the statistical analysis of the data in the order of the research questions. The implications of the findings are discussed in Chapter 5.

The overarching goal of this study was to develop a model predictive of academic success that can be used in the admissions processes to improve university system output and effectiveness. To do this, the study investigated the variables considered during the admissions process (input) and the relationships these variables had with progress (processing) and academic success (output) over a period of six years.

The study further investigated if school exiting results (HSGPA) and the NBT results were significant predictors of academic success after a student's first year (measured as FYGPA) and the final academic grade point average (FinCumGPA) measured over a period of six years, taking into account other variables such as the student's race and gender, as well as school examination authority. The relationship between FYGPA and FinCumGPA was also assessed to present an integrated model predictive of academic success at university.

The research design for this specific study was a retrospective correlational cohort study. In retrospective research the researcher retrospectively investigates the relationships between variables and has no control over the variables (Cohen, Manion, & Morrison, 2007). A cohort study follows a specific population (cohort) over a period of time and can be classified as a longitudinal study. Although correlational research designs are seen as inferior to experimental designs because it does not permit inferences about causality, it can contribute valuable information about relationships between variables and associations (Thompson et al., 2005).

4.1 DESCRIPTIVE STATISTICS OF THE SAMPLE

The sample consisted of 3418 new first-year students who registered at the institution in 2011. The cohort had completed Grade 12 in 2010, and wrote the NBTs and thus had results on the student system. In terms of gender distribution, the majority of the sample (59.7%) was female students. In total, the sample consisted of 59.9% white students and 40.1% black students that included Asian, coloured, black African and Indian students). Table 5 below indicates the race and gender distribution of the sample.

Table 5: Race and Gender Distribution of Sample

RACE		FEMALE	MALE	TOTAL
Black	Asian	128	95	223 (6.5%)
	African	676	410	1086 (31.8%)
	Coloured	42	21	63 (1.8%)
White		1195	851	2046 (59.9%)
Total		2041 (59.7%)	1377 (40.3%)	3418

All further race analyses in this study were conducted in line with the official black African and white race classifications, thus Asian, Indian, African and coloured students were included in the black category. The summarised race and gender classification of the sample is depicted in Figure 7 below.

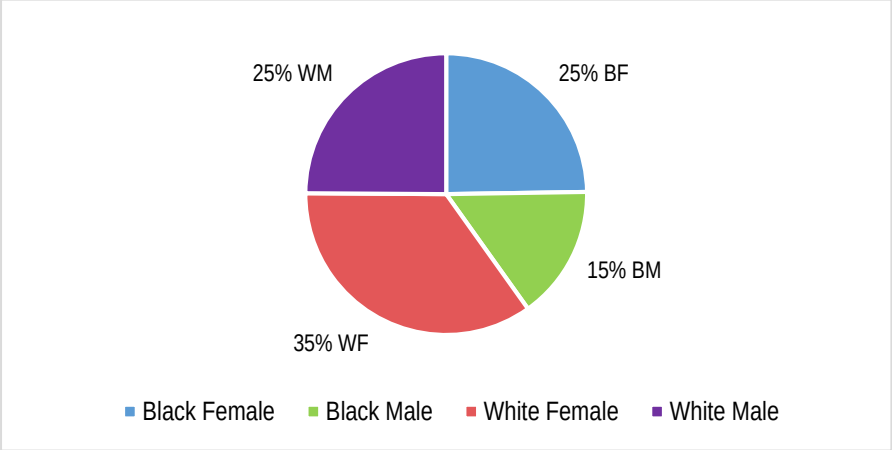


Figure 7: Sample Race and Gender Subgroups

In terms of the geographic location, the School Examination Authority indicates in which province students completed their schooling. The institution used in this study is situated in Gauteng; subsequently the majority (47.5%) of the students in the sample completed their schooling in the surrounding Gauteng areas. The second largest group of students in the sample (18.8%), were from registered private and independent schools not limited to Gauteng, but could be from anywhere in South Africa. (Refer to Table 6 below).

Table 6: School Examination Authority

School Examination Authority	Frequency
Gauteng Schools	1624
Private Schools	636
Limpopo Schools	336
KwaZulu-Natal Schools	226
Schools in Other Provinces	596
Total	3418

All schools wrote the National Senior Certificate (NSC) as the final Grade 12 school exiting examination that was used for calculating the HSGPA, except for some of the private schools that wrote a different final Grade 12 examination by the Independent Examination Board (IEB). This examination is recognised by the South African Department of Basic Education as equivalent to the NSC. For purposes of statistical analyses, the sample was divided into public schools and private schools (refer to Table 7 below).

Table 7: School Examination Authority and Race and Gender Subgroups

Race and Gender	*N*	Public Schools	Private Schools
Black Female	*846*	745 (27%)	101 (16%)
Black Male	*526*	455 (16%)	71 (11%)
White Female	*1195*	910 (33%)	285 (45%)
White Male	*851*	672 (24%)	179 (28%)
Total	*3418*	2782 (81%)	636 (19%)

4.2 DESCRIPTIVE STATISTICS OF HSGPA AND NBT RESULTS

The first independent variable for the study was HSGPA, representing final Grade 12 results (NSC and IEB NSC results) as an average percentage score of six subjects. The second independent variable was the NBTs, presented as percentage scores and benchmark levels on the different tests. Table 8 below provides the descriptive statistics for these variables. Both HSGPA and NBT results are percentages on a scale of 1-100, therefore the results and mean scores represent percentage scores.

Registration at the institution was subject to students' final Grade 12 results complying with the admission requirements of the programmes they applied for. Because the sample consisted of only admitted and registered students, the sample was inherently restricted through institutional admission and selection processes as far as it related to final Grade 12 school results (HSGPA), as is evident in the high mean score of 73.82% of the sample, as presented in Table 8 below.

At this institution, all prospective students for 2011 were requested to write the NBTs for the purpose of obtaining additional information, but not for admission purposes. It was compulsory for all the students to write the Academic and Quantitative Literacy Test, but only students who applied for programmes requiring Mathematics as a school subject, had to write the NBT Mathematical Literacy test. Therefore, all students had NBT AL and QL results (N=3418) and only 2823 students had NBT MATS results. The NBT results are presented as actual percentages on the tests, as well as a benchmark achievement level on each test separately, as Proficient, Intermediate or Basic.

Table 8: Descriptive Statistics for HSGPA and NBT Results

	N	Min	Max	Mean	Std. Dev	Variance	Skewness		Kurtosis	
								Std. Err		Std. Err
HSGPA	3418	50.14	95.88	73.8156	8.00697	64.111	.068	.042	-.459	.084
NBT_AL	3418	27	90	62.5609	11.155	124.428	-.303	.042	-.331	.084
NBT_QL	3418	18	96	60.4699	15.165	229.972	.013	.042	-.724	.084
NBT_MATS	2823	24	95	47.0659	14.057	197.594	.685	.046	-.121	.092

In contrast to the HSGPA, the NBT results were not used for admission decisions; therefore the distribution and standard deviations were wider and there were larger ranges between the minimum and maximum values on the NBT results. The table above also indicates that students generally had lower scores for the MATS test (*M* = 47.07, *SD* = 14.057) when compared to the AL (*M* = 62.56, *SD* = 11.155) and QL (*M* = 60.47, *SD* = 15.165) mean scores.

Figure 8 below depicts the various benchmark performances on the NBTs for the sample. Frith and Prince (2016) explained that the NBT benchmark levels were set to define levels of proficiency at which students could be expected to perform at university in line with education demands. Thus, students testing *Proficient* should not have difficulty succeeding at university, *Intermediate* performance indicates that students would need additional support in order to succeed at university, and *Basic* performance indicates serious learning challenges and that students would not succeed at university without extensive long-term support.

The results in Figure 8 below indicated that the majority of the students in the sample performed Intermediate on all three NBT tests. Based on the definitions of the benchmark levels for Intermediate performance, the majority of these students would likely experience difficulty in regular degree programmes, unless additional support was provided to the students.

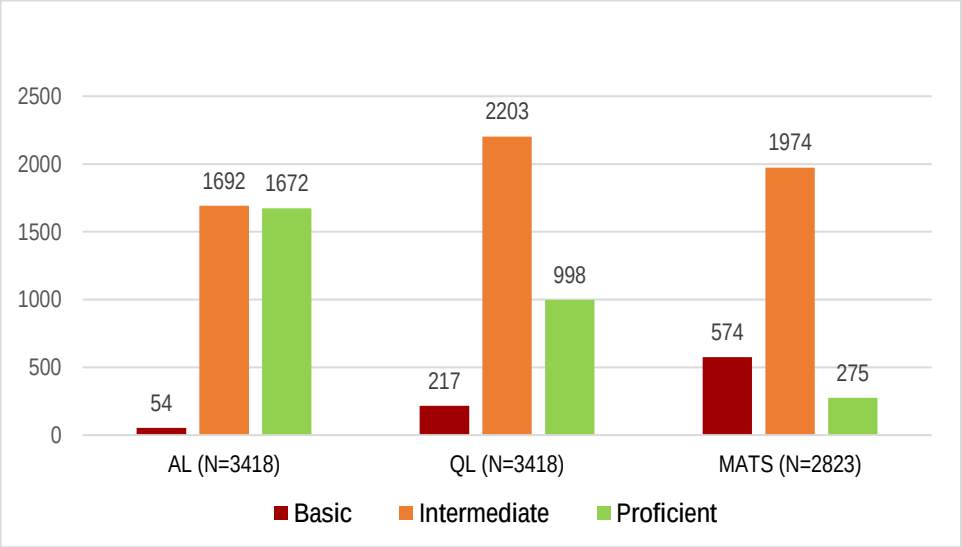


Figure 8: Overall NBT Benchmarks Distribution

More students performed Proficient in the NBT AL test than in any of the other NBT tests. When looking at the MATS performance, second to Intermediate, the majority of the students performed Basic.

In line with the research questions, the independent variables were evaluated in terms of race and gender subgroups. The following tables present the descriptive statistics for the HSGPA and NBTs in the different race and gender subgroups as well as the results of the independent samples t-test.

Table 9: HSGPA and NBT Results for Race and Gender Subgroups

HSGPA	N	Min	Max	Mean	Std. Dev	Variance
Female	2041	50.14	95.25	74.2756	7.73792	59.875
Male	1377	51.13	95.88	73.1338	8.34621	69.659
Black	1372	51.13	92.86	72.0166	7.65500	58.599
White	2046	50.14	95.88	75.0219	8.01319	64.211
Overall Mean	3418	50.14	95.88	73.8156	8.00697	64.111
NBT AL	N	Min	Max	Mean	Std. Dev	Variance
Female	2041	27	90	62.2357	11.081	122.797
Male	1377	27	89	63.0428	11.249	126.548
Black	1372	27	89	58.9133	11.327	128.298
White	2046	28	90	65.0068	10.343	106.983
Overall Mean	3418	27	90	62.5609	11.155	124.428
NBT QL	N	Min	Max	Mean	Std. Dev	Variance
Female	2041	18	96	56.9530	14.318	204.999
Male	1377	22	96	65.6826	14.887	221.625
Black	1372	18	92	53.0620	13.578	184.369
White	2046	27	96	65.4374	14.112	199.152
Overall Mean	3418	18	96	60.4699	15.165	229.972
NBT MATS	N	Min	Max	Mean	Std. Dev	Variance
Female	1581	24	93	44.2037	13.140	172.662
Male	1242	25	95	50.7093	14.345	205.773
Black	1202	24	94	44.8852	12.425	154.381
White	1621	25	95	48.6829	14.953	223.607
Overall Mean	2823	24	95	47.0659	14.057	197.594

Table 10: T-test for Race and Gender Group Mean Scores

		t	df	Sig. (2 tailed)	Mean Difference
HSGPA	Gender	4.039	2799.608	.000	1.142
	Race	-11.041	3029.466	.000	-3.005
NBT AL	Gender	-2.076	3416	.038	-0.807
	Race	-15.959	2755.339	.000	-6.094
NBT QL	Gender	-17.205	3416	.000	-8.730
	Race	-25.709	3015.706	.000	-12.375
NBT MATS	Gender	-12.408	2547.035	.000	-6.506
	Race	-7.358	2784.742	.000	-3.798

In terms of gender, the HSGPA mean score for females was slightly higher (1.1%), than the HSGPA mean score for males. However, the mean scores for males were higher than for females in all three NBT tests. The biggest gender difference was in the NBT QL mean score, which was 8.7% higher for males than females. The NBT MATS mean score for male students was also 6.5% higher than for the females.

Race group differences indicated a slightly higher HSGPA mean score for white students (3%), but larger differences in mean scores in all the NBT results. The NBT MATS mean score for white students was 3.8% higher than for black students. The NBT AL mean score for black students was 6% lower than the mean score for white students. However, the largest difference in mean scores was for the NBT QL where - the mean score for white students was 12.4% higher than for black students. The results of the t-test in Table 10 above, indicated that all the reported differences in mean scores were statistically significant.

To further explore the differences highlighted above, the sample was divided into four race and gender subgroups, namely Black Females (BF), Black Males (BM), White Females (WF) and White Males (WM). The HSGPA and NBT mean scores were then analysed for in-group differences and these results are reported in Table 11 below.

Dividing the sample into the subgroups provided valuable additional information related to race and gender and potential differential validity of the predictor variables HSGPA and NBT results.

Table 11: HSGPA and NBT Mean Scores for Race and Gender Subgroups

	Overall Mean	Black Female (BF)	Black Male (BM)	White Female (WF)	White Male (WM)
HSGPA	73.8156	72.4917	71.2523	75.5384	74.2967
NBT AL	62.5609	59.1678	58.5038	64.4075	65.8484
NBT QL	60.4699	50.9066	56.5285	61.2335	71.3408
N	*3418*	*846*	*526*	*1195*	*851*
NBT MATS	47.0659	42.3146	48.6204	45.7514	52.0705
N	*2823*	*712*	*490*	*869*	*752*

The HSGPA mean scores for both WF and WM students were higher than the overall HSGPA mean score (M=73.81) of the total sample. The HSGPA for WF students was 1.72% higher than the overall mean score and BM students had a mean score 2.56% lower than the overall mean score of the sample. The range between the highest (WF) and lowest (BM) mean scores was 4.29% on HSGPA. Figure 9 below depicts the HSGPA and NBT mean scores within the race and gender subgroups in relation to the overall mean score.

In addition to the findings above on NBT results and mean score distributions (Table 11 above), the NBT results indicated even larger in-group differences and deviations from the overall mean scores than was found in HSGPA mean scores. In the NBT results, the AL mean score for BM students was 4.06% lower than the overall mean score and 3.39% lower for BF students than the overall mean score of 62.56%. There was a difference of 7.35% between the AL mean score for WM and BM students.

The overall mean score difference in the NBT QL results between white and black students was 12.5%. However, the in-group differences in QL mean scores indicated a range of 20.43% between the highest mean score for WM (71.34%) and the lowest mean score for BF (50.91%). The QL mean score for WM students was 10.87% higher than the overall mean score. The QL mean score for WF students (61.23%) was the closest to the overall mean score (60.45%), with only a 0.76% deviation, whereas BM students had a QL mean score of 3.94% lower than the overall mean score and BF students had a QL mean score 9.56% lower than the overall mean score.

The MATS results indicated that the mean scores within the four race and gender subgroups had a range of 9.56%, where the mean score for BM students was 42.31% and the highest MATS mean score for WM students was 52.07%. The deviation from the overall mean score was 5% for WM students and 4.76% below the overall mean for BF students.

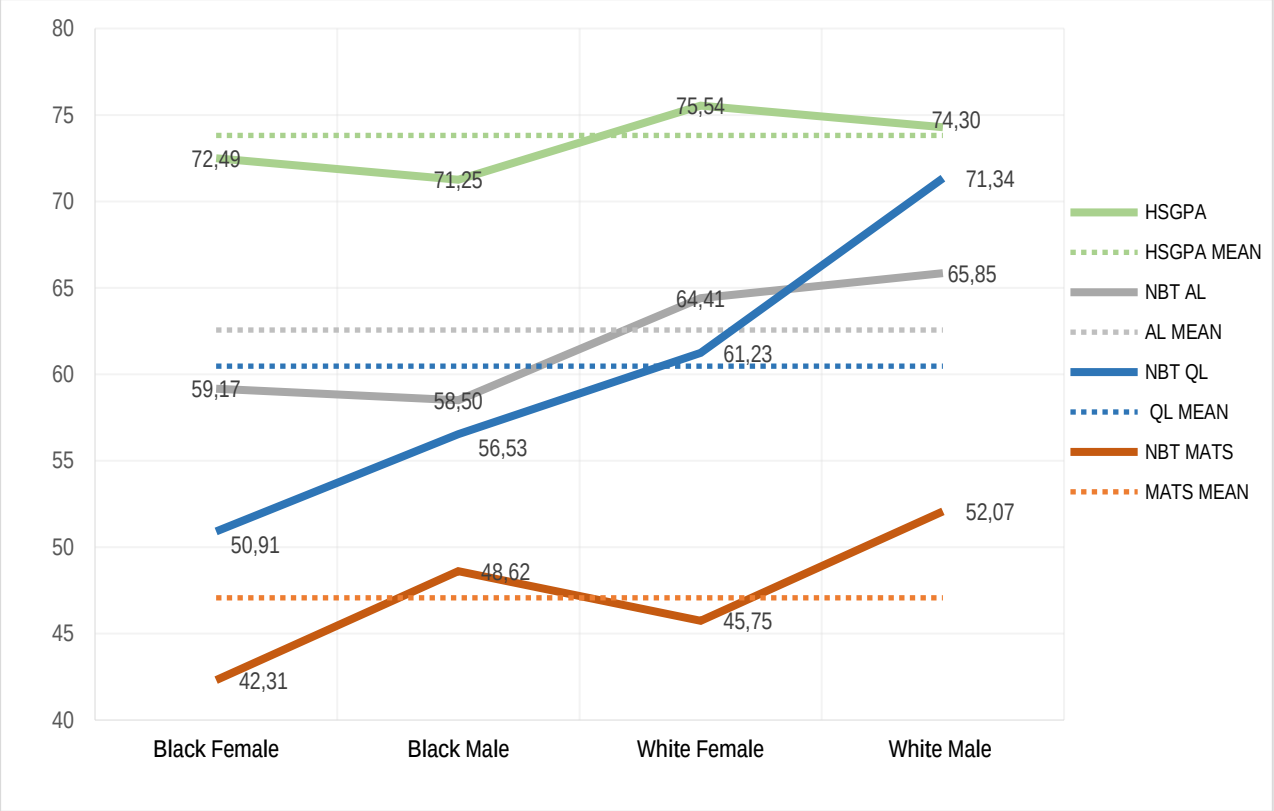


Figure 9: HSGPA and NBT Mean Scores for Race and Gender Subgroups

Overall, the NBT results indicated large in-group differences related to race and gender that should be taken into account when investigating the predictive validity of the NBTs.

The HSGPA and NBT mean scores were further analysed in terms of school examination authorities as public schools and private schools. Table 12 below presents the HSGPA and NBT descriptive statistics for the school examination authorities and is followed by the results of the independent samples t-test presented in Table 13.

Table 12: HSGPA and NBT Mean Scores for School Authorities

School Authority	*N*	HSGPA	NBT AL	NBT QL	*N*	NBT MATS
Public Schools	*2782*	74.32529	61.02552	59.32459	*2290*	46.30087
Private Schools	*636*	71.5859	69.2767	65.4796	*533*	50.3527
OVERALL MEAN	*3418*	73.8156	62.5609	60.4699	*2823*	47.0659

Table 13: Independent Samples t-test for School Authority Mean Scores

	HSGPA	NBT AL	NBT QL	NBT MATS
t	8.387	-19.640	-9.874	-5.761
df	1025.124	1090.929	1010.281	760.086
Sig. (2 tailed)	.000	.000	.000	.000
Mean Difference	2.739	-8.251	-6.155	-4.052

The results indicated that the differences in mean scores for all the independent variables for students from public schools and private schools were statistically significant. The HSGPA mean score for students from public schools was almost 3% higher than for students from private schools. However, the NBT results indicated the contrary, with higher mean scores in AL (8%), QL (6%) and MATS (4%) for students from private schools than for students from public schools.

The differences in HSGPA and NBT mean scores were further analysed in terms of school examination authorities and race and gender subgroups. Table 14 below presents the HSGPA and NBT descriptive statistics for the different race and gender subgroups in public and private schools.

Table 14: HSGPA and NBT Mean Scores for School Authorities and Race and Gender Subgroups

SCHOOL AUTHORITY		*N*	HSGPA	NBT AL	NBT QL	*N*	NBT MATS
Public Schools	Black Female	*745*	72.95182	58.36779	50.34765	*627*	42.06380
	Black Male	*455*	71.89221	57.42637	55.48132	*428*	48.32009
	White Female	*910*	76.24652	62.53846	60.34066	*651*	44.81106
	White Male	*672*	74.89370	64.36012	70.50298	*584*	51.03082
	TOTAL	*2782*	74.32529	61.02552	59.32459	*2290*	46.30087
Private Schools	Black Female	*101*	69.0981	65.0693	55.0297	*85*	44.1647
	Black Male	*71*	67.1519	65.4085	63.2394	*62*	50.6935
	White Female	*285*	73.2774	70.3754	64.0842	*218*	48.5596
	White Male	*179*	72.0554	71.4358	74.4860	*168*	55.6845
	TOTAL	*636*	71.5859	69.2767	65.4796	*533*	50.3527
OVERALL MEAN		*3418*	73.8156	62.5609	60.4699	*2823*	47.0659

Students from public schools represented 81% of the total sample, and within the race and gender subgroups, students from public schools comprised 88% BF, 87% BM, 76% WF and 79% WM of the sample. The total HSGPA mean score for students from public schools was slightly higher (0.5%) than the overall HSGPA mean score of the sample, and the NBT mean scores on all three tests were slightly lower than the overall NBT mean scores of the sample. In contrast, the total HSGPA mean score for students from private schools was 2.3% lower than the overall HSGPA mean score of the sample and 2.8% lower than the HSGPA mean score for students from public schools.

As mentioned above, the NBT mean scores for students from private schools were higher than for students from public schools with NBT AL 8.3%, QL 6.2%, and MATS 4.1% higher. The differences within the race and gender subgroups between the school examination authorities indicated that the mean scores of all students from private schools in the NBT tests were higher than for students from public schools. The differences in sample sizes should be noted when considering the implications of the finding as private schools represented only 18% of the sample. Table 15 below provides a summary of the differences in mean scores between the school examination authorities in the race and gender subgroups.

Table 15: Differences in HSGPA and NBT Mean Scores for Private Schools in Race and Gender Subgroups

Private schools compared to Public schools	HSGPA	NBT AL	NBT QL	NBT MATS
Black Female	-3.9%	6.7%	4.7%	2.1%
Black Male	-4.7%	8.0%	7.8%	2.4%
White Female	-3.0%	7.8%	3.7%	3.7%
White Male	-2.8%	7.1%	4.0%	4.7%
OVERALL MEAN	-2.7%	8.3%	6.2%	4.1%

In line with the overall finding that the HSGPA mean score for students from private schools was lower than the overall HSGPA mean score for students from public schools, the table above indicates that the HSGPA mean scores were lower for all four race and gender subgroups than the overall mean. The HSGPA mean score for BF students from private schools was 4.7% less than the overall mean score for the sample. For BM students from private schools, the HSGPA mean score was 6.7% less than the overall mean score and 4.7% less than the mean score for BM students from public schools.

Although WF students from the private schools had the highest HSGPA, their mean score was still 3% lower than the mean score for WF from public schools. The HSGPA mean score for WM students was 1.8% lower than the overall mean and 2.8% lower than the mean score for WM students from public schools. The results indicated that the lower overall HSGPA mean score for students from private schools, when compared to the mean score of students from public schools, was not due to one specific race or gender group, but rather that the HSGPA means scores were consistently lower in all the race and gender subgroups for students from private schools. The fact that students from private schools wrote a different examination could be the reason for the significant difference ($p<.001$) in HSGPA mean scores.

Contrary to the finding above on lower HSGPA mean scores for students from private schools, the results indicated that students from private schools had higher NBT mean scores. The overall AL mean score for students from private schools was 8.2% higher than the AL mean score for students from public schools. Race and gender group comparisons indicated higher AL mean scores for students from private schools of 6.7%, 8%, 7.8% and 7.1% for BF, BM, WF and WM students respectively.

The QL mean score for students from private schools was 6.2% higher than the mean score of students from public schools. The QL mean score for BM students in particular was 7.8% higher than for BM students from public schools. The results for the MATS mean scores were similar, with all subgroups from private schools achieving a higher mean score when compared the mean score of students from public schools. The MATS mean score for students from private schools was 4.1% higher than the total MATS mean score for students from public schools.

The higher NBT mean scores for students from private schools could indicate that these students were better prepared for the NBTs due to additional training, since such programmes are available to learners, but usually at an additional cost. Private schools are more expensive than public schools, and it could be that the learners from private schools were more likely to have access to these programmes due to a better financial position.

The descriptive statistics for HSGPA and NBTs highlighted large group differences in mean scores. For example, initially the results indicated that in terms of race, white students had the highest HSGPA and NBT mean scores, and in terms of gender, female students had a higher HSGPA mean score, while males had higher NBT mean scores. However, further aggregation of the data into the different race and gender subgroups, revealed larger differences in mean scores between the race and gender subgroups that should be taken into account when the predictive validity of these independent variables is investigated later in this chapter.

The following section provides the descriptive statistics related to the various faculties and degree programmes that students were registered for, and is followed by the descriptive statistics of the dependent variables used in this study.

4.3 DESCRIPTIVE STATISTICS OF FACULTIES

Table 16 below indicates the faculties where a student was initially registered, and also the faculties where the same student exited the system, either through graduation or dropout. The numbers refer to actual registrations in the programmes offered by the faculties at the point of entry into the institution as well as the last active programme on a student's record over the period of six years. Hence, the totals were not indicative of student progress or dropout during their studies, but merely reflected the first and the last faculty on a student's record from 2011 to 2016.

There were small differences in the total numbers per faculty. These differences indicated programme changes where students transferred between degree programmes during their studies. The biggest number of students registered for programmes offered by the Faculty of Natural and Agricultural Sciences (NAS), followed by Engineering and Built Environment (EBIT) and the Faculty of Economic and Management Sciences (EMS). Due to the low student numbers in the faculties of Education, Law and Theology, these faculties were grouped with the Faculty of Humanities (abbreviated as HELT) as the degree programmes offered in these faculties have similar admission requirements and processes. Similarly, the faculties of Health Sciences and Veterinary Sciences (abbreviated as HS&VET) were grouped together due to the similarity in selection processes and admission requirements.

Table 16: Faculty Distribution of Sample

	INITIAL FACULTY		FINAL FACULTY		Programme changes
	N	%	N	%	
EBIT	845	24.7	851	24.9	6
EMS	654	19.1	730	21.4	76
HELT:	737	21.6	764	22.4	27
HUM	354	10.4	355	10.4	1
EDU	297	8.7	310	9.1	13
LAW	70	2.0	83	2.4	13
THEO	16	.5	16	.5	
HS&VET:	307	9	370	10.8	63
HEALTH	301	8.8	329	9.6	
VET	6	.2	41	1.2	
NAS	875	25.6	703	20.6	-172
TOTAL	3418		3418		

In the table above, the differences in numbers between the initial and final faculty refer to programme changes. It should be noted that the Faculty of NAS offers a gateway degree for students to eventually transfer to the Faculties of Veterinary Science and Health Sciences, as well as into various other programmes. Therefore, the number of programme changes (172 students) from NAS was not concerning.

Table 17 below indicates the race and gender, as well as school examination authority distribution of the sample per faculty group.

Table 17: Race and Gender Subgroups and School Authority per Faculty Groups

FACULTY GROUP		N	% of Race & Gender	% in Faculty Group	Public Schools	Private Schools
EBIT	Black Female	140	16%	16%	124	16
	Black Male	202	38%	24%	175	27
	White Female	127	11%	15%	97	30
	White Male	382	45%	45%	300	82
	TOTAL	851			696 (82%)	155 (18%)
EMS	Black Female	260	31%	36%	231	29
	Black Male	107	20%	15%	91	16
	White Female	204	17%	28%	147	57
	White Male	159	19%	22%	119	40
	TOTAL	730			588 (80%)	142 (20%)
HELT	Black Female	157	19%	21%	141	16
	Black Male	39	7%	5%	31	8
	White Female	452	38%	59%	349	103
	White Male	116	14%	15%	98	18
	TOTAL	764			619 (81%)	145 (19%)
HS&VET	Black Female	75	9%	20%	64	11
	Black Male	36	7%	10%	30	6
	White Female	203	17%	55%	161	42
	White Male	56	7%	15%	48	8
	TOTAL	370			303 (82%)	67 (18%)
NAS	Black Female	214	25%	30%	185	29
	Black Male	142	27%	20%	128	14
	White Female	209	17%	30%	156	53
	White Male	138	16%	20%	107	31
	TOTAL	703			576 (82%)	127 (18%)

Although private schools represented only 18.8% of the overall sample, they represented between 18% and 20% of the students within the different faculty groups. The largest group of WM students and BM from private schools registered in EBIT and the largest group of WF students from private schools registered in the HELT faculty group.

The majority of students in EBIT were WM students (45%) followed by BM students (24%) and less female students with BF and WM representing 16% and 15% of the faculty group respectively. EMS consisted of more female than male students with 36% BF students, followed by 28% WF students. WM and BM students made up 22% and 15% respectively.

In the greater Humanities HELT faculty group, 59% of the students were WF, followed by 21% BF and 15% WM students. Only 5% of students in the HELT faculty group were BM students. HS&VET consisted also mostly of WF students (55%), followed by BF students (20%) and WM students (15%), whilst only 10% of students were BM. NAS had the most even distribution between race and gender subgroups with 30% BF and 30% WF students and 20% BM and 20% WM students.

In total, 45% of all WM and 38% of all BM students registered in EBIT. Most BF students registered in EMS (31%) and most WF students (38%) registered in HELT faculty groups. This could indicate study programme preferences related to specific race and gender subgroups.

The following section provides the descriptive statistics of the dependent variables used in this study.

4.4 DESCRIPTIVE STATISTICS OF FYGPA, FINCUMGPA AND FINAL ACADEMIC STATUS

The two dependent variables for this study were FYGPA and FinCumGPA. The FYGPA (first-year grade point average) was calculated according to the institutional regulations as a weighted average of all registered modules in relation to the credit value of modules taken in the student's first academic year. The FYGPA was therefore the GPA at the end of 2011 for all the students in the sample. Cumulative GPAs were available for each consecutive year that a student was registered for and was calculated as a weighted average of the credit values of modules taken up to that particular year. For example, CUMGPA2012 was the weighted average for all modules taken in 2011 and 2012.

The FinCumGPA was the final weighted average across all the years a student was registered at the institution between 2012 and 2016, as the last or final cumulative GPA on a student's record, irrespective of their academic status. The FinCumGPA was therefore not sequential, but nominal, as the last cumulative grade point average of all students in the sample, including students who had dropped out, were academically excluded or students who completed their degrees between 2012

and 2016. The reason for using the FinCumGPA was to ensure that most students were included in analysing the data and relationships between the variables. Only students that dropped out or were academically excluded after their first year that had the same FYGPA and FinCumGPA scores, since their FYGPA is also their last or final cumulative GPA on their student records, were excluded from FinCumGPA (n=392).

Table 18 below provides the descriptive statistics of all the GPAs over six years from 2011 to 2016. The mean scores across the six years remained consistently above the FYGPA mean score of 56%, indicating that students generally performed worse during their first year at university. For this reason, the importance of the first-year experience is emphasised, and research on predicting first year academic success is crucial. The total number of students (N) decreased annually due to dropouts, academic exclusions and graduating students from 2013 onwards.

The results further indicated that after the first year, the GPA mean scores increased up to the third year, with a slight decline towards the sixth year. The mean score for FinCumGPA (*M* = 58.48, *SD* = 11.40) was 2.28% higher than FYGPA (*M* = 56.20, *SD* = 13.33).

Table 18: Grade Point Averages

	N	Mean	Std. Dev	Variance	Skewness	
						Std. Err
FYGPA2011	3418	56.19801	13.328273	177.643	-.785	.042
CUMGPA2012	3026	57.89220	10.693259	114.346	-.295	.045
CUMGPA2013	2901	58.63930	10.361590	107.363	-.185	.045
CUMGPA2014	2183	58.48545	10.531334	110.909	-.143	.052
CUMGPA2015	1264	57.12750	10.255880	105.183	.013	.069
CUMGPA2016	657	57.29191	11.584646	134.204	-.028	.095
FinCumGPA	3026	58.48210	11.403989	130.051	-.518	.045

To investigate group differences, the descriptive statistics for the dependent variables were provided for the different race and gender subgroups. Table 19 below indicates the cumulative GPAs over the six years (2011-2016), as well as the number of students included in the calculation.

Table 19: 2011-2016 GPA mean scores for Race and Gender Subgroups

Race & Gender	FYGPA2011	CUMGPA2012	CUMGPA2013	CUMGPA2014	CUMGPA2015	CUMGPA2016	FinCumGPA
BF	56.17205	56.22938	56.60339	55.84170	54.24379	55.18200	56.14618
N	846	763	727	528	296	164	763
BM	54.99587	54.79931	54.51582	53.89917	53.96188	52.73904	52.79966
N	526	454	418	332	230	142	454
WF	57.97311	60.95169	62.46291	63.33788	61.94519	63.93840	63.14360
N	1195	1061	1031	749	351	163	1061
WM	54.47420	57.12588	57.62078	57.23820	56.84496	56.80870	57.70174
N	851	748	725	574	387	188	748
OVERALL MEAN	56.19801	57.89220	58.63930	58.48545	57.12750	57.29191	58.48210
N	3418	3026	2901	2183	1264	657	3026

Similar to the HSGPA findings on race and gender, WF students had the highest mean scores overall for FYGPA (*M* = 57.97) as well as for FinCumGPA (*M* = 63.14) and consistently had the highest GPA mean scores from 2012-2016 among the four subgroups.

The FYGPA mean scores for WF and WM students were lower than their FinCumGPA mean scores, as opposed to BF and BM students who had higher FYGPA mean scores and lower FinCumGPA mean scores. BM students had the biggest in-group difference in mean scores between FYGPA and FinCumGPA with a decrease of 3.95%.

Figure 10 below depicts the in-group differences in mean scores for FYGPA and FinCumGPA, highlighting the in-group differences. For BF students the FYGPA and FinCumGPA mean scores were quite similar to the FinCumGPA mean score, at 0.03% lower than the FYGPA mean score. The FYGPA mean score for BM students was 2.2% higher than their FinCumGPA. The FYGPA mean scores were lower than the FinCumGPA (at 5.17% and 3.23% respectively) for both WF and WM students.

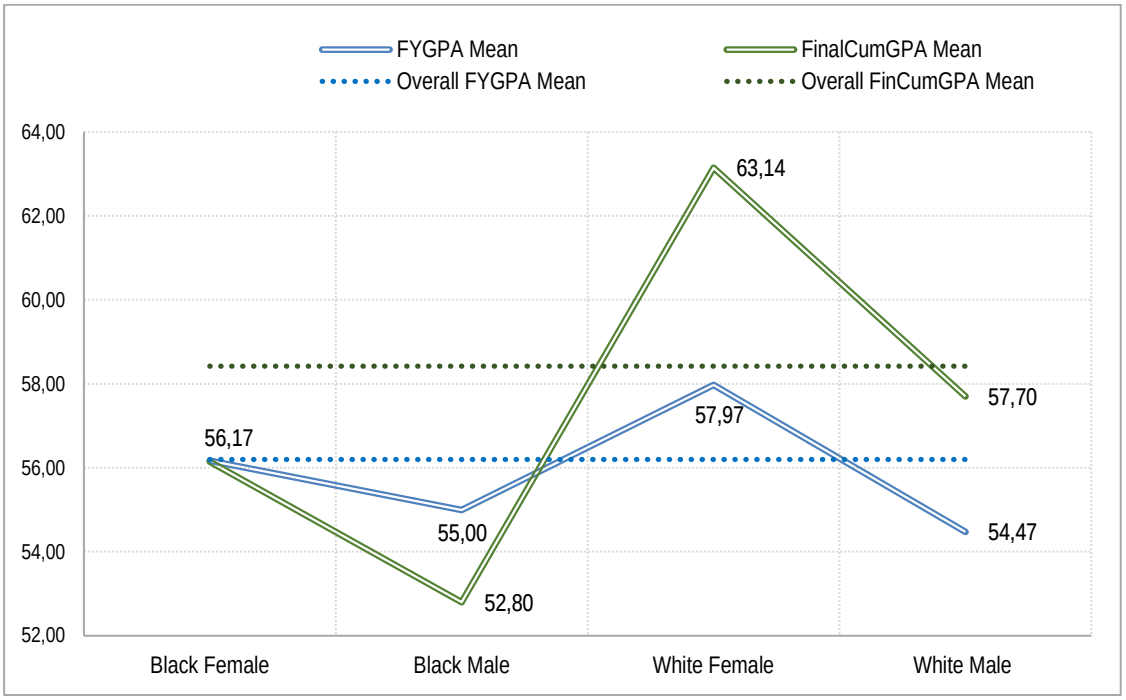


Figure 10: FYGPA and FinCumGPA Mean Scores for Race and Gender Subgroups

The data in Table 19 above further indicated that cumulative GPA mean scores only increased or decreased within a range of about 2.5% for most students, except for WF students where an increase of 5.97% in cumulative GPA mean scores from first year 2011 to 2016 was evident. It should be noted that only a small group of students was included in the cumulative GPA calculations from 2013 since large groups of students exited the system after three years (718 at the end of 2013, 919 at the end of 2014 and 607 at the end of 2015).

The GPA mean score for WF students was consistently higher than the overall mean score over the six years. WM students had the lowest FYGPA mean score, but this increased to the second highest from 2012-2016. The cumulative GPAs for BM students decreased from the FYGPA to the sixth year. BM students also had a slight decrease in mean scores from 2013 to 2016. However, the cumulative GPAs increased for both WF and WM students after the first year towards 2016. The cumulative GPAs at the end of 2015 were lower for all the subgroups, except for BM students where it remained at 53%. The graph below (Figure 11) depicts the FYGPA and annual cumulative GPA mean scores from 2011 to 2016 for the four race and gender subgroups.

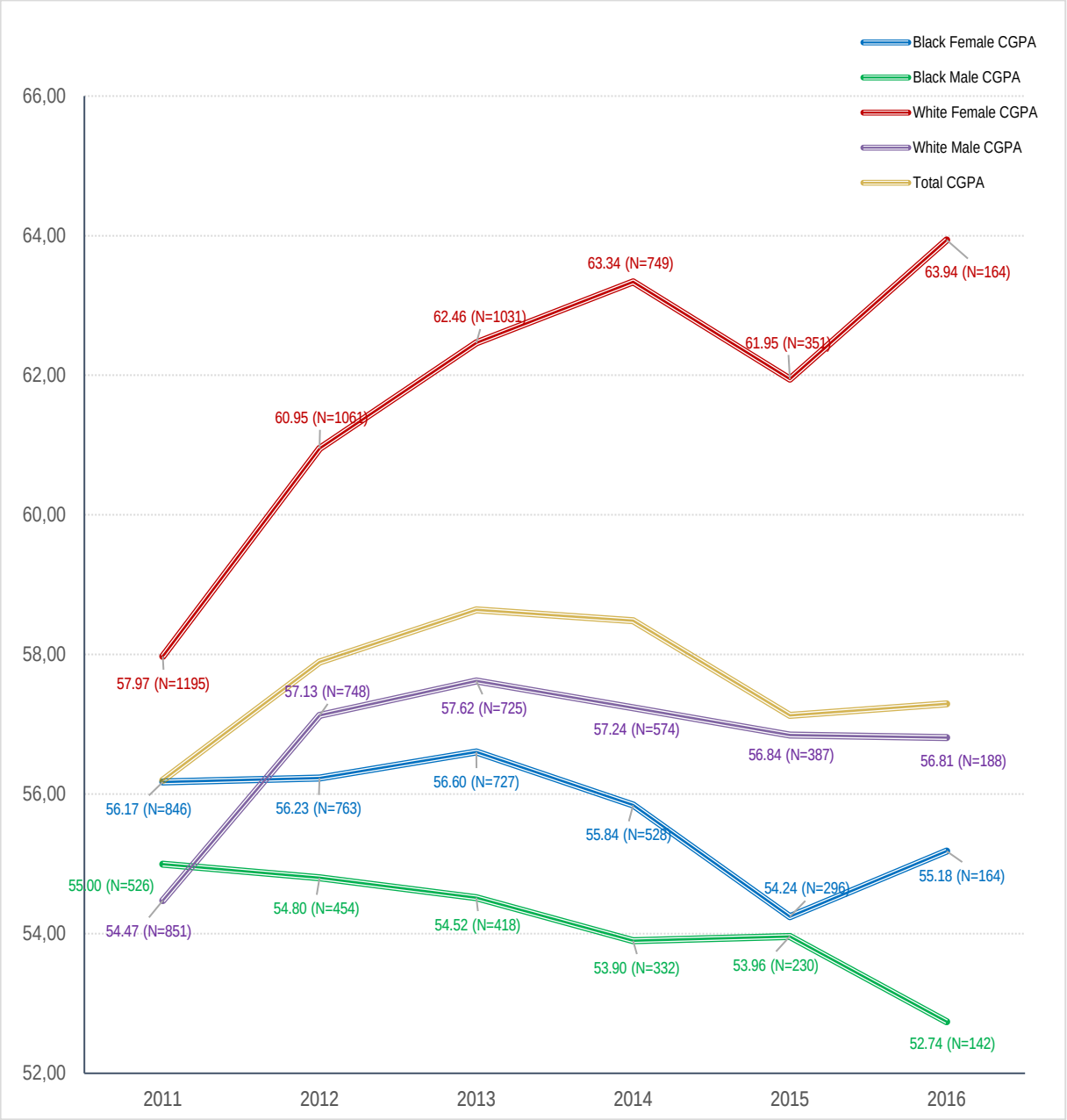


Figure 11: Race and Gender Subgroup GPAs from 2011 - 2016

To investigate group differences between students from public schools and students from private schools, the descriptive statistics for the dependent variables were provided for the school examination authorities. Table 20 below indicates the FYGPA and FinCumGPA for students from public and private schools.

Table 20: FYGPA and FinCumGPA Mean Scores for School Authorities

School Authority	*N*	FYGPA	*N*	FinCumGPA
Public Schools	2782	55.88690	2782	58.06604
Private Schools	636	57.55886	636	60.29045

Table 21: Independent Samples t-test for School Authority Mean Scores

	FYGPA	FinCumGPA
t	-2.857	-4.196
df	968.074	840.039
Sig. (2 tailed)	.000	.004
Mean Difference	-1.672	-2.224

The results indicated that the differences in FYGPA mean scores and FinCumGPA mean scores between students from public schools and students from private schools were statistically significant. The FYGPA mean score for students from private schools was 1.67% higher than for students from public schools. Similarly, the FinCumGPA mean score for students from private schools was 2.22% higher than the mean score for students from public schools.

4.5 FINAL ACADEMIC STATUS

The Final Academic Status is the last academic status on a student's record and the corresponding cumulative grade point average was used to calculate the FinCumGPA. Dropouts refer to students who discontinued their studies and did not return to the institution. Students who did not perform academically according to the various faculty rules were excluded and not allowed to return to the institution. A "Completed status" was assigned to students who completed their degrees and an "Active status" to students who were still studying at the end of 2016. Table 22 below provides a summary of the various final statuses of the sample over the six years.

Table 22: Summary of Final Academic Status per Faculty Group

STATUS		EBIT	EMS	HELT	HS&VET	NAS	TOTAL
2011	*Dropout*	34	21	56	6	82	199
	Excluded	59	10	44	0	80	193
2012	*Dropout*	16	6	13	1	18	54
	Excluded	20	9	18	2	20	69
2013	*Dropout*	32	10	11	4	10	67
	Excluded	8	13	7	2	16	46
	Completed	38	296	139	24	105	602
2014	*Dropout*	10	8	11	0	8	37
	Excluded	21	4	7	1	26	59
	Completed	118	203	310	57	138	826
2015	*Dropout*	6	4	5	0	4	19
	Excluded	14	8	5	4	6	37
	Completed	220	89	103	42	100	554
2016	*Dropout*	5	1	2	0	3	11
	Excluded	35	14	3	1	7	60
	Completed	100	27	27	159	59	372
	Active	115	7	3	67	21	213
TOTAL		851	730	764	370	703	3418
	Dropout	103	50	98	11	125	**387** (11.32%)
	Excluded	157	58	84	10	155	**464** (13.58%)
	Completed	476	615	579	282	402	**2354** (68.87%)
	Active	115	7	3	67	21	**213** (6.23%)

A total of 68.87% of students completed their studies over the six-year period, 387 students dropped out and 464 students were excluded (24.90%). The results further indicated that the most dropouts and exclusions (N=392) occurred during the first year at university (11.47%) and thereafter it decreased during the second and third years. The NAS faculty in particular, lost 23% of the first-year intake during 2011 due to exclusions and dropouts.

The cohort started to graduate from 2013 onwards, (for the three-year programmes), though it should be noted that the minimum completion time for some degree programmes are four or five years (completion times are discussed below). A very small percentage of students was still active and studying at the end of the sixth year (6.23%). The majority of students with an Active status at the end of 2016 were in EBIT and the HS&VET faculty group – this could be expected due to the fact that these faculties also offer five-year degree programmes.

In terms of faculties, 84.2% of EMS students completed their degrees within six years, 76.2% in Health and Veterinary Sciences and 75.8% in the HELT faculty group. Only 55.69% of EBIT and 57.2% of NAS students completed their degrees within the six years.

The completed final academic status was further grouped in terms of the minimum degree completion time (refer to Table 23 below). Generally, students are funded to complete their degrees in the minimum time, with the maximum allowance of a further two years. However, in terms of efficiency and effectiveness, universities require students to complete their studies in minimum time or as soon as possible after the minimum time. In total, 69% of the students in the sample completed their degrees within the six years - of these, more than 60% completed in minimum time and a further 28.5% after an additional year.

Table 23: Degree Completion Times

Completion Time	EBIT	EMS	HELT	HS&VET	NAS	TOTAL	
Minimum Time	200 (42%)	337 (55%)	457 (79%)	254 (90%)	176 (44%)	1424	*60.49%*
Minimum Plus 1 Year	215	186	94	24	152	671	*28.50%*
Minimum Plus 2 Years	58	75	22	4	68	227	*9.64%*
Minimum Plus 3 Years	3	17	6	0	6	32	*1.36%*
TOTAL Completed	476 (56%)	615 (84%)	579 (76%)	282 (76%)	402 (57%)	2354 (69%)	

Most of the students in HS&VET completed their degrees in minimum time. This is followed by the HELT faculty group, where 76% of students completed their degrees, and of these 79% in minimum time. Although 84% of students in EMS completed their degrees within six years, only 55% completed in minimum time. Of the students studying in NAS, 57% completed their degrees, 44% of which was in minimum time. Similarly, for EBIT, only 56% of students completed their degrees and 42% of the degrees were completed in minimum time.

To investigate in-group differences, the descriptive statistics on Final Academic Status were provided for the race and gender subgroups, see Table 24 below. The total number of students who dropped out or were excluded during the six years were very similar between the subgroups (BF 26%, BM 25%, WF 25% and WM 24%). However, when looked at within the specific race and gender subgroups, 41% of BM students dropped out or were excluded during the six years at the institution.

Table 24: Final Academic Status for Race and Gender Subgroups

STATUS	BF	BM	WF	WM	Total
Dropout or Excluded: (% in Race & Gender Group)	218 25.77%	216 41.06%	214 17.91%	203 23.85%	851
Dropout	87	70	134	96	387
Excluded	131	146	80	107	464
Active: (% in Race & Gender Group)	60 7.09%	58 11.03%	37 3.10%	58 6.82%	213
Completed: (% in Race & Gender Group)	568 67.14%	252 47.91%	944 79.00%	590 69.33%	2354

Figure 12 below depicts the race and gender subgroup distribution per Final Academic Status. The majority of students who dropped out or left the University were WF (35%) students and only 18% of the total dropouts were BM students. Although fewer BM students dropped out, the largest group of excluded students were BM students (31%). The majority of students who completed their degrees were WF (40%) and BF, with WM making up 49% and BM only 11% of the students who completed their studies.

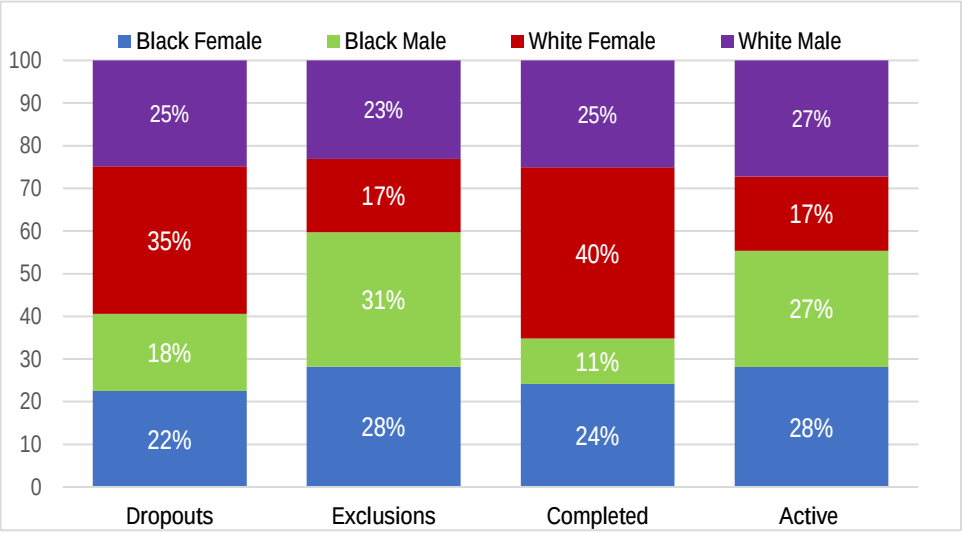


Figure 12: Final Academic Status for Race and Gender Subgroups

Figure 13 below depicts the Final Academic Statuses for the different race and gender subgroups. As mentioned above, a total of 41% of the BM students in the sample dropped out or were excluded from the institution between 2011 and 2016. Very similar profiles were recorded for BF and WM students with regard to the percentage of students who dropped out, were excluded, or students still active and students who graduated. One difference was that 2% more WM students completed their studies and 2% less dropped out or were excluded, when compared to the BF students in this study.

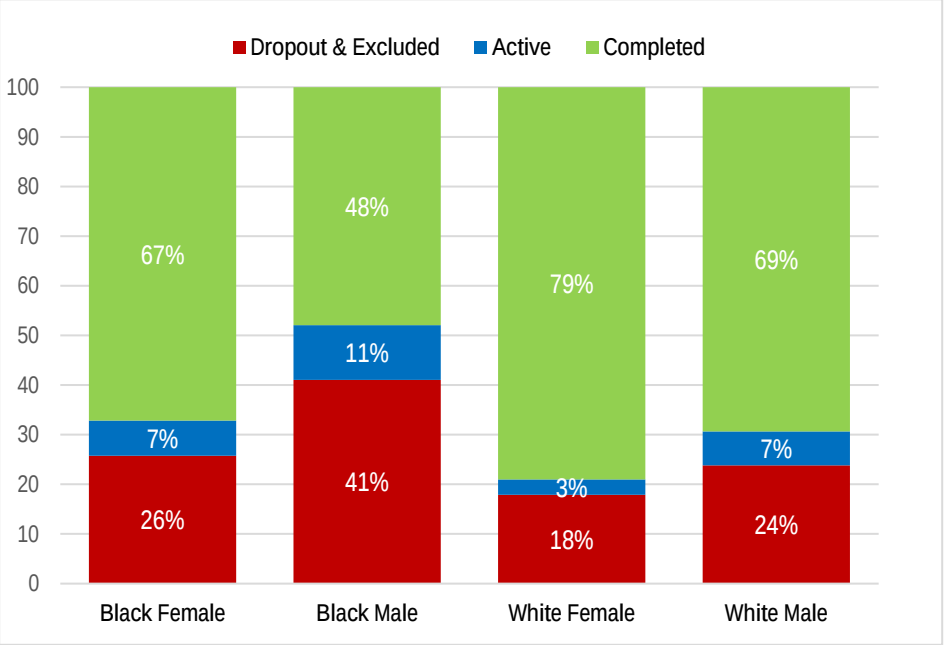


Figure 13: Race and Gender Subgroups Final Academic Status

In terms of the completed status, 79% of WF completed their degrees over the six years. This is followed by 69% of WM and 67% of BF students. In this sample, only 48% of BM students completed their degrees during the six years. A larger percentage of BM (11%) had an active status indicating that they were still in the process of completing their degrees.

The following section provides the statistical analyses aimed at addressing the research questions, and specifically investigate the relationships between the variables.

4.6 STATISTICAL ANALYSIS: PREDICTIVE VALIDITY

The primary goal of this study was to develop a model that is predictive of academic success that can be used in the admissions processes to improve university system output and effectiveness. To achieve this goal, the study investigated the variables that are assessed during the admissions process (input) and the relationships that these variables had with academic progress (processing) and academic success (output) over a period of six years. The relationships that exist between these variables are also discussed in Chapter 2, where the conceptual framework for this study is given. Chapter 4 provides an analysis of the results, and thus more context is given to the relationships as they correspond to each of the research questions. The variables and the possible relationships between these variables are set out in Figure 3 on p. 35 of this study. The research questions, and how they relate to these variables, will be addressed next.

The first research question addressed the direct relationship between Input and Processing (ABC), the second research question focused on the relationship between Processing and Output (CD) and the last research question explored the relationship between Input and Output (ABD).

Research Question 1: Assessing the Relationship between Input and Processing

(RQ 1.1) What is the relationship between HSGPA, NBT results and FYGPA? What additional information or predictive variance do NBT results provide to HSGPA?

In order to answer this research question, HSGPA, NBT results and FYGPA were first analysed through correlational statistics, followed by a regression analysis. Pearson's correlation coefficients

were computed among HSGPA, NBT results and FYGPA, and are presented in Table 25 below. The correlation coefficient (*r*) indicates the extent to which a change in one variable relates to a change in another variable. In this study, the correlation coefficients were interpreted according to Cohen's (1988) guideline for research in social sciences, as weak (*r* = 0.1), moderate (*r* = 0.3), and strong (*r* = 0.5).

The results indicated significantly weak to moderately positive correlations between HSGPA, NBT results and FYGPA. The strongest relationship was between HSGPA and FYGPA, *(r)* = 0.459, *p* < .001; while the weakest significant relationship was between NBT QL and FYGPA *(r)* = 0.179, *p* <.001. In general, the magnitude of the relationship between the predictor variables and FYGPA was higher for HSGPA than for the NBT results. All the correlations were statistically significant at 99% confidence levels.

Table 25: Pearson's Correlation Matrix: HSGPA, NBT results and FYGPA

	HSGPA	NBT_AL	NBT_QL	NBT_MATS	FYGPA
HSGPA	1				
NBT_AL	.406**	1			
NBT_QL	.459**	.605**	1		
NBT_MATS	.480**	.417**	.583**	1	
FYGPA	.459**	.217**	.197**	.282**	1
N	3418	3418	3418	2823	3418
**. Correlation is significant at the 0.01 level (2-tailed).					

To assess the impact of confounding variables, if any, partial correlations between HSGPA, NBT results and FYGPA - controlling for race, gender and school examination authority - were computed. The results are presented in Table 26 below, and it indicated the correlations between HSGPA, NBT results and FYGPA when race, gender and school examination authority remained constant. A lower partial *r* than bivariate *r* indicated that much of the correlation was accounted for by confounding variables. However, the results of the partial correlations below indicated that race, gender and school examination authority, as confounding variables, had a small effect on the overall relationships between HSGPA, NBT results and FYGPA.

Table 26: Partial Correlations Controlling for Race, Gender and School Authority

	HSGPA	NBT_AL	NBT_QL	NBT_MATS	FYGPA
HSGPA	1				
NBT_AL	.385**	1			
NBT_QL	.475**	581**	1		
NBT_MATS	.504**	.402**	.554**	1	
FYGPA	.457**	.223**	.242**	.313**	1
N	3418	3418	3418	2823	3418
**. Correlation is significant at the 0.01 level (2-tailed).					

The correlational analysis above indicated a direct relationship between HSGPA, NBT results and FYGPA and that this relationship was not strongly strengthened or weakened (influenced) by the non-cognitive variables of race, gender and school examination authority.

To establish whether HSGPA and NBT results were significant predictors of FYGPA, stepwise multiple linear regression analysis was performed. Prior to performing the regression analysis, the data were evaluated against the assumptions of regression, namely normality, linearity, homoscedasticity, and absence of multicollinearity. This was necessary as assumption violations could result in biased estimates and untrustworthy confidence intervals and significant tests (Williams et al., 2013). Normality was assessed through a P-P plot. There was no drastic deviation visible and the assumption of normality was accepted. The linearity of the relationship between the predictor variables, HSGPA and NBT results and FYGPA was assessed through the examination of scatterplots. Residual plots were also examined for the linear relationship between the residual values and the predicted scores. The absence of multicollinearity was confirmed with VIF values below 10, indicating that the assumption was met. Thus, the results indicated that the data met the regression assumptions.

The FYGPA was regressed with HSGPA together with the NBT results in order to determine the incremental value (R^2 as coefficient of determination), if any, of HSGPA and NBT results on predicting FYGPA. In a stepwise regression model, all the predictors were evaluated and only predictors that contributed significantly were included in the regression equation.

Table 27 below indicates the results of the stepwise multiple regression analysis presented in four models that were all statistically significant (p<.001). In model 1, HSGPA was a significant predictor of FYGPA $F(1,2821) = 751.370$, $p < .001$ and accounted for 21% of the total variance in FYGPA. In the second model NBT MATS was added to HSGPA and the variance increased by 0.5% to 21.5%. The third model included NBT QL and another 0.3% was added to the variance predicted FYGPA. The last model included all the variables, HSGPA, NBT MATS, QL and AL and the total variance that could be accounted for in FYGPA by the predictor variables was 22%. Thus, the inclusion of the NBT results to HSGPA increased the predictive variance with 1%.

Table 27: Stepwise Regression Analysis FYGPA

Stepwise Regression		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.459	.210	751.370	$p < .001$	$F(1,2821) = 751.370$, $p < .001$, $R^2 = .210$
		Predicted FYGPA = -.153 +(.763 x HSGPA)*				
Model 2	HSGPA NBT MATS	.464	.215	386.919	$p < .001$	$F(2, 2820) = 388.919$, $p < .001$, $R^2 = .215$
		Predicted FYGPA = 1.001 +(.699 x HSGPA) + (.076 x NBT MATS*)*				
Model 3	HSGPA NBT MATS NBT QL	.467	.218	262.433	$p < .001$	$F(3, 2819) = 262.433$, $p < .001$, $R^2 = .218$
		Predicted FYGPA = 1.247 + (.726 x HSGPA) + (.107 x NBT MATS*) + (-.061 x NBT QL**)*				
Model 4	HSGPA, NBT MATS NBT QL NBT AL	.469	.220	199.083	$p < .001$	$F(4, 2818) = 199.083$, $p < .001$, $R^2 = .220$
		Predicted FYGPA = -.316 + (.712 x HSGPA) + (.105 x NBT MATS*) + (-.087 x NBT QL*) + (.069 x NBT AL**)*				

*sig. p<.001
**sig. p<.05

(RQ 1.2) How is the relationship between HSGPA, NBT results and FYGPA different for race and gender subgroups?

Although the partial correlational analysis above indicated that the relationship between HSGPA, NBT results and FYGPA was not significantly strengthened or weakened by the non-cognitive variables of race, gender and school examination authority, this study specifically investigated the impact of race and gender on the relationships between these variables. Therefore, correlation coefficients and regression analyses between HSGPA, NBT results and FYGPA were estimated specifically for the different race and gender subgroups as presented in Tables 28 and 29 below.

Table 28: HSGPA, NBT Results and FYGPA Correlations for Race and Gender Subgroups

	BF FYGPA	BM FYGPA	WF FYGPA	WM FYGPA	Overall Pearson FYGPA
HSGPA	.352**	.394**	.465**	.567**	.457**
NBT_AL	.202**	-.013	.310**	.289**	.223**
NBT_QL	.219**	.079*	.315**	.280**	.242**
NBT_MATS	.245**	.227**	.391**	.337**	.313**
N	*846 / 712*	*526 / 490*	*1195 / 869*	*851 / 752*	*3418 / 2823*
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).					

The correlations between the predictor variables and FYGPA were found to be significant for all race and gender subgroups, except NBT AL for BM students. Although the strength of the relationships between the variables varied in the subgroups, the direction of the relationship remained the same, except for BM students where the NBT AL did not correlate significantly with FYGPA (r = -.013, p = .384).

Among the race and gender subgroups, HSGPA correlated the highest with FYGPA for WM students (r = .567, p < .01). The highest correlations between FYGPA and the NBT results were for WF students (AL r = .310 p < .001; QL r = .315, p < .01; and MATS r = -.391, p < .001). A weak correlation was found between QL (r = .079, p < .01) and FYGPA and a slightly higher correlation between MATS (r = .227, p < .001) and FYGPA for BM students. When compared to the other race and gender subgroups, BF students had the lowest correlation (r = .352, p < .001) between HSGPA and FYGPA.

Some of the weak correlations observed above may be due to the smaller sample sizes in the subgroups as well as the restriction of range. The scores of the predictor variables, HSGPA in particular, were considered restricted (as pointed out in the discussion on the descriptive statistics) and had a narrower range than the larger applicant pool that included students who were not admitted to the institution. Furthermore, the division of the sample into subgroups provided an even narrower range that could result in an underestimated relationship. The restriction of range was not corrected for in this study, because the unrestricted variance of the predictor variables was not available for students who were not admitted to the institution.

Stepwise linear regression analysis was repeated for the different race and gender subgroups to determine the regression coefficients and proportion of variance (R^2) in FYGPA that could be accounted for by HSGPA and NBT results for BF, BM, WF and WM students separately.

Two models were found to be statistically significant for BF students and are presented in Table 29 below. With stepwise regression analysis all the predictors were evaluated and only predictors that contributed significantly were included in the regression equation. The results of the stepwise regression analysis indicated in Model 1 that HSGPA was a significant predictor of FYGPA and accounted for 12.4% of variance in the FYGPA. In Model 2, the NBT MATS was added to HSGPA in the equation and the proportion of variance increased by 1%. Both NBT AL and NBT QL variables were excluded from the models by the stepwise analysis.

The stepwise regression analysis was repeated for BM students to determine the proportion of variance (R^2) in FYGPA that could be accounted for by HSGPA and NBT results. (See Table 29 below) Contrary to the results of the Pearson's correlation coefficients that indicated that there was no significant relationship between NBT AL and FYGPA (r = -.013, p = .384) for BM students, the stepwise regression analysis included the NBT AL in two of the three models. In Model 1, HSGPA accounted for 15.5% of variance in FYGPA. This variance increased by 0.9% when the NBT AL scores were added to HSGPA in the second model. However, when both NBT AL and NBT MATS scores were used together with HSGPA, the total variance increased by another 0.6% to 17.1% in FYGPA in Model 3.

Table 29: Stepwise Regression Analyses: Race and Gender Subgroups

BLACK FEMALE		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.352	.124	100.584	$p < .001$	$F(1,710) = 100.584$, $p < .001$, $R^2 = .124$
		Predicted FYGPA = 13.825 +(.584 x HSGPA)*				
Model 2	HSGPA NBT MATS	.366	.134	54.747	$p < .001$	$F(2, 709) = 54.747$, $p < .001$, $R^2 = .134$
		Predicted FYGPA = 14.777 +(.503 x HSGPA) + (.116 x NBT MATS**)*				
BLACK MALE		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.394	.155	89.456	$p < .001$	$F(1,488) = 89.456$, $p < .001$, $R^2 = .155$
		Predicted FYGPA = 8.895 +(.647 x HSGPA)*				
Model 2	HSGPA NBT AL	.405	.164	47.646	$p < .001$	$F(2, 487) = 47.646$, $p < .001$, $R^2 = .164$
		Predicted FYGPA = 13.235 +(.678 x HSGPA) + (-.112 x NBT AL**)*				
Model 3	HSGPA NBT AL NBT MATS	.413	.171	33.300	$p < .001$	$F(3, 486) = 33.300$, $p < .001$, $R^2 = .171$
		Predicted FYGPA = 14.228 +(.616 x HSGPA) + (-.136 x NBT AL**) + (.099 x NBT MATS**)*				
WHITE FEMALE		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.465	.216	238.664	$p < .001$	$F(1,867) = 238.664$, $p < .001$, $R^2 = .216$
		Predicted FYGPA = -2.200 +(.797 x HSGPA)*				
Model 2	HSGPA NBT MATS	.484	.235	132.679	$p < .001$	$F(2, 866) = 132.679$, $p < .001$, $R^2 = .235$
		Predicted FYGPA = 3.926 +(.617 x HSGPA) + (.162 x NBT MATS*)*				
Model 3	HSGPA NBT MATS NBT AL	.488	.238	90.186	$p < .001$	$F(3, 865) = 90.186$, $p < .001$, $R^2 = .238$
		Predicted FYGPA = 1.709 +(.580 x HSGPA) + (.142 x NBT MATS*) + (.093 x NBT AL**)*				
WHITE MALE		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.567	.322	356.712	$p < .001$	$F(1,750) = 356.712$, $p < .001$, $R^2 = .322$
		Predicted FYGPA = -17.447 +(.968 x HSGPA)*				
Model 2	HSGPA NBT AL	.573	.328	182.954	$p < .001$	$F(2, 749) = 182.954$, $p < .001$, $R^2 = .328$
		Predicted FYGPA = -21.091 +(.913 x HSGPA) + (.118 x NBT AL**)*				

*sig. p<.001
**sig. p<.05

The results of the stepwise regression analysis for WF students also indicated three models, presented in Table 29 above. In Model 1, HSGPA was found to account for 21.6% of variance in FYGPA. The second model added NBT MATS, and the variance increased to 23.5% that could be predicted in FYGPA. Model 3 included HSGPA, NBT MATS and NBT AL scores, and the variance that could be explained in FYGPA by these variables accounted for 23.8%

The stepwise regression analysis for WM students indicated two models. In the first model, 32.2% of variance in FYGPA could be accounted for by HSGPA. In Model 2, NBT AL scores were added and the total predicted variance increased to 32.8% of FYGPA.

Overall, the results of the stepwise regression analyses among the different race and gender subgroups indicated that HSGPA significantly predicted FYGPA. The NBT MATS added to the explained variance for BF, WF and BM students. The NBT AL also added to some explained variance for BM, WF and WM students. An interesting finding was that the NBT QL scores were not significant predictors in any of the race and gender subgroup regression models.

(RQ 1.3) How is the relationship between HSGPA, NBT results and FYGPA different for school examination authorities?

Separate stepwise linear regression analysis was conducted for the different school examination authorities to investigate the predictive validity of HSGPA and NBT results for FYGPA, for students from public (government or state) and private schools. The results are presented in Table 30 below.

Overall, the results of the stepwise regression analyses among the school examination authorities indicated that HSGPA significantly predicted FYGPA. The indication was that HSGPA accounted for 22.1% of variance in FYGPA for students from public schools. The addition of NBT MATS increased the variance by 0.4%, and including NBT QL in the last model, the predicted variance increased by a further 0.5% to a total of 23%. With regard to the results for students from private schools, HSGPA explained 22.3% of the variance and by adding NBT QL scores the total variance increased to 23.2%. NBT MATS was not found to be a significant predictor of FYGPA for students from private schools, and the NBT AL was not a significant predictor in any of the models.

Table 30: Stepwise Regression Analyses: Schooling Authorities

PUBLIC SCHOOLS		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.470	.221	647.296	$p < .001$	$F(1, 2288) = 647.296$, $p < .001$, $R^2 = .221$
		Predicted FYGPA = -1.943 +(.778 x HSGPA)*				
Model 2	HSGPA NBT MATS	.474	.225	331.764	$p < .001$	$F(2, 2287) = 331.746$, $p < .001$, $R^2 = .225$
		Predicted FYGPA = -.668 +(.715 x HSGPA) + (.074 x NBT MATS*)*				
Model 3	HSGPA NBT MATS NBT QL	.479	.230	227.100	$p < .001$	$F(3, 2286) = 227.100$, $p < .001$, $R^2 = .230$
		Predicted FYGPA = -.821 +(.756 x HSGPA) + (.110 x NBT MATS**) + (-.077 x NBT QL*)*				
PRIVATE SCHOOLS		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.472	.223	152.413	$p < .001$	$F(1, 531) = 152.413$, $p < .001$, $R^2 = .223$
		Predicted FYGPA = -2.787 +(.843 x HSGPA)*				
Model 2	HSGPA NBT QL	.481	.232	79.872	$p < .001$	$F(2, 530) = 79.872$, $p < .001$, $R^2 = .232$
		Predicted FYGPA = -2.546 +(.928 x HSGPA) + (-.097 x NBT QL*)*				
*sig. p<.001 **sig. p<.05						

The first part of the research question focused on the predictive relationship between HSGPA, NBT results on FYGPA, and on how the relationship is affected by race, gender and school examination authority. The results of all the stepwise regression analyses above indicated that race, gender and school examination authority impacted on the overall relationships between HSGPA, NBT results and FYGPA.

(RQ 1.4) How do the NBT benchmarks relate to dropout or exclusion after the first year?

The following section addresses the NBT benchmark levels and specifically whether the categorical benchmark levels are indicative of early dropout after the first year at university. Three benchmark levels are applied to the results of each of the NBT tests, namely Basic, Intermediate and Proficient. Frith and Prince (2016) reported that NBT benchmark levels were set to define levels of proficiency at which students are expected to perform in line with educational demands. Students testing Proficient should not experience any difficulty in succeeding at university. Intermediate performance indicates that the students would need additional support in order to succeed at university. Basic performance indicates serious learning challenges and that such students would not succeed without extensive long-term support.

This research question sought to validate whether the NBT benchmark levels were indicative of dropout after the first year. Table 31 below indicates the cross-tabulated results of NBT benchmarks on each test and the number of students who dropped out or where excluded after the first year, as well as the number of students who continued to subsequent years. The "continued" is not indicative of degree completion and only denotes that the student did continue with his/her studies after the first year.

Table 31: NBT Benchmarks and Dropout

NBT Tests Benchmarks		N	Dropout	Continued
AL	Basic	54	5 (9%)	49 (91%)
	Intermediate	1692	222 (13%)	1470 (87%)
	Proficient	1672	165 (10%)	1507 (90%)
QL	Basic	217	19 (9%)	198 (91%)
	Intermediate	2203	268 (12%)	1935 (88%)
	Proficient	998	105 (11%)	893 (89%)
MATS	Basic	574	69 (12%)	505 (88%)
	Intermediate	1974	223 (11%)	1751 (89%)
	Proficient	275	10 (4%)	265 (96%)

A total of 54 students performed Basic for AL, and of these the majority (91%) of the students continued while only 9% dropped out. Similarly, for QL, of the students who performed Basic, only 10% dropped out while 90% continued to the second year. The results for MATS indicated that 12% of the students who performed Basic dropped out, and 88% continued. The dropout rate for the students who performed Intermediate on AL was 13%, 12% for QL, and 11% MATS respectively. The dropout percentages of students who performed Proficient on the AL, QL and MATS were 10%, 11% and 4%, respectively. The majority of the students continued with their second year irrespective of their NBT benchmark levels being Basic, Intermediate or Proficient. Therefore, the indication is that the NBT benchmark levels did not relate to progress in terms of identifying students who were less likely to continue with their studies after the first year.

The following section addresses the relationship between processing variables and output, specifically the FYGPA and FinCumGPA.

Research Question 2: Assessing the Relationship between Processing and Output

(RQ 2.1) What is the relationship between FYGPA and FinCumGPA?

In order to answer this research question, FYGPA and cumulative GPA were analysed through correlational statistics. Pearson's correlation coefficients were computed between FYGPA and the cumulative GPA for the subsequent years 2012, 2013, 2014, 2015 and 2016, as well as with the final cumulative grade point average (FinCumGPA). The results of the correlation matrix are presented in Table 32.

Table 32: Pearson's Correlation Matrix

	N	FYGPA	CGPA2012	CGPA2013	CGPA2014	CGPA2015	CGPA2016	FinCumGPA
FYGPA	3418	1						
CGPA2012	3026	.862**	1					
CGPA2013	2901	.757**	.934**	1				
CGPA2014	2183	.669**	.864**	.945**	1			
CGPA2015	1264	.623**	.815**	.910**	.961**	1		
CGPA2016	657	.725**	.822**	.896**	.926**	.968**	1	
FinCumGPA	3026	.682**	.868**	.933**	.964**	.980**	1.000**	1
**. Correlation is significant at the 0.01 level (2-tailed).								

The significantly moderate to strong positive correlations between the variables were expected, as the cumulative grade point averages took into account the performance of the preceding year or years in calculating the weighted average. Therefore, the strong correlations were not surprising.

The purpose of the correlation analysis above was to indicate the strength of the relationship between FYGPA (as a predictor variable) and subsequent years at university, and in particular with FinCumGPA as a dependent variable related to a student's final academic status. The FinCumGPA is the weighted average across all the years that a student was registered at the institution between 2012 and 2016, as the last or final cumulative GPA on the student's record, irrespective of the year. FinCumGPA was therefore not sequential, but nominal of all students in the sample, including students who dropped out, were excluded, or who completed their degrees between 2012 and 2016.

Due to the fact that many students either dropped out, were excluded or graduated, the total number of students decreased substantially from 2013. As FinCumGPA consisted of the final cumulative GPA on a student's record, the high correlations were expected. As an illustration, the CGPA2016 (n=657) was the actual FinCumGPA for all the students who had a final cumulative GPA in 2016, hence the correlation coefficient (r) = 1.000. Similarly, the CGPA2013 was also the FinCumGPA for the total number of students who dropped out, were excluded or graduated at the end of 2013.

There was a strong correlation (r =.682 p < .001) between FYGPA as a predictor variable and FinCumGPA as the dependent variable. The results indicated a strong relationship between FYGPA and the final grade point average on a student's record (FinCumGPA) - regardless of when a student dropped out, were excluded or completed his/her studies during the six-year period. For the purpose of this study, FinCumGPA was used as an alternative criterion indicator of final academic status as opposed to using the yearly cumulative GPAs for 2012 to 2016. By making use of FinCumGPA, most cases were included in the statistical analysis, and the various regression models were not limited to the number of students with data in a particular year, except for 392 cases, where the FYGPA was also the FinCumGPA.

A linear regression analysis was performed to determine if FYGPA was a significant predictor of FinCumGPA and the results are presented in Table 33 below. Prior to performing the regression analysis, the data were evaluated against the assumptions of regression. Normality was assessed through a P-P plot, there was no drastic deviation visible, and the assumption of normality was accepted. The linearity of the relationship between the predictor variable, FYGPA and FinCumGPA was assessed through the examination of a scatterplot. A residual plot was also examined for the linear relationship between the residual values and the predicted scores. Although a high correlation (r =.682 p < .001) was found between FYGPA and FinCumGPA, the correlation was acceptable (r = < .8), and the assumption of multicollinearity was not violated. The absence of multicollinearity was further confirmed with a VIF value below 10, indicating that the assumption was met.

The FinCumGPA was regressed with FYGPA in order to determine the value (R^2) of FYGPA in predicting final academic status as FinCumGPA. The *F*-test results showed that FYGPA was a statistically significant predictor of FinCumGPA $F(1, 3024) = 2631.223$, $p < .000$, and accounted for 46.5% of the total variance in FinCumGPA.

Table 33: Regression Model FYGPA and FinCumGPA

Linear Regression		R	R^2	F	Sig.	Model Equation
ALL	FYGPA	.682	.465	2631.223	$p < .001$	$F(1, 3024) = 2631.223$, $p < .001$, $R^2 = .465$
		Predicted FinCumGPA = 18.338 +(.688 x FYGPA)*				
*sig. p<.001						

Regression coefficients are another indicator of the relative strength of the predictor variables. They may be interpreted as the number of points that a dependent variable (FYGPA) changes for a unit change in a predictor variable (FYGPA), all other factors held constant. For example, a student's FinCumGPA increased by 0.69 percentage points for every percentage increase in FYGPA.

(RQ 2.2) How is the relationship between FYGPA and FinCumGPA different for Race and Gender Subgroups?

Separate linear regression analyses were performed to determine if FYGPA was a significant predictor of FinCumGPA for the different race and gender subgroups and the results are presented in Table 34 below. The results indicated that FYGPA accounted significantly ($p < .001$) for between 33.5% and 56.8% of variance in FinCumGPA for all race and gender subgroups. It should be noted that the sample sizes differed between the subgroups as indicated by the *F* statistics.

Table 34: Regressions Models per Race and Gender Subgroups

Linear Regression		R	R^2	F	Sig.	Model Equation
Black Female	FYGPA	.655	.429	570.732	$p < .001$	$F(1, 761) = 570.732$, $p < .001$, $R^2 = .429$
		Predicted FinCumGPA = 17.070 +(.674 x FYGPA)*				
Black Male	FYGPA	.578	.335	227.349	$p < .001$	$F(1, 452) = 227.349$, $p < .001$, $R^2 = .335$
		Predicted FinCumGPA = 22.531 +(.528 x FYGPA)*				
White Female	FYGPA	.724	.525	1168.413	$p < .001$	$F(1, 1059) = 1168.413$, $p < .001$, $R^2 = .525$
		Predicted FinCumGPA = 22.576 +(.675 x FYGPA)*				
White Male	FYGPA	.754	.568	980.899	$p < .001$	$F(1, 746) = 990.899$, $p < .001$, $R^2 = .568$
		Predicted FinCumGPA = 16.208 +(.729 x FYGPA)*				
*sig. p<.001						

Overall, the correlations were moderate to strong between FYGPA and FinCumGPA for the different race and gender subgroups. The strongest correlation was for WM (r =.754 p < .001) followed by WF students (r =.724 p < .001). The lowest correlation in the subgroups was for BM students, although the correlation was still considered moderate to strong (r =.578 p < .001). For BM students, FYGPA accounted for 33.5% of variance in FinCumGPA ($F(1, 452) = 227.349$, $p < .001$, $R^2 = .335$), compared to the other race and gender subgroups, FYGPA accounted for 42.9%, 52.5% and 56.8% for BF, WF and WM students respectively.

(RQ 2.3) How is the relationship between FYGPA and FinCumGPA different for different school examination authorities?

The results of the regression analyses for the different school examination authorities are presented in Table 35 below. The results indicated that FYGPA accounted for 44.9% of variance in FinCumGPA for students from public schools. The percentage of variance that could be accounted for in FinCumGPA by FYGPA was 8.6% higher, at 53.5% for students from private schools. Consequently, FYGPA was a stronger predictor of FinCumGPA for students from private schools than for students from public schools.

Table 35: Regression Models per School Examination Authority

Linear Regression		R	R^2	F	Sig.	Model Equation
Public Schools	FYGPA	.670	.449	2003.833	$p < .001$	$F(1, 2458) = 2003.833$, $p < .001$, $R^2 = .449$
		Predicted FinCumGPA = 26.298 +(.568 x FYGPA)*				
Private Schools	FYGPA	.731	.535	649.112	$p < .001$	$F(1, 564) = 649.112$, $p < .001$, $R^2 = .535$
		Predicted FinCumGPA = 23.180 +(.645 x FYGPA)*				
*sig. p<.001						

The results from the linear regression analyses above indicated that the relationship between FYGPA and FinCumGPA changed in terms of race and gender, and also for students from public and private schools respectively.

Research Question 3: Assessing the Relationship between Input and Output

(RQ 3.1) What is the relationship between HSGPA, NBT results and FinCumGPA?

In order to address this research question, HSGPA, NBT results and FinCumGPA were analysed through correlational statistics. Pearson's correlation coefficients were computed among HSGPA, NBT results, FYGPA and FinCumGPA. The results are presented below and indicated significantly low to moderately positive correlations between HSGPA, NBT results, FYGPA and FinCumGPA.

Apart from FYGPA, HSGPA had the strongest relationship with FinCumGPA ($r = .433$, $p < .001$). Both the NBT AL and NBT QL results correlated slightly stronger with FinCumGPA ($r = .242$, $p < .001$ and $r = .214$, $p < .001$, respectively). Conversely, the NBT MATS results correlated stronger with FYGPA than with FinCumGPA ($r = .282$, $p < .001$ and $r = .218$, $p < .001$, respectively).

Table 36: Pearson's Correlation Matrix

	N	HSGPA	NBT AL	NBT QL	NBT MATS	FYGPA	FinCumGPA
HSGPA	3418	1					
NBT AL	3418	.406**	1				
NBT QL	3418	.459**	.605**	1			
NBT MATS	2823	.480**	.417**	.583**	1		
FYGPA	3418	.459**	.217**	.197**	.282**	1	
FinCumGPA	3026	.433**	.242**	.214**	.218**	.682**	1
**. Correlation is significant at the 0.01 level (2-tailed).							

Stepwise multiple linear regression analysis was performed to determine if HSGPA and NBT results were significant predictors of FinCumGPA. Prior to performing the regression analysis, the data were evaluated against the assumptions of regression namely normality, linearity, homoscedasticity, and absence of multicollinearity. Normality was assessed through a P-P plot, there was no drastic deviation visible and the assumption of normality was accepted. The linearity of the relationship between the HSGPA, NBT results, and FinCumGPA was assessed through the examination of a scatterplot. A residual plot was also examined for the linear relationship between the residual values and the predicted scores. The results of the correlation analysis above indicated that all correlations were acceptable (r = < .8) and the assumption of multicollinearity was not violated. The absence of multicollinearity was further confirmed with a VIF value below 10, indicating that the assumption was met. FYGPA was not included in the stepwise regressions analysis and was only included in the correlation matrix for comparison and ease of reference purposes.

The FinCumGPA was regressed with HSGPA together with the NBT results in order to determine the incremental value (R^2 as coefficient of determination), if any, of HSGPA and NBT results on predicting FinCumGPA. With a stepwise regression model, all the predictors were evaluated and only predictors that contributed significantly to the model were included in the regression equation.

Table 37 below indicates the results of the stepwise multiple regression analysis and presents two models that were statistically significant (p<.001). In the first model, HSGPA was a significant predictor of FinCumGPA $F(1,2519) = 581.713$, $p < .001$ and accounted for 18.8% of the total variance

in FinCumGPA. In the second model, NBT AL was added to HSGPA and the variance increased to 19.3%. Thus, when including the NBT AL results to HSGPA, the percentage of variance that could be accounted for in FinCumGPA increased by 0.4%.

Table 37: Stepwise Regression Analysis: FinCumGPA

Stepwise Regression		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.433	.188	581.713	$p < .001$	$F(1,2519) = 581.713$, $p < .001$, $R^2 = .188$
		Predicted FinCumGPA = 12.946 +(.617 x HSGPA)*				
Model 2	HSGPA NBT AL	.439	.193	300.787	$p < .001$	$F(2, 2518) = 300.787$, $p < .001$, $R^2 = .193$
		Predicted FinCumGPA = 11.258 +(.571 x HSGPA) + (.081 x NBT AL*)*				
*sig. p<.001						

(RQ 3.2) How is the relationship between HSGPA, NBT results and FinCumGPA different for Race and Gender Subgroups?

Stepwise linear regression analysis was repeated for the different race and gender subgroups to determine the regression coefficients and proportion of variance (R^2) in FinCumGPA that could be accounted for by HSGPA and NBT results. With stepwise regression analysis all the predictors were evaluated and only predictors that contributed significantly were included in the regression equation. The results of the analyses are presented in Table 38 below.

Table 38: Stepwise Regression Analyses: Race and Gender Subgroups

BLACK FEMALE		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.333	.111	80.079	$p < .001$	$F(1,642) = 80.079$, $p < .001$, $R^2 = .111$
		Predicted FinCumGPA = 21.323 +(.480 x HSGPA)*				
BLACK MALE		**R**	**R^2**	**F**	**Sig.**	**Model Equation**
Model 1	HSGPA	.407	.166	82.999	$p < .001$	$F(1, 418) = 82.999$, $p < .001$, $R^2 = .166$
		Predicted FinCumGPA = 14.205 +(.542 x HSGPA)*				
Model 2	HSGPA NBT QL	.426	.181	46.218	$p < .001$	$F(2, 417) = 46.218$, $p < .001$, $R^2 = .181$
		Predicted FinCumGPA = 11.889 +(.491 x HSGPA) + (.104 x NBT QL**)*				
WHITE FEMALE		**R**	**R^2**	**F**	**Sig.**	**Model Equation**
Model 1	HSGPA	.377	.142	129.937	$p < .001$	$F(1, 784) = 129.937$, $p < .001$, $R^2 = .142$
		Predicted FinCumGPA = 25.412 +(.500 x HSGPA)*				
WHITE MALE		**R**	**R^2**	**F**	**Sig.**	**Model Equation**
Model 1	HSGPA	.490	.240	211.284	$p < .001$	$F(1, 669) = 211.284$, $p < .001$, $R^2 = .240$
		Predicted FinCumGPA = 6.469 +(.690 x HSGPA)*				
Model 2	HSGPA NBT AL	.496	.246	108.978	$p < .001$	$F(2, 668) = 108.978$, $p < .001$, $R^2 = .246$
		Predicted FinCumGPA = 3.515 +(.645 x HSGPA) + (.096 x NBT AL**)*				

*sig. p<.001
**sig. p<.05

The results of the stepwise regression analyses indicated that HSGPA was a significant predictor of FinCumGPA in all the race and gender subgroups. It was evident that HSGPA accounted for 11.1% of variance in FinCumGPA for BF students, whereas HSGPA predicted 14.2% of FinCumGPA for WF students. The NBT results were only included as significant predictors in the regression models of BM and WM students. Furthermore, HSGPA accounted for 16.6% of variance in FinCumGPA for BM students, as per Model 1, but with the addition of NBT QL in Model 2, a total of 18.1% variance could be explained in FinCumGPA. The stepwise regression analysis presented two models for WM students. In Model 1, HSGPA contributed 24% to FinCumGPA and with the addition of NBT AL, the variance increased by 0.6% in Model 2.

Overall, the results indicated that HSGPA was a significant predictor of FinCumGPA across all race and gender subgroups. In addition to HSGPA, the stepwise regression equations indicated that NBT QL was a significant predictor for only BM students and NBT AL was a significant predictor for only WM students.

(RQ 3.3) How is the relationship between HSGPA, NBT results and FinCumGPA different for school examination authorities?

Stepwise linear regression analysis was also conducted for the different school examination authorities to investigate the predictive validity of HSGPA and NBT results on FinCumGPA for students from different schools. The results are presented in Table 39 below.

Overall, the results of the stepwise regression analysis indicated that HSGPA can significantly predict FinCumGPA. HSGPA accounted for 19.6% of variance in FinCumGPA for students from public schools, and the addition of NBT AL increased the variance by 0.2% to 19.8% of the total variance in FinCumGPA that can be predicted.

The results of the stepwise regression analysis also indicated two models for students from private schools. In Model 1, HSGPA accounted for 23.8% of variance in FinCumGPA. When NBT QL was added to the regression equation, the total variance predicted increased to 26.5% in Model 2. The results from the stepwise regression analysis below indicated that the relationship between HSGPA, NBT results and FinCumGPA changed for the different students in terms of race and gender subgroups and school examination authority.

Table 39: Stepwise Regression Analysis: Schooling Authorities

PUBLIC SCHOOLS		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.443	.196	496.486	$p < .001$	$F(1, 2036) = 496.486$, $p < .001$, $R^2 = .196$
		Predicted FinCumGPA = 11.816 +(.622 x HSGPA)*				
Model 2	HSGPA NBT AL	.445	.198	250.745	$p < .001$	$F(2, 2035 = 250.745$, $p < .001$, $R^2 = .198$
		Predicted FinCumGPA = 11.114 +(.592 x HSGPA) + (.048 x NBT AL**)*				
PRIVATE SCHOOLS		R	R^2	F	Sig.	Model Equation
Model 1	HSGPA	.487	.238	149.846	$p < .001$	$F(1, 481) = 149.846$, $p < .001$, $R^2 = .238$
		Predicted FinCumGPA = -5.398 +(.767 x HSGPA)*				
Model 2	HSGPA NBT QL	.515	.265	86.452	$p < .001$	$F(2, 480) = 86.452$, $p < .001$, $R^2 = .265$
		Predicted FinCumGPA = 5.778 +(.901 x HSGPA) + (-.153 x NBT QL*)*				
*sig. p<.001 **sig. p<.05						

(RQ 3.4) How do the NBT benchmarks relate to Final Academic Status?

Table 40 below indicates the cross-tabulated results of NBT benchmark levels and the number of students who dropped out or were excluded, students who were still active after six years and the students who completed their degrees.

The results indicated that 69% of students who performed Basic in AL completed their degrees and only 12% dropped out. Similarly, the majority of students who performed Basic (68%) in QL completed their degrees. Furthermore, a total of 73% of students who performed Basic in MATS completed their degrees. Overall, the table below indicates findings contrary to the definitions of the NBT benchmark levels.

Table 40: NBT Benchmarks Final Academic Status

NBT Tests Benchmarks			Dropout / Excluded		Active		Completed	
		Total	N	%	N	%	N	%
AL	Basic	54	12	22	5	9	37	69
	Intermediate	1692	401	24	202	12	1089	64
	Proficient	1672	264	16	180	11	1228	73
QL	Basic	217	45	21	24	11	148	68
	Intermediate	2203	471	21	254	12	1478	67
	Proficient	998	161	16	109	11	728	73
MATS	Basic	574	93	16	64	11	417	73
	Intermediate	1974	449	23	222	11	1303	66
	Proficient	275	53	19	21	8	201	73

Contrary to the definitions of the NBT benchmark levels, these results indicated that the benchmark levels do not relate to degree completion in terms of identifying students who were less likely to complete their degrees, as the finding was that the majority of students completed their degrees, regardless of their NBT benchmark levels.

4.7 SUMMARY OF RESULTS

The overall research design used in this study was a retrospective correlational cohort study to investigate the predictive validity of HSGPA and NBT results. Consequently, correlational analyses and various regression analyses formed part of the statistical methodology followed to answer the research questions.

The overarching goal of this study was to develop a model that can predict academic success and that can be used in the admissions processes to improve university system output and effectiveness. This was done by investigating if school exiting results (HSGPA) and the National Benchmark Tests (NBT results) were significant predictors of academic success after the first-year (FYGPA) and the final academic grade point average (FinCumGPA) measured over a period of six years, taking into account race, gender and school examination authority.

Subsequently, the relationship between FYGPA and FinCumGPA was assessed in order to develop an integrated model predictive of academic success. In addition, the NBT benchmark levels were evaluated against first-year progress and final academic status.

Firstly, the descriptive analysis for the predictor variables (HSGPA and NBT results) and the criterion variables (FYGPA and FinCumGPA) were obtained. The HSGPA mean score of female students was found to be higher than for male students, whereas the NBT mean scores were higher for male students than for female students. White students had a higher HSGPA and NBT mean scores than black students. The mean scores of both FYGPA and FinCumGPA were higher for female students than for male students. White students had higher FYGPA and FinCumGPA mean scores than black students. To investigate differences further, the data were analysed according to four race and gender subgroups as black females (BF), black males (BM), white females (WF) and white males (WM). The HSGPA mean score for WF students was the highest and for BM students the lowest when compared to the other race and gender subgroups. The NBT mean scores were highest for WM students on all three tests, and BF students had the lowest mean scores on NBT QL and MATS, while BM students had the lowest mean score for NBT AL.

The descriptive analysis of the criterion variables indicated that WF students had the highest FYGPA and FinCumGPA mean scores. WF and WM students had lower FYGPA mean scores than FinCumGPA mean scores, as opposed to BF and BM students, who had higher FYGPA mean scores and lower FinCumGPA mean scores. Although WF students had the highest FYGPA and FinCumGPA, 35% of the students who dropped out were WF students. In terms of the completed status, 79% of WF students completed their degrees over the six years, followed by 69% WM and 67% BF students. Only 48% of BM students in this sample completed their degrees during the six years. A larger percentage of BM students (11%) had an active status after six years, indicating that they were still in the process of completing their degrees.

The key findings of the descriptive data analysis for the different race and gender subgroups can be summarised as follows:

- White female students had the highest HSGPA mean scores, as well as the highest FYGPA and FinCumGPA mean scores. The academic performance of WF students generally increased after their first year, with a higher FinCumGPA mean score than their FYGPA mean score. Proportionally, when compared to the other subgroups, the largest group of students who

dropped out or voluntarily left the university were WF students. Yet, 80% of WF students still completed their degrees within six years.

- White male students had the highest standardised test (NBTs) mean scores. Similar to WF students, the academic performance of WM students generally increased after their first year, with a higher FinCumGPA mean score than their FYGPA mean score. Almost 70% of WM students completed their degrees within six years.
- Black female students had the lowest NBT mean scores for Quantitative Literacy and Mathematical Literacy. The FYGPA mean score of BF students were higher than their FinCumGPA mean score, indicating that academic performance declines after their first year. However, still close to 70% of BF students completed their degrees within six years.
- The HSGPA mean score was the lowest for BM students, as well as the NBT Academic Literacy mean score. As with BF students, BM students had a higher FYGPA mean score than their FinCumGPA mean score, indicating a decline in academic performance after their first year. Only 48% of BM students completed their degrees within six years, and 41% of BM students dropped out or were excluded during this time.

The first and third research questions focused on the predictive validity of HSGPA and NBT results on FYGPA and FinCumGPA respectively. In order to answer the research questions, Pearson's correlation coefficients were computed among HSGPA, NBT results, FYGPA and FinCumGPA.

The results indicated significantly low to moderately positive correlations between the variables. HSGPA correlated stronger with FYGPA and FinCumGPA than the NBT results. Intercorrelations between HSGPA and NBT results were moderate, indicating that the variables were somewhat related. This finding is in line with a recent study that investigated the relationship between NSC results and NBT tests, and explained that the NBT tests, were complementary to HSGPA, hence the weaker correlations as opposed to very strong intercorrelations between the predictor variables (Prince, 2017).

Secondly, multiple stepwise linear regression analysis was performed to determine if HSGPA and NBT results were significant predictors of FYGPA and FinCumGPA, respectively. Prior to performing the regression analysis, the data were evaluated to ensure that the assumptions of regression, namely normality, linearity, homoscedasticity, and absence of multicollinearity, were met.

The FYGPA and FinCumGPA (separately) were regressed with HSGPA together with the NBT results in order to determine the incremental value (R^2 as coefficient of determination), if any, of HSGPA and NBT results in predicting FYGPA and FinCumGPA. All the predictor variables were evaluated in the stepwise regression model, and only predictors that contributed significantly were included in the regression equation. The regression models were based on the full sample including all students in the overall models, and separate regression models were determined for the different race and gender subgroups, as well as for students from public schools and students from private schools. Table 41 below provides a summary of the results of the various stepwise regression models related to the research questions.

Table 41: Summary of Regressions Models HSGPA and NBT Results Predicting FYGPA and FinCumGPA

		FYGPA (R^2 *change*)	FinCumGPA (R^2 *change*)
All Students	HSGPA	21%	18.8%
	HSGPA + NBT MATS + NBT QL + NBT AL	22% (1%)	
	HSGPA + NBT AL		19.3% (0.5%)
RACE & GENDER SUBGROUPS:			
Black Female	HSGPA	12.4%	11.1%
	HSGPA + NBT MATS	13.4% (1%)	
Black Male	HSGPA	15.5%	16.6%
	HSGPA + NBT AL + NBT MATS	17.1% (1.6%)	
	HSGPA + NBT QL		18.1% (1.5%)
White Female	HSGPA	21.6%	14.2%
	HSGPA + NBT MATS + NBT AL	23.8% (2.2%)	
White Male	HSGPA	32.2%	24%
	HSGPA + NBT AL	32.8% (0.6%)	24.6% (0.6%)
SCHOOL AUTHORITIES:			
Public Schools	HSGPA	22.1%	19.6%
	HSGPA + NBT MATS + NBT QL	23% (0.9%)	
	HSGPA + NBT AL		19.8% (0.2%)
Private Schools	HSGPA	22.3%	23.8%
	HSGPA + NBT QL	23.2% (0.9%)	26.5% (2.7%)

Overall, HSGPA accounted for the largest percentage of variance in both FYGPA and FinCumGPA in all regression models. When the NBT results were added to HSGPA in various test combinations, the NBT results provided for small percentages of additional variance in FYGPA and FinCumGPA in some models.

The NBT results were not found to be significant predictors of FinCumGPA for BF and WF students. The NBT MATS had the largest predictive power for WF students, adding 1.9% to HSGPA in predicting FYGPA and the largest contribution of the NBT results to HSGPA predicting FinCumGPA, was the NBT QL, adding 2.7% to predictive variance for students from private schools. HSGPA was consistently the strongest significant predictor of FYGPA for all students in the sample and across the race and gender subgroups, as well as school examination authorities. Furthermore, in predicting FinCumGPA, the results indicated that HSGPA was the strongest predictor accounting for the largest percentage of variance in FinCumGPA.

The second research question focused on the relationship between FYGPA and FinCumGPA. Table 42 below presents a summary of all the regression models of FYGPA in predicting FinCumGPA. The results indicated that the proportion of variance in FinCumGPA that could be explained by FYGPA differed considerably when race and gender and school examination authority were taken into account.

Table 42: Summary of Regressions FYGPA predicting FinCumGPA

% Variance Predicted by FYGPA in FinCumGPA	
All Students	46.5%
RACE & GENDER SUBGROUPS	
Black Female	42.9%
Black Male	33.5%
White Female	52.5%
White Male	56.8%
SCHOOL AUTHORITIES	
Public Schools	44.9%
Private Schools	53.5%

Overall, the proportion of variance in FinCumGPA that could be accounted for by FYGPA ranged from 33.5% to 56.8%. In terms of race and gender, FYGPA predicted FinCumGPA 23.3% more for WM students than for BM students. For students from private schools, FYGPA predicted FinCumGPA 8.6% more than for students from public schools.

In addition to investigating the predictive validity of the NBT results through the regression models above, the study also evaluated the NBT benchmark levels against academic progress and as well as against final academic status.

In terms of progress after the first year, the evaluation indicated that more than 88% of students who achieved Basic performance on any of the NBT tests, progressed after their first year to the second year. Thus, the majority of the students continued with their studies irrespective of their NBT benchmark levels. Therefore, the indication was that the NBT benchmarks did not relate to progress in terms of identifying students who were less likely to continue with their studies after their first year.

Furthermore, the NBT benchmark levels were evaluated against final academic status and the results were similar, indicating that at least 68% of students who achieved Basic performance, actually completed their degrees. This finding is contradictory to the NBT benchmark level definitions stating that Basic performance indicated serious learning challenges and those students would not succeed without extensive long-term support at university (Frith & Prince, 2016).

Chapter 4 presented the results of this study. The descriptive statistics for all variables in this study were presented and was followed by the statistical analysis of the data to answer each research question. Various stepwise and enter regression analyses resulted in a total of 38 regression models that were computed in this study. The implications of the results and findings are discussed next in Chapter 5.

CHAPTER 5

DISCUSSION

Chapter 5 provides a discussion and an interpretation of the findings presented in Chapter 4. The limitations and implications of the research findings are also discussed, and this chapter concludes with recommendations for further research.

5.1 INTRODUCTION

Departing from the theoretical principles of the systems theory, and building on Astin's I-E-O model (Astin, 1991) as presented in Chapter 2, the main goal of this study was to develop a model predictive of academic success that can be used in the admissions processes (input) to improve university system output and effectiveness. Astin's I-E-O model provided a logical framework for this study to assess relationships, as the model promotes the study of several variables simultaneously through multivariate analysis of complex interactions (see for example studies by Bergeron, 2013; Blair, 2014; Campbell, 2012; Edmunds, 2010b; Harner, 2014; Irlbeck et al., 2014; Korobova, 2012; Miller, 2013; Moore, 2013; Murray, 2006; Murray, 2014; Niehaus, 2012; Yanto et al., 2011; York et al., 2015).

The study investigated if school exiting results (HSGPA) and the National Benchmark Tests (NBT results) were significant predictors of academic success after first-year (FYGPA) and final academic grade point average (FinCumGPA), measured over a period of six years, taking into account race, gender and school examination authority. The relationship between FYGPA and FinCumGPA was also assessed in order to develop an integrated model predictive of academic success. In addition, the NBT benchmark achievement levels were evaluated against first-year progress and final academic status. In keeping with Astin's I-E-O model, the research questions that guided this study resolved to find relationships between Input and Processing; the relationship between Processing and Output, and lastly the relationship between Input and Output as depicted in Chapter 2 (refer to Figure 6, Conceptual Framework in Chapter 2 of this study).

The study aimed to answer the following research questions:

Research Question 1: Assessing the relationship between Input and Processing (ABC)

- What is the relationship between HSGPA, NBT results and FYGPA? What additional information or predictive variance do NBTs provide to HSGPA? How is the relationship between HSGPA, NBT results and FYGPA different for race and gender subgroups? How is the relationship between HSGPA, NBT results and FYGPA different for school examination authorities? How do the NBT benchmarks relate to dropout or exclusion after first-year?

Research Question 2: Assessing the relationship between Processing and Output (CD)

- What is the relationship between FYGPA and FinCumGPA? How is the relationship between FYGPA and FinCumGPA different for race and gender subgroups? How is the relationship between FYGPA and FinCumGPA different for different school examination authorities?

Research Question 3: Assessing the relationship between Input and Output (ABD)

- What is the relationship between HSGPA, NBT results and FinCumGPA? How is the relationship between HSGPA, NBT results and FinCumGPA different for race and gender subgroups? How is the relationship between HSGPA, NBT results and FinCumGPA different for school examination authorities? How do the NBT benchmarks relate to Final Admission Status?

5.2 INTERPRETATION OF THE FINDINGS

The findings on the predictive validity of the final NSC results (HSGPA) and the NBT results on a student's academic success provided a range of statistics, especially when the variables are taken into account as presented in Chapter 4. This section provides an interpretation of the overall findings.

Firstly, the descriptive analysis for the predictor variables (HSGPA and NBT results) and the criterion variables (FYGPA and FinCumGPA) were obtained. These results highlighted differences in performance on both predictor and criterion variables as it related to race and gender. For example, it was found that the HSGPA and NBT results, as well as FYGPA and FinCumGPA mean scores were higher for white students than for black students. Similarly, female students had a higher HSGPA mean score and higher FYGPA and FinCumGPA mean scores than male students. However, the NBT mean scores on all three tests were higher for male students than for female students.

In general, these findings were not surprising, as many previous studies found similar differences in predictor and criterion performance in terms of race and gender variables. In fact, in some of these studies, race and gender were specifically included in the predictive models and regression analyses to determine the impact of race and gender, and in other studies, the differential prediction of academic performance in terms of race and gender were investigated (see for example research by Al-hattami, 2012; Blanchet, 2016; Kyei-Blankson, 2005; Powell, 2003; Sanchez, 2013; Schutts, 2016; Yanto, 2012).

In this study, the observed differences in performance were further examined by analysing the data in four subgroups namely black females (BF), black males (BM), white females (WF) and white males (WM). Although, as indicated above, many predictive studies have investigated race and gender differences, this specific level of granular analysis for the different race and gender subgroups used in this study, is not common in related research. The results of this study indicated that the granularised level of analysis was useful, as it provided specific information for the different race and gender subgroups relating to the predictor and criterion variables.

Of all the subgroups, WF students had the highest HSGPA, FYGPA and FinCumGPA mean scores, while WM students had the highest NBT mean scores. The academic performance of both WF and WM students generally increased after their first year, as they had higher FinCumGPA mean scores than their FYGPA mean scores. On the other hand, the FYGPA mean scores for BF and BM students were higher than their FinCumGPA mean scores, indicating a decline in academic performance after their first year.

More than 80% of WF students and close to 70% of all BF and WM students completed their degrees within the six years. However, less than half, only 48% of BM students completed their degrees within the same time, and a total of 41% of BM students dropped out during this period. The findings indicated that BM students were most at risk of dropout and non-completion of their studies at university. This finding is supported by other studies. A recent study in America on school performance as opposed to university performance, also found that African American males were most likely to drop out from school (Powell, 2018). Another American study on predicting first-year academic success for African American students in predominantly white institutions, found that 39% of African American students dropped out during their first year (Benton, 2018). However, when looking specifically at gender and race subgroups, it has also been reported that black males have

the highest attrition rates among race and gender groups, with about two thirds of black male students dropping out of higher education (Strayhorn, 2014).

The descriptive statistics of the predictor variables and the criterion variables were also analysed for students from public schools and students from private schools. The results indicated that the HSGPA mean score for students from public schools were higher than for students from private schools. One reason for the differences in HSGPA mean score could be the fact that students from private schools wrote a different examination than students from public schools. Some private schools in South Africa offer an equivalent NSC examination by the Independent Examinations Board (IEB) that is bound within the constraints of national legislation and provisions of national quality assurance (Oberholzer, 2018). Another reason for the higher HSGPA mean score for students from public schools may be related to reported grade inflation (Govender & Moodley, 2012; Nel & Kistner, 2009; Simkins, 2011). Hunt et al. (2011) reported that NSC marks have been inflated by up to 25%, and another study by Dennis and Murray (2012) found NSC Mathematics marks being inflated by 20%. Thus, grade inflation would consequently result in a higher HSGPA mean score for students from public schools.

Although students from private schools had a lower HSGPA mean score than students from public schools, the converse was found in terms of the standardised tests. Students from private schools had higher mean scores on all three NBT tests, than students from public schools. Another study at a South African university also found that students from private schools performed significantly better in the admission tests when compared to students from public schools (Wadee & Cliff, 2016). The higher NBT mean scores for students from private schools could possibly indicate that these students were better prepared for the NBTs through additional training, since students from private schools would potentially have access to such additional training due to better financial resources.

In terms of the criterion variables of academic performance, the FYGPA and FinCumGPA mean scores for students from private schools were higher than for students from public schools. Thus, students from private schools had a lower HSGPA mean score, higher NBT mean scores, and had higher FYGPA as well as FinCumGPA mean scores. Given that admission to South African universities is based on school performance (NSC) it may be that some students from private schools were not admitted due to their lower NSC results, although these students would perform better at university than students from public schools, as they obtained higher FYGPA and FinCumGPA mean

scores. Van Broekhuizen et al. (2017) stated that 'significant inequalities' in university outcomes between race groups are largely due to a weak national (public) schooling system. Supporting this statement, the results of this study point to even further inequalities in university outcomes between students from public schools and students from private schools.

The results of the inferential statistical analysis of the data, focusing on predicting academic success, found that the NSC had a stronger relationship with first-year academic performance and final academic performance, than the relationship of the standardised tests (NBTs) with first-year and final academic performance. In other words, the NSC was a stronger predictor of first-year and final cumulative academic performance, whilst the NBTs added very little, and in some cases no additional predictive value. For example, the NBT results were not significant predictors of FinCumGPA for BF and WF students, and were therefore not included in these regression models for these students.

These findings are in line with a few other studies that found final school results, in particular NSC results predictive of first-year performance (Kridiotis, Bezuidenhout, & Raubenheimer, 2016; Tewari, 2014; Visser & Van Zyl, 2013). Likewise, other similar studies that compared the predictive strength of the NSC with NBT results, also found that HSGPA was the strongest predictor of first-year academic performance (Du Plessis & Gerber, 2012; Wilson-Strydom, 2012).

The weak correlations between the two predictor variables (NSC and NBT results) indicated that the relationships between the NSC and NBT domains of Academic Literacy, Quantitative Literacy and Mathematical Literacy were not strong. The weak relationship between NSC and NBT results could also indicate that the NSC and NBT tests did not measure the same constructs. In such a case it could be argued that the NBT results should provide additional information about scholars entering universities. In fact, according to Frith and Prince (2018) the purpose of the NBT project was to develop a benchmark assessment to measure the academic proficiency of prospective students that would provide complementary information to school exiting results. Prince (2017) explained that the NBT results were complementary to the NSC results because the tests were designed for different purposes. He argued that the NSC was a national school exiting examination that was not intended to assess readiness for higher education. Also, according to Prince (2017), the fact that NBT tests were criterion-referenced and final school examinations (NSC) were norm-referenced could be another reason why the results were complementary. In another article on both the NSC and NBT results Prince (2017) stated:

> "The results of the NSC are norm-referenced (they yield an estimate of the position of the tested individual learner in relation to her peers) and are often difficult to interpret for the purposes of admission, placement and curriculum development… The NBTs are criterion-referenced (they generate a statement about the behaviour that can be expected of a person with a given score) and test students in three domains: Academic Literacy, Quantitative Literacy and Mathematics" (Prince, 2017, page 133).

Le Roux and Sebolai (2017) studied the linearity of the relationship between the NSC and NBT and found a curvilinear relationship and a moderate correlation between NSC Mathematical Literacy test and NBT Quantitative Literacy test. They concluded that because the NSC and NBTs were related but not identical, both should be used as complementary measures in the admissions and placement processes of students to universities.

Although the arguments above could, to some extent, explain the reason for the weak correlations found between the NSC and NBT results in this study, these arguments did not answer the research question related to what additional information the NBT results provided to NSC.

Thus, in answering the research question of whether the NBT results added additional value to NSC (as HSGPA) in predicting FYGPA and FinCumGPA, this study found that the results did add additional value. The indication was that, statistically, the NBT results did provide additional information to HSGPA (albeit only between 0.4% and 2.7% additional variance) in predicting FYGPA and FinCumGPA for all students in the overall sample, and specifically for BM and WM students (though the NBT results were not significant predictors of FinCumGPA for BF and WF students). However, the practical value of the additional information that the NBT results provided in some of the regression models is questionable given the small percentages of additional variance. Wilson-Strydom (2012) reported similar results when comparing the predictive validity of the NSC and NBT, indicating relatively small contributions of the NBT results in the regression models.

Given that the additional or complementary information that the NBT results were supposed to provide to NSC results, was not evident in the regression models in this study, the NBT benchmark levels were then evaluated against final academic status. However, further to the poor correlations and lack of predictive validity of the NBTs, it was found that the benchmark categories used to classify students as "Proficient", "Intermediate" and "Basic" according to their level of preparedness for university (in terms of academic literacy, quantitative literacy and mathematical literacy), did not

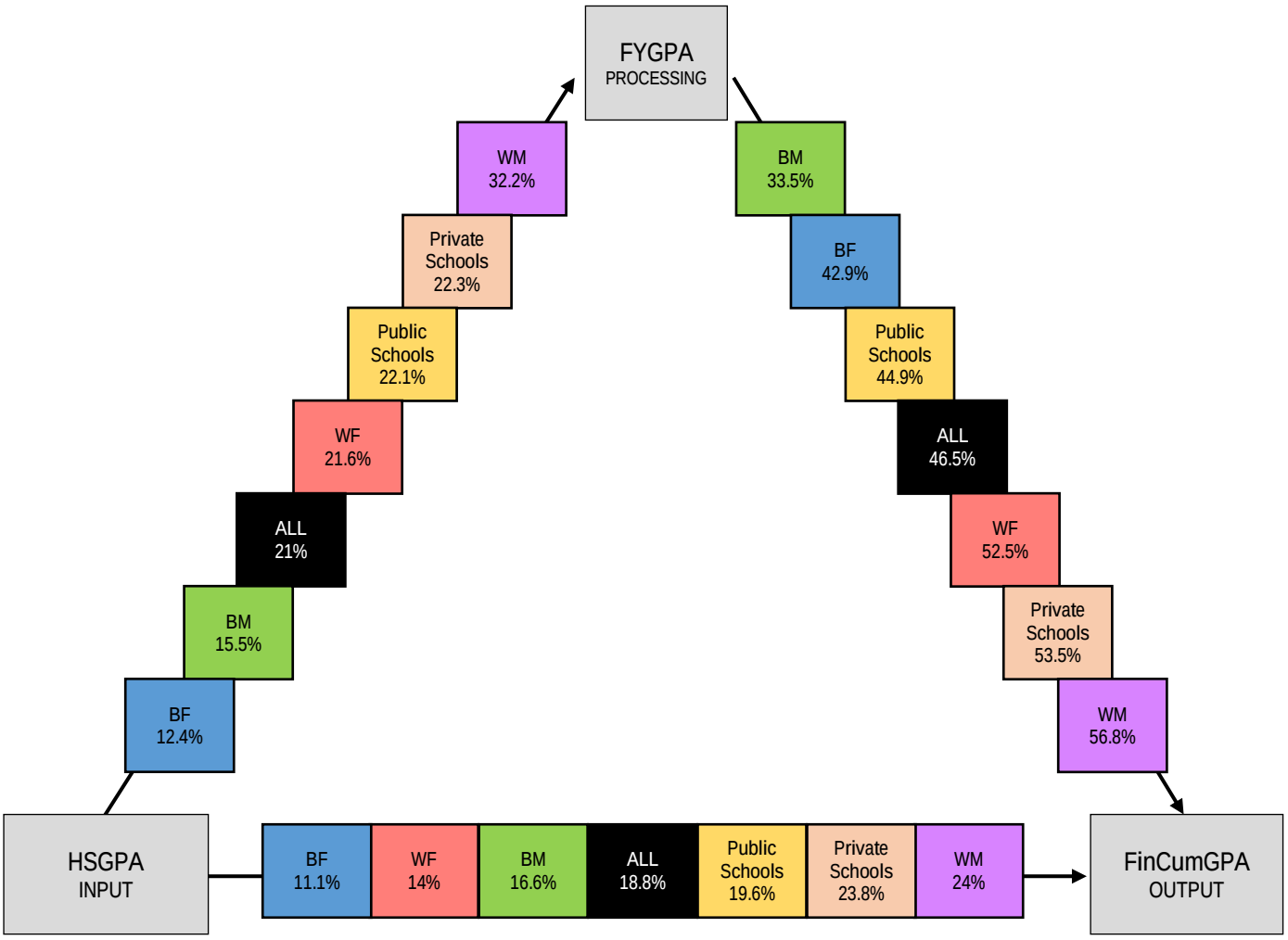
correspond with students' actual progress and final academic status. For example, contrary to the benchmark level definitions, the majority of the students who performed Basic in the NBT tests, actually completed their degrees within six years. In fact, at least 68% of students achieving Basic performance completed their degrees, and the percentages were similar for students who performed Intermediate (at least 64%) and Proficient (at least 73%) that completed their degrees. According to the NBT test developers, CETAP (2017, p17), Basic achievement indicates "Serious learning challenges identified. Students will not cope with university study".

To increase throughput and student success, universities should be able to identify students at risk of potential dropout or poor academic progress as early as possible to ensure that additional support is provided to such students. However, the analysis of the benchmark levels and academic status of the students in this study revealed that the Basic benchmark achievement level did not accurately identify students who would not be successful at university, or that who experience serious learning challenges and would not succeed without significant institutional interventions and support.

As a result of these findings, and due to the lack of predictive validity, the NBT results were not included in the integrated admissions model presented below.

5.3 TOWARDS PREDICTING ACADEMIC SUCCESS

The overarching goal of this study was to develop a model predictive of academic success that can be used in the admissions processes to improve university system output and effectiveness. The model below depicts the percentages of variance that HSGPA predicted in FYGPA and in FinCumGPA as well as the percentages of variance that FYGPA predicted in FinCumGPA. The overall model (ALL) refers to the results of the regression analyses of all students in the sample. The different race and gender subgroups, as well as school examination authorities were included in the model and integrated in the results of the various regression models for the specific subgroups.



Source: Author's own illustration

Figure 14: Integrated Admissions Model: Predicting FYGPA and FinCumGPA

The research questions that informed this study will now be looked at as they relate to the model in Figure 14.

Research Question 1: Assessing the relationship between Input and Processing (ABC)

In the overall model that included all the students in the sample, HSGPA predicted 21% of FYGPA (marked as ALL in Figure 14 above). Thus, the results indicated that, in general, the NSC is predictive of first-year academic performance measured as FYGPA. However, vast differences are observed in the percentage of variance HSGPA explained in FYGPA for the different race and gender subgroups. For example, HSGPA predicted almost 20% more variance in FYGPA for WM students than for BF students. Only 12.4% of variance in FYGPA could be explained by HSGPA for BF students, whereas 32.2% of variance in FYGPA could be explained by HSGPA for WM students. Similarly, HSGPA predicted 15.5% of FYGPA for BM students, and 21.6% for WF students. These differences in regression models indicated that the overall regression model based on all students in the sample, with HSGPA as predictor variable, could over-predict FYGPA for BF and BM students with 8.6% and 5.5% respectively, and under-predict FYGPA for WM students by 11.2%.

In terms of schools, despite the statistically significant differences in HSGPA and FYGPA mean scores for students from public schools and students from private schools, the difference between these students were minimal (0.2%) as far as it related to the predictive validity of HSGPA and FYGPA. In other words, the NSC results did not really predict more variance in first year academic performance for students from private schools than for students from public schools, as there was a difference of 0.2%.

Overall, the results highlighted the need for granularised admission practices with regard to a student's race and gender. Furthermore, the results indicated that first-year academic performance was largely affected by other variables not accounted for in this study, and that the impact of the unaccounted-for variables on FYGPA may be larger for BF and BM students than for WF and WM students where HSGPA explained more variance in FYGPA.

There is great emphasis on FYGPA as an outcome variable and the overall importance of the first-year experience in educational research, as first-year performance at a higher education institution is linked to retention and persistence, as well as future academic success (Curtis et al., 2007; Iddrisu, 2009; Mudric, 2012; Nadasen & List, 2016).

Research also indicated that students were most vulnerable for dropout during their first year at a higher education institution (Ameri, 2015; Kruzicevic et al., 2012). The results of the study confirm this, and found that 51% of student dropouts occurred during their first year at university.

The reasons for dropout were not necessarily related to academic performance only, and many other factors have been found to impact on student persistence and retention (Burrus et al., 2013; McDaniel, 2016; Therriault & Krivoshey, 2014; Zekarias, Aba-Milki, & Mikre, 2015). Shay (2017) asserted that student persistence and retention were affected by input variables related to students' background (including age, schooling, race and gender) and by institutional variables (academic, environmental and social) that students were exposed to during their studies. These variables created a complex interaction between students' commitments (including the resources available to them) and the institutional conditions (including academic demands) that determined the extent to which students successfully integrate and succeed.

In this study, the reasons for dropout were not specifically investigated, although the descriptive statistics indicated that half of the students who dropped out, were academically excluded due to poor academic performance during their first year.

Research Question 2: Assessing the relationship between Processing and Output (CD)

The results of this study found that first-year academic performance had a very strong relationship with final academic performance. The regression analysis indicated that FYGPA was a significant predictor of FinCumGPA and that 46.5% of variance in FinCumGPA could be predicted by FYGPA when all students in the sample were in included in the regression model.

However, the differences observed in the percentages that FYGPA explained in FinCumGPA for students of different race and gender subgroups, as well for students from different school examination authorities, were alarming. FYGPA explained 23.3% more variance for WM students in FinCumGPA than for BM students. Where more than half of FinCumGPA could be predicted for WM students, only about a third of FinCumGPA could be predicted for BM students. Thus, unaccounted-for variables had a larger impact on the academic performance of BM students than for WM students.

Similarly, the results indicated a difference of 8.6% in total variance FYGPA explained in FinCumGPA between students from public schools and students from private schools. Although the relationship between NSC results and FYGPA was not very different for students from public schools and students from private schools, this finding indicated that the impact of schooling (public vs private) may be manifested in academic performance after a student's first year. While students from private schools had a lower HSGPA mean score than students from public schools, students from private schools had higher FYGPA and FinCumGPA mean scores. Furthermore, the results of the regression models indicated that the first-year academic performance was more predictive of their final academic performance for students from private schools, than for students from public schools.

Overall, the findings of this study related to the relationship between first-year academic performance and final academic performance pointed to serious inequalities in university outcomes for students from different race and gender subgroups, as well as for students from public and private schools.

Research Question 3: Assessing the relationship between Input and Output (ABD)

The results of the regression analysis between Input and Output indicated that HSGPA was a significant predictor of FinCumGPA. In the overall model, HSGPA explained 18.8% of variance in FinCumGPA based on all students in the sample.

Similar to the findings above, large differences were found in the relationship between HSGPA and FinCumGPA for students from different race and gender subgroups. The percentage of variance HSGPA explained in FinCumGPA for WM students (24%) is more than double the percentage of variance HSGPA explained in FinCumGPA for BF students (11.1%).

HSGPA accounted for 19.6% of variance in FinCumGPA for students from public schools, and for students from private schools, HSGPA accounted for 23.8% of variance in FinCumGPA. In reference to the relationship between HSGPA and FYGPA, the results of the regression models indicated a minimal difference in predictive variance (0.2%) for students from private schools and students from public schools. The analysis of the relationship between HSGPA and FinCumGPA however, indicated that, not only does HSGPA predict more variance in final academic performance for students from private schools when compared to students from public schools; but also that HSGPA is more predictive (albeit only 1.5%) of final academic performance than of first-year academic performance for students from private schools. This was an interesting finding that was isolated to

students from private schools and also for BM students where HSGPA predicted more variance in FinCumGPA than in FYGPA.

In this study, the overall model based on all the students in the sample, indicated that HSGPA was a stronger predictor of FYGPA (21%) than of FinCumGPA (18.8%). The predictive strength of HSGPA on FinCumGPA also declined by 7.6% and 8.2% for WF and WM students respectively when compared to the predictive strength of HSGPA on FYGPA. This was not surprising, as research indicated that the strength of correlations of HSGPA and academic performance declined after the first year (Al Alwan et al., 2013; Santelices & Wilson, 2012; Wikström & Wikström, 2012) because many other factors affect success during a student's studies (Zwick, 2007).

Shay (2017) found that background variables significantly impacted on student success. She summarised the findings from a research study at a South African university on academic exclusion and survival analysis as follows:

> "The study concluded that being white, ineligible for financial aid and proficient in English, and having attended a top public or private school and obtaining good high school grades increased the likelihood of graduating. On the other hand, men who are on financial aid, non-English speaking, who attended poorly resourced schools and achieve low school grades are more likely to be academically excluded" (Shay, 2017, p13).

Taking into consideration the various regression models, the overall results of this study reflected the above findings. The regression models indicated that the relationships between school results, first-year academic performance and final academic performance, were very different for students of different race and gender subgroups as well as for students from private and public schools. These findings highlighted the need for different admission models and granularised admission practices for different students (in terms of race, gender and schooling) as the overall model that is based on all students in the sample would result in both under- and over-prediction of the criterion variables.

The practical implications of the findings are summarised in the next section and is followed by the limitations of the study.

5.4 PRACTICAL IMPLICATIONS OF THE FINDINGS

This study found that HSGPA was the strongest predictor of academic success. The results indicated that final NSC results could predict FYGPA as well as FinCumGPA, for all students in the overall model, and for the different race and gender subgroups, as well as school examination authorities. Even though the inclusion of the NBT results provided some additional variance to HSGPA (ranging from 0.2% to 2.7%) in predicting FYGPA and FinCumGPA for some of the models, the practical significance of the NBT results remained questionable. Furthermore, the evaluation of the NBT benchmark levels against academic progress and final academic status revealed no apparent relationship between the variables and casted even more doubt on the use and value of the NBT results for admission or placement purposes. As a result of these findings, the use of the NBT results for admission or placement purposes at universities is not justified, and consequently not recommended.

In terms of the NSC results as a predictor variable, the moderate correlations that emerged between HSGPA and both FYGPA and FinCumGPA were important findings. Since university admission requirements are set in terms of NSC performance, the moderate relationship between the NSC results and academic performance, indicated that university admission criteria are set on a real (and statistically significant) relationship between school results and university performance.

The high correlation between FYGPA and FinCumGPA indicated a strong relationship between first-year academic performance and the final grade point average on a student's record, regardless of when during the six-year period a student dropped out, were excluded or completed his/her studies. In line with other research findings, the results of this study indicated that FYGPA was the best predictor of further academic performance at university (see for example Alkhasawneh, 2011; Curtis et al., 2007; Garza & Bowden, 2014; Iddrisu, 2009; Mudric, 2012).

Furthermore, the results of this study confirmed that students were most likely to drop out of university during their first year, as also found in other studies (Ameri, 2015; Kruzicevic et al., 2012). These findings emphasised the importance of the first-year experience and first-year academic performance of students to ensure further academic progress and eventual success. To increase throughput and student success, universities must identify students who are at risk of potential dropout or poor academic progress as early as possible to ensure that the necessary additional support is provided to such students.

The literature consistently indicated differences in performance on predictor and dependent variables as it related to, among others, race and gender, and school type or location (Al-Hattami, 2012; Sanchez, 2013; Tesema, 2013). In this study, the descriptive analysis of the predictor and outcome variables also indicated statistically significant differences in mean scores across the race and gender subgroups as well as for students from public and private schools. Although the various relationships between the predictor and outcome variables were specifically and separately examined for the different race and gender subgroups and school examination authorities, differential validity and differential prediction of the predictor variables were not statistically investigated in this study.

The results of the study further indicated large differences in the predictive validity for different race and gender subgroups as well as for students from public and private schools. For example, the predictive models for WM students indicated that HSGPA predicted 32.2% of FYGPA and 24% of FinCumGPA, and FYGPA predicted 56.8% of FinCumGPA. In contrast, the predictive models for BF students indicated that HSGPA predicted only 12.4% of FYGPA and 11.1% of FinCumGPA, and FYGPA predicted 42.98% of FinCumGPA. These findings highlighted the importance of granularised and differentiated admissions and selection processes, as the overall model can over-predict and under-predict academic performance for different groups of students in terms of race, gender and school examination authority. Consequently, these findings have significant implications for university selection and admission practices. Universities can use these findings to develop admissions policies that take group differences into account to ensure that admissions decisions are fair and unbiased and allow equal opportunities to all applicants.

Although the difference in the predictive validity of HSGPA predicting FYGPA for students from public and private schools was not big, there was a large difference between the two groups related to predicting FinCumGPA. HSGPA explained 4.1% more variance in FinCumGPA for students from private schools, and the FYGPA for students from private schools explained 8.6% more variance in FinCumGPA than for students from public schools. Furthermore, first-year academic performance had a stronger relationship with final academic performance for students from private schools, than for students from public schools. This finding indicated that students from private schools performed academically different during and after their first year, than students from public schools.

Overall, the practical implications of this study are particularly relevant in the context of higher education admission and enrolment management. The group differences highlighted in this study with regard to race and gender as well as public and private schools, should be taken into consideration in the development of fair admissions policies.

5.5 LIMITATIONS OF THE STUDY

The results of this study should be interpreted taking into consideration several limitations related to the sample, research methodology and statistical analysis.

The first limitation is related to the sample. The analysis for this research was based on a single cohort of students who registered at one specific university as new first-year students in 2011. These students were admitted to the university based on certain specific admission requirements related to their NSC results. In some of the selection programmes, other criteria may have been applied in addition to the NSC results. Although admissions processes and requirements are institution-specific, the statutory minimum requirements for admission to universities for degree studies are stated in terms of NSC achievements. Consequently, the results of this study are more relevant and generalisable to institutions that base their admission decisions on NSC results, as opposed to institutions that use additional criteria for admissions. Furthermore, it should be noted that this study focused only on the NSC as a school exiting qualification for scholars from public and private schools. Scholars with international qualifications were not included in this sample, hence the results of this study are not relevant to these students.

Secondly, the "black" race classification used in this study included coloured (5%), Indian (16%) and black African (79%) students. Given the small numbers of coloured and Indian students, the combined classification was justified. Therefore, when interpreting the results, one must keep in mind that the reference to BF or BM students included all students of colour as explained above.

The third limitation relates to the exclusion of some variables associated with predicting academic success. It is well-known that many factors have an impact on student performance, and that there is no perfect model to predict academic success. Most prediction models account for only between 25-30% of variance in outcome measures, consequently about 70% of variance in academic

performance remained unexplained (Atkinson & Geiser, 2009). In this particular study, the results were similar, indicating that overall close to 80% of variance in FYGPA and FinCumGPA cannot be explained by HSGPA. For example, in this study, the criterion measures of academic performance - both as first-year grade point average (FYGPA) and as final cumulative grade point average (FinCumGPA) - were not evaluated in the context of the different faculties and degree programmes that could have impacted and affected students' performance. However, the research design used in this study sought to establish only whether there were relationships between the variables, without attempting to identify underlying causal factors impacting the relationships.

Another limitation of this study is that the relationships between the predictor and outcome variables were not corrected for restriction of range and criterion unreliability, therefore the true nature of the relationships between the variables may be underestimated. The scores of the predictor variables, HSGPA in particular, were restricted (as pointed out in the descriptive statistics) and had a narrower range than the larger applicant pool that included students who were not admitted to the university. The restriction of range could not be corrected for in this study, because the unrestricted variance of the predictor variables was not available for students who were not admitted to the university.

Regardless of the limitations mentioned above, the results of this study provided valuable information related to predicting academic success. The contribution of the study is discussed next, followed by recommendations for future research.

5.6 CONTRIBUTION OF THE STUDY

The fact that the South African higher education system is burdened by low participation, high attrition and low completion rates (Badsha & Cloete, 2011; DHET, 2016; USAf, 2015) has been mentioned before. Ensuring the success rate or throughput rate of students is a challenge for South African universities, as statistics reveal that approximately only half of the undergraduate cohort entering public universities, actually graduate (DHET, 2017). Universities were therefore encouraged by the Department of Higher Education and Training to continuously research and analyse institutional and national data to better understand factors that predict student success and influence student throughput (DHET, 2017).

This study responded to the call for relevant South African research on factors that could predict and positively influence academic success. The study set out to develop a model that is predictive of academic success. Admissions processes assess several variables when considering the admission of students to a university. These variables, as well as the relationships of these variables with academic progress and academic success were taken into account, and were measured over a period of six years.

To the best of the researcher's knowledge, this is the first South African study to investigate the predictive validity of the NSC and NBT results on academic success. This study involved the longitudinal analysis and predictive validity of the NSC and NBT results on academic success measured as first-year grade point average and as final cumulative grade point average over a six-year period. The NSC is considered a relatively new certificate and the first student cohort only entered the higher education system in 2009, thus research on predicting future academic success, especially in longitudinal studies, may not have been published yet.

The current available research on the NSC and the predictive value thereof, focused mainly on predicting first-year academic success as opposed to degree completion (see Müller, 2013; Oosthuizen & Eiselen, 2012; Potgieter & Davidowitz, 2010; Schoer et al., 2010; Visser & Van Zyl, 2013; Wilson-Strydom, 2012) and therefore these studies recommended further research to establish the validity of the NSC longitudinally (Govender & Moodley, 2012; Wilson-Strydom, 2012). Moreover, some of the first studies published on the NSC reported issues with the quality, validity and serious grade inflation (Nel & Kistner, 2009; Govender & Moodley, 2012). Simkins (2011, p.11) stated "The 2008 NSC results were a mixed bag, reflecting real progress, grade inflation, and some worrying chaos in the middle of the schooling system". The results of these studies casted serious doubt and uncertainty on the standards and validity of the NSC results (Fisher, 2011).

This study is therefore considered significant because it contributes to the limited South African body of knowledge concerning the validity of the NSC to predict academic success. For the purposes of this study, and to achieve the main goal, academic success was measured as both first-year grade point average and as final cumulative grade point average over a period of six years. The results of this study further contribute to the scientific research available on the validity of the NBTs in admissions processes.

In particular, this study specifically investigated a recommendation from the study by Rooney and Walbeek (2015), who recommended: “It would be useful to know whether the increasing importance given to NBT results are justified in terms of a superior ability to predict whether a student will graduate or not, relative to Grade 12 marks.” In a recent study on the linearity of the relationship between the NSC and NBT results, Le Roux and Sebolai (2017) found them to be related but not identical, and recommended that both results should be used as complementary tools in university admissions and placement processes. Their study, however, was a comparative correlational study and thus did not investigate the predictive validity of the NSC and NBT results.

The results of this study indicated that the NSC was indeed a significant predictor of first-year grade point average, as well as final cumulative grade point average, while the NBT results demonstrated poor predictive validity for both these averages. In addition, the evaluation of the NBT benchmark levels against academic progress and final academic status also revealed no apparent relation. These findings highlighted a need for the comprehensive review of the value and appropriateness of the NBT results in university admission and placement decisions, while at the same time the value and use of the NSC was supported and recommended for admission purposes.

Higher education institutions in South Africa must develop admissions policies that will ensure the admission of students with the potential to succeed (White Paper 3, DoE, 1997). Selesho (2013) concluded that admission requirements for university entrance, as set in school exiting results, were based on the extent to which academic success could be predicted. Therefore, the central principle is that school exiting results are indicative of acquired knowledge and readiness for higher education (Essack et al., 2012). Higher education institutions can apply the findings of this study when developing such admissions policies.

The results of this study further found the NSC results to be the strongest predictor of FYGPA as well as FinCumGPA for all students in the overall model, and for the different race and gender subgroups as well as school examination authorities. The consistent contribution of the NSC, despite being a preselected group, in all the regression models of this study must be recognised, as it is indicative that institutions are making the right admission decisions. The overall goal of this study was to develop an admissions model predictive of academic success that can be used in the admissions processes to improve university system output and effectiveness. This focus on improving institutional effectiveness and efficiency is relevant to the field of organisational and industrial psychology.

In addition, industrial psychologists may find value in the research results related to group differences in academic performance based on race, gender and school examination authorities. Industrial psychologists should be aware of potential issues related to test bias and fairness in the field of psychometrics that focus on test measurement, differential validity and differential prediction. In this study, the disaggregation of the data into different race and gender subgroups and school examination authorities, proved to be not only useful, but also necessary in order to present meaningful predictive models. Thus, the results indicated that an overall model to predict academic success for all students is not appropriate, but that different admission models should be developed for different groups of students. The findings on group differences in terms of race, gender and school examination authority are also important for institutional admissions policies and regulations to ensure admission decisions are fair and justified.

On a practical level, the results of this study provided valuable information to institutions with regard to the admission of students and student throughput or success. The importance of first-year academic performance was emphasised in this study, as the results indicated the significant predictive validity of first-year academic performance on further academic success. Consequently, the different admissions models presented in this study can be used to identify students at risk of dropping out, and to develop support programmes to improve first-year academic performance.

Despite the strengths and weaknesses identified earlier in this study, it must be noted that this study responded to the call by education authorities for relevant South African research on factors that could predict and positively influence academic success. At the same time, the significance of this study's contribution to the very limited existing body of South African research on predicting academic success, cannot be underestimated. The practical significance of the findings would dependent on institutions developing admissions policies and regulations that are aligned with this study, to allow equal opportunities for all applicants and to ensure fair admission decisions, and eventually have a positive effect on academic success.

5.7 RECOMMENDATIONS

Based on the results and findings of this study, recommendations for future research are firstly presented related to future research and secondly related to practice and implementations.

5.7.1 Recommendations for Future Research

Academic success is influenced by a number of variables. While the focus of this study allowed for the investigation of only a few variables related to the prediction of academic success, it is recommended that future research should seek to find optimal predictive models by taking into account as many variables as possible. Research found that there is no perfect model to predict academic success. Most prediction models account for only between 25-30% of variance in outcome measures, consequently about 70% of variance in academic performance remains unexplained (Atkinson & Geiser, 2009). In this particular study, the results were similar, indicating that overall, close to 80% of variance in FYGPA and FinCumGPA could not be explained by the NSC as the predictor variable. Future research should thus continue to focus on identifying factors that contribute to predictive models in an effort to explain more of the unexplained, and possibly increase the percentage variance that can be predicted in academic performance.

In this study, the relationships between the predictor and outcome variables were not corrected for restriction of range, and therefore the true nature of the relationships between the variables may be underestimated. The restriction of range could not be corrected for in this study because the unrestricted variance of the predictor variables was not available for students who were not admitted to the university. Future research could, if possible, correct the data for the restriction of range, in order for the true relationship between both the NSC and NBT results and academic success to be potentially be less underestimated.

The disaggregation of data proved to be a useful method of analysis that provided additional critical information on a granular level that would otherwise have been obscured by aggregated analysis. For example, the granularised analyses revealed vastly different prediction models for students of different race and gender subgroups, as well as for students from public and private schools. Future research should furthermore seek to find optimal predictive models by taking into account as many variables as possible.

Another recommendation for future research would be to granularise the predictive models even further into faculty groups, to establish how students from different race and gender subgroups and schools perform differently, or not, within the context of different faculties. Predictive models could also be investigated on programme levels, since admission requirements are mostly set for the different degree programmes and not on faculty levels.

It is recommended that future research could investigate student retention in light of the findings of this study. In view of the results of this study revealing that the NBT benchmark achievement levels failed to identify students at risk of dropout and also that these benchmark levels did not correspond with academic progress, future research should continue to investigate the value of the NBT results, also from different perspectives. Through investigating predictive models for students within specific benchmark achievement levels, additional information could be revealed. For example, future research could determine if predictive models for students with "basic" achievement levels are different for students with "proficient" achievement levels.

Future research on the NBT results could also focus more on the specific test domains, in particular Academic Literacy, Quantitative Literacy and Mathematical Literacy. The results of this study, in particular the different regression models, presented interesting findings related to the NBT tests related to identifying significant predictors of academic success for students from different race and gender subgroups as well as students from different schools.

As an illustration, the predictive models for black students (male and female) and white female students revealed that the NBT Mathematical Literacy was a significant predictor of first-year academic success. Similarly, NBT Academic Literacy was included in the predictive models of white students (female and male) and black male students. Future research could investigate why the NBT Quantitative Literacy was not identified as a significant predictor of first-year academic success in any of the regression models for the different race and gender subgroups.

5.7.2 Recommendations for Practice

The findings of this study highlighted the importance of granularised and differentiated admissions and selection processes for different groups of students in terms of race, gender and school examination authorities. Consequently, the findings have significant implications for university

selection and admission practices in developing admissions policies that take group differences into account to ensure admission decisions are fair and unbiased and allow for equal opportunities to all applicants.

The results of this study indicated that the NSC was a significant predictor of first-year grade point average as well as final cumulative grade point average, while the NBT results demonstrated poor predictive validity for both first-year grade point average and cumulative grade point average. In addition, the evaluation of the NBT benchmark levels against academic progress and final academic status also revealed no apparent relation. These findings identified a need for the comprehensive review of the value and appropriateness of the NBT results in university admission and placement decisions. At the same time, the findings supported and recommended the value and use of the NSC for admission purposes.

The importance of first-year academic performance is emphasised in this study, as the results indicated the significant predictive validity of first-year academic performance in predicting academic success in subsequent years. Institutions should make use of predictive models to identify students at risk of dropout and exclusion as early as possible. Also, given the strong relationship of first-year academic performance with final cumulative academic performance, institutions should develop support programmes aimed at improving first-year academic performance.

Higher education institutions should furthermore develop admissions policies and regulations that are aligned with recommendations of this study to allow for equal opportunities to all applicants and to ensure fair admission decisions.

5.8 CONCLUSION

The expansion of higher education in the 20th century lead to increased opportunities and access. The notion that higher education was reserved for only a small elite group of students was dismissed, as increasingly more people pursued higher education qualifications. However, with the increasing demand for access to higher education there was a simultaneous decrease in student throughput rates, both nationally and internationally (CHE, 2013; DHET, 2013). Consequently, institutional selection and admission processes were emphasised to ensure that students with the potential to succeed were admitted (Al-Hattami, 2012; Arikan, 2010; DoE, 1997).

Thus, the emphasis was on the system of tertiary education as a whole, meaning that the input and processes should be re-evaluated to ensure a successful output.

The theoretical principles of systems theory, and Astin's I-E-O model (as presented in Chapter 2) provided a logical framework to achieve the main goal of this study, and to answer the research questions. The goal was to develop a model that can predict academic success. This model should be applied in admissions processes at universities to improve the eventual output (i.e. increased throughput rates).

In previous research, systems theory had been applied specifically in the educational domain serving different purposes, such as inter alia a framework for research (William, Watson, & Watson, 2011), to understand the nature of education (Banathy, 1996; Thien & Razak, 2012; Watson & Watson, 2011), to measure the effectiveness of higher education (Courtney, Janicki, & Russell, 2005; Creemers & Scheerens, 1992; Scheerens, Hendriks, Luyten, Sleegers, & Glas, 2013; Scheerens, 2005, 2013) and also as a tool for strategic enrolment management (Black, 2008; Lohmann, 2006; Wallace-Hulecki, 2011). Collins and Millard (2013, p.73) explained that when the systems theory is applied to a university, it "allows greater understanding of the forces that act on each student, the impediments to their success, and the potential opportunities for growth that might be overlooked".

Feedback on the overall functioning of higher education in South African is dismal, and it is characterised as a system with low participation, high attrition, and low completion rates (Badsha & Cloete, 2011; DHET, 2016; USAf, 2015). Furthermore, research revealed that only about half of undergraduate students entering public universities, actually graduate (DHET, 2017).

As already mentioned in this study, the success rate or throughput rate of students is a major concern for South African universities and a challenge that requires urgent attention. The DHET considers increased throughput rates as a top strategic priority for university education. Universities must thus address this challenge, together with providing access to and ensuring the success of students whose race and gender placed them at a disadvantage in a previous dispensation, by inter alia developing admissions policies that will ensure the admission of students with the potential to succeed (DHET, 2012). The White Paper in 2013 (DHET, 2013, p. xiv) stated:

> "As participation increases, universities must simultaneously focus their attention on improving student performance. Improving student access, success and throughput rates is a very serious

challenge for the university sector and must become a priority focus for national policy and for the institutions themselves, in particular in improving access and success for those groups whose race, gender or disability status had previously disadvantaged them".

To improve university outputs and success, university systems must work according to the principles of effectiveness and efficiency, as defined in White Paper 3 (DoE, 1997 p.12): "An effective system or institution functions in such a way that it leads to desired outcomes or achieves desired objectives". This means that an "effective and efficient system is one that retains the students it admits and enables as many students as possible to complete their studies in regulation time or as close to it as possible, obviously without compromising quality" (DHET, 2016 p.17). In other words, to achieve this systemic efficiency and effectiveness, universities as a whole must function optimally.

In order to improve academic success, White Paper 3 advised higher education institutions to develop admissions policies that will ensure the admission of students with the potential to succeed (White Paper 3, DoE, 1997). Selesho (2013) further asserted that admission requirements for university entrance, as set in school exiting results, are based on the extent to which academic success can be predicted. According to Essack, the central principle is that school exiting results are indicative of acquired knowledge and readiness for higher education (Essack et al., 2012).

The results of this study support this principle, as it found that HSGPA was the strongest predictor of FYGPA as well as FinCumGPA for all students in the overall model. Thus, the consistent contribution of the NSC in all the regression models in this study, is indicative that institutions are indeed making the right admission decisions.

However, the reality in South Africa is that there are 'significant inequalities' in university outcomes between the different race groups (Van Broekhuizen et al., 2017). In this study, the disaggregation of the data into different race and gender subgroups and school examination authorities, proved to be useful and necessary. The findings indicated differences in mean scores of the predictor and criterion variables, and vastly different predictive models were presented for students from different race and gender subgroups, and from different school examination authorities. It can thus be concluded that an overall model to predict academic success for all students is not appropriate.

The main goal of this study was to develop a model predictive of academic success that can be used in the admissions processes to improve university system output and effectiveness. Because the criterion variable of academic success was measured over a period of six years, the focus of this study leaned more towards an access model as opposed to an admissions model. Furthermore, research emphasised that meaningful access is not only about increasing participation rates, but also about the performance and success of students (Casazza & Silverman, 2013).

The results of this study should thus be interpreted in the context of access to guide higher education admission decisions. The results should furthermore be applied to develop policies and rules that are fair, equitable, reliable and justifiable in terms of the ability and probability of students to succeed. In order to predict, and eventually ensure academic success, the rules and policies should consider individual differences in the prediction models for students of different race and gender groups, as well as for students from different school examination authorities.

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