An Evaluation of the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE)

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Acronyms

ASAP- Academic Support and Advancement Program

CHE-Council on Higher Education

DHL- Department of Higher Learning

EBPM- Evidence-Based Policy-Making

EU- European Union

HBCU- Historically Black Colleges and Universities

HRD- Human Resource Development

NBHW-National Board of Health and Welfare

NDPSP- National Development Policy Support Programme

NSFAS-National Student Financial Aid Scheme

PSAs-Public Services Agreements

PSPPD- Programme to Support Pro-poor Policy Development

SI-Supplement Instructions

STEM- Science, Technology, Engineering and Math

UNITE-University of KwaZulu-Natal Intensive Tuition for Engineers Program

UKZN-University of KwaZulu-Natal

Abstract

An Evaluation of the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE)

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This qualitative study is an evaluation of the University of KwaZulu-Natal's Intensive Tuition for Engineers (UNITE) program. It is based on the high attrition rate phenomenon prevalent within Science, Technology, Engineering and Math (STEM) degrees in many countries, including South Africa. A number of South African universities such as the University of KwaZulu-Natal, have sought to address this by establishing foundation programs like UNITE, designed specifically to assist students from disadvantaged backgrounds, who otherwise might not have the chance to study engineering at university level. These programs however experience challenges which limit their success and consequently result in a shortage of engineers in the country.

This study therefore using purposive sampling, interviews and questionnaires collected data from seventeen students who had been through the UNITE program before and after 2005 as well as one lecturer and administrator in the program. This was done to efficiently and effectively investigate significant challenges faced by the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE) program and examines how these challenges influence the program performance with regards to achieving its targets and goals. To overcome the problem of biasness and validation, this research used multiple methods and measures of an empirical phenomenon called triangulation. This study concluded that the program falls short of its targets and is underperforming. The following have been cited as contributing challenges which have preserved the status quo: (a) curriculum structure upon time table, (b) lack of competent secondary educational background, (c) exclusion policy, (d) students personal problems and non-use of support program, (e) lack of funding (f) language barrier, and (h) class sizes. Interventions to address these challenges have either been insufficient, wrongly conceived or non-existent. Within the framework of evidence based

theory, the data collected from the evaluation process and relevant literature was methodically analyzed to make recommendations that will address these challenges and maximize the program's performance.

Chapter 1

Introduction

1.1 Background

South Africa's integration into competitive global markets has brought about a corresponding investment in Human Resource Development (HRD). Most countries and multilateral institutions acknowledge the need to give systematic attention to the role of HRD in supporting national economic growth and development programs. In its Program in Public Administration and Finance (1995), the United Nations (UN) asserts that if countries are to improve their human conditions, there must be an increase in their human resources development as it enhances competitiveness, supports economic growth and increases productivity. South Africa has developed a strategic paper on HRD which is fundamentally important for its development and poverty eradication discourse. Among other things, the paper promoted global thinking through education, a widely accepted leading instrument for promoting HRD and economic growth. According to Bloom et al (2006), South Africa has the highest tertiary education enrolment rate in Sub-Saharan Africa which is a testimony to its commitment in promoting HRD through education. Higher education institutions in South Africa have been encouraged to provide programs and policies that produce the kind of graduates the economy needs, especially in the fields of science, technology, engineering and mathematics (STEM) (Chisholm et al, 2005).

Hence, South Africa's universities have sought to align themselves with the government's broader strategy through the development of progressive policies and programs in the following ways:

1) Wide implementation of foundation programs to primarily equip historically disadvantaged students with the necessary skills to study in universities and increase their chances of graduating.

2) The expansions of student numbers.

3) Improve access to higher education for historically disadvantaged students so as to overcome the inequalities of the past (Joubert, 2002).

This will consequently increase the capacity of skills in the fields that are experiencing a shortage in expertise, such as engineering, science and technology. Moreover, these foundation programs have also been used as intervention strategies for reducing the high levels of attrition which have plagued universities, particularly in the STEM fields (Du Toit and Roodt, 2006).

According to the Department of Higher Learning (DHL), in 2009, the average success rate of first time entering undergraduates was above 70% in 19 of 23 universities and above 80% in seven universities with almost 32 000 students enrolled in foundation programs. In 2010, foundation programs provided for 15 863 students and the 2011/12 allocation made provisions for 16 268 students. Despite the overwhelming success in enrollment into the institutions of higher learning, it was noted that students have immensely underperformed with a more severe attrition rate in engineering education (Case, 2006 and Du Toit and Roodt, 2006). The history of certain race groups being disadvantaged as a result of the former apartheid system in the country was provided as one of the prevailing reason amongst others to explain this phenomenon. Other contributing reasons for this are brain drain, restricted knowledge and expertise in mathematics and science and overcrowded classes (Du Toit and Roodt (2009). The swim or sink approach that seems to be prevalent in engineering faculties in all universities has also been forwarded as a contributing factor as it poses challenges for students (Shackleton, 2006).

According to the Council of Higher Education (CHE) report for 2013, poor academic preparation in school is another dominant learning-related reason for engineering student's generally poor academic performance at the university. In fact, it is unlikely that the basic education sector will be able to produce the numbers of adequately prepared matriculants that higher education requires in the foreseeable future (Mail & Guardian, 2013). In an attempt to reduce attrition statistics at the University Of KwaZulu-Natal School Of Engineering, the school implemented the University of KwaZulu-Natal Intensive Tuition for Engineers Program (UNITE) twenty five years ago. This foundation program serves as an intervention

strategy designed to reduce the attrition rate and equip historically disadvantaged students with the necessary skills to study in the university and improve their chances of graduating. Similar programs exist in all South African Universities. These programs are however plagued by an alarmingly high attrition rate and the UNITE program is no exception (Bengesai, 2011). In 2013, out of 76 enrolled students, only 10 progressed and were absorbed into the mainstream. This phenomenon has undermined both the prolific concept of the UNITE program and its efforts in contributing to human resource development in the fields of science, technology, engineering and mathematics. It is from these premises, that this study intends to evaluate the UNITE program in order to highlight its plight, so that it could be modified and aligned with the University of KwaZulu-Natal's (UKZN) objective of producing more engineering graduates and the government's HRD objective of producing the kind of graduates which the economy needs by using Basic Education and Higher Education Institutions as a vehicle.

1.2 University of KwaZulu-Natal Intensive Tuition for Engineers Program (UNITE)

The objectives of the UNITE foundation program are to assist students from academically disadvantaged schools, to equip them with the necessary skills to study in the universities and to improve their chances of graduating, thus producing successful engineers. The criteria used to admit deserving candidates are based on their potential to become excellent engineers. Hence, students with self-confidence, an interest in technology and with at least a 'D' symbol in Higher Grade Mathematics, Physical Science and English are invited to apply (CAO Handbook, 2014).

The UNITE program curriculum structure plays a vital role in the quest to achieve its goals. UNITE students require full first year credits in Engineering Drawing and Maths. The non-credited subjects are Chemistry, Physics, Mechanics and Communication Skills. Students are also exposed to actual engineering projects through factory visits and guest lectures by professional engineers. There are other mechanisms in place designed to assist students such as the Academic Support and Advancement Program (ASAP) which is affiliated with the College of Agriculture, Engineering and Science. It offers academic support to all students within the college that enhances their academic progress and performances. It also facilitates

student and staff development workshops, supplement instructions (SI) sessions, tutoring sessions, writing program and one-on-one consultations with various academic officers affiliated with the five schools in the college. This interactive learning environment is said to be necessary for developing learning and life skills necessary for university study and increasing the chances of students graduating.

Students who successfully complete the UNITE programme are awarded a Preparatory Certificate in Engineering which will allow them to enrol in the Faculty of Engineering at first year level. Considering the fact that the UNITE programme provides for students from previously disadvantaged backgrounds and the cost of higher education is high, one expects the programme to provide necessary financial support to these students. This does not seem to be the case though. The UNITE programme department has however established synergistic relations with private and governmental corporations with an intention to acquire bursaries for students within the programme. This relationship was forged on the common recognition of the need for engineers in South Africa. These bursaries cover most costs, including tuition, books and accommodation but exclude meal allowances. The UNITE programme does not only equip students with the necessary skills to study at the university and improve their chances of graduating but to also improve access to higher education for historically disadvantaged students to enable them overcome the inequalities of the past (Joubert, 2002). This consequently, will increase the capacity of skills in the fields that are experiencing shortages in expertise and in turn promote economic growth and mitigate poverty.

1.3 Aims and objectives

The causes and remedies of the attrition rate in the institutions of higher learning in South Africa have been researched, particularly the STEM sector. However, the body of research available has not had much impact in addressing the major challenges this sector faces. This study points out that many universities have established foundation programs to address high attrition rates. However, these programs continue to experience challenges which limit their success. Subsequently, the country continues to experience a shortage in engineers, particularly those who are meant to be produced through these programs. This includes

students from previously disadvantaged backgrounds who otherwise would not have had the chance to study engineering at university level.

The aim of this study therefore is to investigate significant challenges encountered by the UNITE program and to ascertain the level of influence in its performance with regards to achieving its targets and goals. This study also evaluates the causes and impediments to finding interventions for this phenomenon within the UNITE program. This study is of paramount importance because it provides an understanding of the shortcomings and suggests possible interventions which may subsequently enhance, modify and align the UNITE program with the institution's objectives and significantly contribute to the development of graduates that the economy needs, especially in the STEM fields. The study focused on:

1) The evaluation of the extent to which the programs objectives and goals are being realized. This is done by evaluating the program reports, available evidence and appropriateness of the curriculum structure for UNITE programs.

2) The extent that students social, economic and political factors affect the realization of the objectives and goals of UNITE.

3) The extent to which current intervention strategies can be further exploited to align the behavior of both the lecturers and students with the objectives and goals of the program.

1.4 Key Research questions

The key research questions have been designed in order to address the broad research objectives in more details. The key research questions and broad research questions have been constructed using the key concepts outlined in the theoretical framework discussed in Chapter 2.

1) How complex and manageable are modules offered within the curricular structure of the UNITE program, taking into account the environment in which students are subjected to perform under and their educational background? (Duration of hours

attended a day? How many modules undertaken per semester? How ready the students were to deal with and manage those modules?)

2) To what extent did the lack or availability of funding affect the UNITE program in realizing its goals and objectives?

3) How does the stringent strategy of excluding students based on failing one module promote diligence of both students and lecturers in the assumption of their respective roles within the achievements of goals and objectives of the UNITE program?

1.5 Broad Research issues investigated

The key research questions have been designed in order to address the broad research objectives in more detail. The sections have been constructed using the key concepts outlined in the theoretical framework discussed in Chapter 2.

1) The first broad issue under investigation in this study is the extent to which the program's objectives and goals are being realized by investigating if the curricular structure is appropriate in the realization of the objectives and goals of the foundation programs in these fields.

2) The second broad issue investigated is the extent to which social, economic and political factors affect the realization of the objectives and goals of foundation programs within the engineering, science, technology and mathematics field. It further assessed the extent to which these factors have been incorporated in the planning and design of the foundation programs in order to realize their objectives and goals.

3) The third broad issue investigated is the effectiveness of intervention strategies used to align the behavior of both the lecturers and students with the objectives and goals of the program. It also assessed the extent in which these strategies and instruments were appropriate given the nature of objectives and goals which were to be realized.

1.6 Conclusion

Proficiency in the STEM sector has been used as one of the variables which indicate economic growth. It is common knowledge that lack of development in the STEM sector has a negative impact on the development of the economy, not only in South Africa but in other developing and underdeveloped countries as well. This is evident in the stagnant economic growth of such countries as compared to those who excel in this sector. The inadequacy of the education system to produce the kind of graduates that the economy needs to foster economic growth and reduce poverty has been one of the attributing factors. Even though there has been an improvement in the intake of STEM students entering into universities and other institutions alike, the output has been alarmingly poor with high attrition rates particularly in this sector. Given the dire depiction of the situation, the need to review and evaluate existing programs to address this issue within the sector warrants urgent interventions. This must be done in order to find and develop systematic mechanisms and methods of education policy and program development which assists in HRD development in the STEM field. This study intends to contribute to such development.

Chapter 2

Literature Review and Theoretical Framework

2.1 Introduction

Over the years, an alarming high attrition rate at institutions of higher learning in the (STEM) field has encouraged scholars and interested groups to conduct research that seek to understand pertinent issues and provide interventions for this phenomenon based on empirical evidence. Research in this area was also driven by a need to align the South African development discourse with higher learning's responsibility to develop and provide programs and policies that will produce the kind of graduates the economy needs in order to mitigate poverty. This chapter highlights the available literature that focuses on the broad STEM curriculum structure of South Africa's core undergraduate qualifications and issues and interventions pertaining to it. However, the available literature has neglected or given insufficient attention to the effectiveness or ineffectiveness of vital foundation programs which are offered by different disciplines within institutions of higher learning as form of intervention. The literature further explores practical interventions which have been employed to improve the achievement of Black students in STEM at Historically Black Colleges and Universities (HBCU) in the United States of America (USA). This led this study to suggest that such interventions should be implemented within the South African context because of similarities in the nature and characteristics of the problems, provided that the correct framework to implement them can be devised. The literature also covered literature on the Evidence Based Framework concepts.

Global governance discourse over the years has encouraged governments and their institutions around the world to develop and improve policies and programs in many different aspects of government. The intention is to provide programs and projects which communicate the needs of the greater constituencies. Evidence-based policies and programs have been at the heart of that transformation. The evidence-based framework has been defined as an approach which helps people make well informed decisions about policies, programs and projects by putting the best available evidence at the center of policy development and

implementation (Davies, 1999). The aim is to improve relevance, efficiency and effectiveness of policy reforms. It therefore, directs a process for making decisions about a program, practice, or policy that is grounded in the best available research evidence. This is informed by experiential evidence from the field and relevant contextual evidence. This study is therefore guided by the principles of the Evidence Based Framework. It uses formative evaluation research approaches of evidence collection which best complements answering the broad and key study questions posed in this paper, thereby achieving the study's objectives.

2.2 Literature Review

The causes and solutions of the high attrition rate in the institutions of higher learning in South Africa have been researched (Du Toit and Roodt 2006, 2009). Researchers have also ascertained that there is an overwhelming success in the enrollment rate into the institutions of higher learning. Programs such as UNITE have contributed to the expansion of student numbers and improved access to higher education for those historically disadvantaged, to overcome the inequalities of the past (Joubert, 2002). This consequently increases the capacity of skills in the fields that are experiencing a shortage in expertise such as engineering, science, technology and mathematics which in turn drives economic growth. These sectors however face major challenges and they need to be addressed.

The notable short comings of the South African higher education system in trying to remedy disparities between the intake rate and the out-put rate in the STEM field have been highlighted by some researchers (Letseka, Breier and Visser, 2010; Paideya, 2011; Scott and Hendry, 2006). One of the reasons suggested was that each institution, school, faculty or program has its own peculiar circumstances and conditions (Du Toit and Roodt, 2009). Thus, the blanket approach or one size fits all approach will not yield expected results in all programs. Reported studies on skills shortages in the technology sector have identified matriculation performance in South Africa as one of the contributing factors. The 2008 Kuenzi's report and the 2011 figures from the South African info newsletter released in 2012 depict a dire picture. The figures from these studies indicate that "in 2006, only 16% (84,564) of 528,525 candidates passed with grades required for university entry. In 2010 and 2011, the figures were respectively 23.5% (126,322 of 537,543) and 24.3% (120,549 of 496,090). In

2006, only 4.8% (25,633) passed higher-grade mathematics, and only 5.7% (30 174) passed higher-grade science" (Simkins, Rule and Bernstein, 2006, p. 9). The 2010 and 2011 figures are not directly comparable with the 2006 higher-grade mathematics and science figures since the distinction between higher and lower grades has since been abolished. The 2010 and 2011 mathematics pass rate – using 30% as a pass criterion – was 47.4% and 46.3% respectively. These corresponding figures for science came to 44.9% and 53.4%. In addition, a decline in the number of Grade 12 science learners was reported (Mail & Guardian, 2013).

The above mentioned figures reflects university entering students' lack of preparedness for university entry-level mathematics and science and this has a direct negative impact on students' performance, especially those enrolled in foundation programs such as UNITE. The body of research affirms this view as it notes that students have immensely underperformed with a more severe attrition rate in engineering education (Case, 2006 and Du Toit and Roodt, 2006). According to Du Toit and Roodt (2009), the contributing reasons peculiar to engineering include brain drain, restricted knowledge and expertise in mathematics and science and overcrowded classes. The other problem was the sink or swim aproach that seems to be prevalent among engineering faculties or schools at all the universities and this poses a challenge to many students (Shackleton, 2006).

Access, success and completion rates continue to be racially skewed, with white completion rates being on average 50% higher than black African rates. The net result of the disparities in access and success show that under 5% of African and coloured youths are succeeding in higher education(Fisher and Scot, 2011).The history of disadvantaged backgrounds brought on by the apartheid government is viewed as one of the factors responsible for this problem (Fisher and Scot, 2011). The attrition rate statistics and demographics are not only prevalent and limited within the South African context but in the USA as well and they are characterised by the location of a systematically disadvantaged population which is always on the receiving end (Kao and Thompson, 2003). Kao and Thompson (2003) claim that black students in America perform poorly in Science, Technology, Engineering, and Mathematics because the society into which they were born has been constructed in a way that denies them opportunity and support before birth. It could therefore be argued that this claim is synonymous with that of black people in South Africa who were and still disadvantaged as a result of the apartheid system.

2.2.1 The South African Department of Education's Report

Based on findings by a number of studies, only 30% of the total intake of students and 48% of contact students, graduate within five years (Simkins, Rule and Bernstein, 2006). When allowance was made for students taking longer than five years to graduate or returning to the system after dropping out, it was estimated that about 55% of the intake will never graduate. The South African government, through the Council on Higher Education (CHE) appointed a task team in 2013. The team was given the task to conduct a study on the attrition rate and other aforementioned pertinent and related issues with the intention of finding effective interventions. The main objective was to investigate the appropriateness of the broad curriculum structure of South Africa's core undergraduate qualifications. The study first sought to broaden an understanding of undergraduates' performance patterns in higher education and then identify and prioritize systemic obstacles to students' success in higher education as a basis for analyzing sectors of the system that can meaningfully contribute in ensuring improvement (CHE, 2013). The team was also given the task to analyze the role of curriculum structure as a systemic variable affecting students' performance and to identify major structural problems, as many curricula contain key transitions for which students are differentially prepared (CHE, 2013). The development of alternative curricula for five major qualifications by expert working groups was also included in the investigative study. A major structural problem identified, was that the undergraduate curricula do not meet contemporary local and global conditions and there was a need to enhance it to meet those conditions. The CHE (2013) study further asserts that a challenge central to South Africa's higher education, and which cuts across the main structural shortcomings of the current curricula, is the need to deal constructively with diversity in students' educational, linguistic and socio-economic backgrounds. The study from the available data indicates that moving from the current rigid curriculum structure to another rigid one would not satisfactorily address the diversity that characterizes the student body. It instead proposes a flexible curriculum structure that establishes new mainstream parameters of duration, starting point and progression pathways and makes provision for shorter pathways within the new norms (CHE, 2013).

2.2.2 Practical models, methods and interventions (Gasman and Nguyen's Study)

Gasman and Nguyen's (2014) study which is based on American Historically Black Colleges and Universities is fundamental for this study as it highlights credible and practical methods, models and intervention that UNITE might emulate to achieve progress within the program. Also, both studies focuses on black students' performances within the STEM schools or faculties and the students share the same history of disadvantaged backgrounds. Gasman and Nguyen's (2014) primary focus was to highlight the outstanding progress achieved through Historically Black Colleges and Universities (HBCU) unconventional methods, models and interventions. The study also brought out how these methods, models and intervention were adopted and applied by the UNITE program to assist in reducing their attrition rate.

Gasman and Nguyen (2014) further examine the steps taken by Historically Black Colleges and Universities (HBCU) in improving the achievement of black students in STEM fields and provides practical evidence of the proficient ability of models, methods and interventions used by them. The authors however state that even though there is progress made by blacks in the STEM fields, there is a lot to be done as African Americans continue to lag behind whites in receiving bachelor degrees in STEM fields. The authors further provide figures which best depicts this fact, with "Blacks receiving just 9 % of all bachelor degrees awarded in 2010. [Furthermore], Blacks constitute only 7% of degrees awarded in biological sciences, 6% percent in physical sciences, 5% percent awarded in mathematics and statistics, and 4% in engineering" (NSF, 2011c, p. 12 in Gasman and Nguyen, 2014). According to Gasman and Nguyen (2014), these patterns reflect the fact that African American women and men continue to be underrepresented among U.S. scientists and engineers. She suggests that HBCUs should carry on with the responsibility to bring about and accelerate progress and that other institutions should learn from HBCUs successes and approaches to learning, in their efforts to promote STEM graduates and diversify the STEM work force. In agreement with Shackleton (2006), Gasman and Nguyen (2014) suggest that a meaningful environment can only be achieved by altering the climate in the STEM disciplines. This includes developing programming and learning around peer mentoring, providing formal research opportunities and hiring more woman and Black in the faculty to improve the gender and racial concordance between student and faculty mentors. Other effective methods and

interventions can be implemented to increase the number of Black graduates in STEM. HBCUs, according to Gasman and Nguyen (2014), use approaches, methods and interventions which are distinct from the traditional models of teaching and learning in STEM, moving from the culture of independence to one based on interdependent success (Seymour & Hewitt, 1997). Gasman and Nguyen (2014) claim that empirical research on HBCUs and STEM education indicate that the success of HBCU students is attributed to a classroom and campus culture based on communal success (interdependent) as opposed to a 'weed out' culture based on competitiveness and individual progress (independent). Working together, as opposed to against each other is pivotal to the success of these institutions. STEM-focused researchers could look to HBCUs for direction, inspiration, and concrete ways to motivate Black STEM students.

Gasman and Nguyen (2014) argue that among all the best practices and recommendations that emerge from the examination of HBCUs and STEM's successes, one thing remains fundamental and common in all of them. This is the fact that HBCUs know their students well; they have a clear understanding of where their students come from, how their family background and history contribute to and affect their college experiences (socially and academically) and what they need in order to succeed in college.

Gasman and Nguyen's (2014) study provide credible empirical evidence on the efficiency of the models, methods and interventions used by HBCUs for students' success within STEM schools. These are aimed at creating a culture of success and support that promotes retention and confidence among students and creating an environment that is likely to promote success in STEM fields through believing in the ability of students to succeed if basic support is provided. This could be achieved in many HBCUs if the high aspirations of Black students were cultivated rather than torn down or discouraged (Allen, 1992; Palmer & Gasman, 2008; Perna, 2009). The positive attitude of faculty members which sieves down to inspire and motivate students to succeed was highly recommended. For example, faculty members in many HBCUs assume that their students will go on to graduate school. For many faculty members, placement in graduate school was a goal (Perna et al., 2009). One strategy for achieving this goal is students being taught how to balance academic and social responsibilities in order to succeed in their STEM program. Students were also groomed for graduate school and given the tools needed to achieve that. Another intervention by the

faculty and staff was to identify underperforming STEM students early and work with these students to ensure that they had the support required to succeed (Perna et al., 2009).

Many Black students attending HBCUs and other majority institutions have a lot of 'catch-up' work to do as their primary and secondary courses did not prepare them well for college-level science courses (Kao & Thompson, 2003). Faculty members work hard to recognize these differences during classroom instructions and to provide necessary supplementary learning support so that all students could be academically successful (Gasman and Nguyen, 2014; Perna et al., 2009). At Xavier University, students participate in intensive summer program aimed at making up for past deficiencies. This program immerses the students in the STEM curriculum (American Medical Association, 2009). Although the UNITE program seeks to bridge past deficiencies in math and science, the attrition rate level is still high, making one wonder whether faculty members do not work hard enough to ensure students success or if it is more than that.

Black students in STEM at HBCUs have also benefited from the small class sizes and low faculty to student ratio. Gasman and Nguyen (2014) claim that at many historically White institutions, the introductory STEM courses enrolls a large numbers of students, a practice that makes it difficult for students to ask questions from or have personal interactions with their lecturers. Students also face long lines during faculty office hours. In contrast, at most HBCUs, the environment is similar to a small liberal arts college (Gasman and Nguyen, 2014; Perna et al., 2009). This environment serves as a nurturing incubator for talents. Case studies at HBCUs demonstrates that professors go above and beyond their teaching responsibilities by knowing students' by their first names, as well as staying after class and providing advice and recommendations for graduate school and professional opportunities (Perna et al., 2009).

HBCUs are aware of the financial constraints of African American students pursuing degrees in the STEM fields. Faculty and staff members at HBCUs consistently watch out for their students, making sure that students had money for food, books and to travel home to see their families (Gasman and Anderson-Thompkins, 2003). Although this type of care is not required and not indicative of every HBCU faculty member, having an attentive, nurturing faculty was a strong point of many HBCUs and it plays a key part in young STEM students being successful (Gasman and Anderson-Thompkins, 2003).

2.3 Theoretical Framework

2.3.1 Evidence Based Theory

Over the years, there has been a paradigm shift from the conventional ways of finding solutions to address societal problems and improving policies and programs which relied on ideology, costs, ethics, social background and expert opinion to evidence based theories and practices (Lipton 1992). Governments and organizations are also moving away from 'opinion- based policies' towards 'evidence-based' ones (Green and Tones, 1999). There has been a surge of interest in evidence based theory and practices particularly in the late 1990s, and this is evident in the surge of academic writing on the topic. Evidence-based theory and practices have been employed across many disciplines. For example, Sherman (1999) argues that for evidence based policing, decisions about where to target police strategies should be based on epidemiological data about the nature and scope of the problem. He adds that the kinds of interventions employed should be guided by careful evaluative studies and preferably randomized field trials. Similar sentiments and arguments have been shared by other writers in different disciplines such as correctional treatment (cf: MacKenzie, 1999) and education and social welfare (cf: Gibbon, 2002 and Sheldon, 2000).

The need to approach policies and programs using evidence based theory is prevalent amongst governments based on initiatives undertaken in the late 1990s. In the United States of America and England, there has been a vigorous promotion of evidence based theory in medicine and the social sectors (Davies, Nutley and Smith, 2000; Nuttall, Goldblatt, and Lewis 1998). In Sweden, the National Board of Health and Welfare (NBHW) was commissioned by the government to draft a program for advancing knowledge in social services to ensure that they are evidence based (NBHW, 2001). In South Africa, there has not been any deviation from the international community with regards to moving towards evidence based theory and practices improving on policies and programs. The Programme to Support Pro-poor Policy Development (PSPPD) which is part of the larger National Development Policy Support Programme (the budget support program between the South African government and the European Union) is an example of a number of governmental initiatives that invests in evidence based approaches (The Presidency, 2011).

Most researchers and writers argue that evidence based theory and practices demand that decision makers are aware of the research evidence that bears on policies and programs under consideration (Davies, Nutley and Smith, 2000). Thus, evidence-based policy has been defined as an approach which helps people make well informed decisions about policies, programs and projects by putting the best available evidence at the heart of policy development and implementation (Sanderson, 2000). The use of strong evidence can make a difference to policy making in several ways that may include achieving recognition of a policy issue, informing the design and choice of policy, forecasting the future, monitoring policy implementation and evaluating impacts. The aim is to improve relevance, efficiency and effectiveness of policy and program reforms. It therefore directs a process for making decisions about a program, practice, or policy that is grounded in the best available research evidence and informed by experiential evidence from the field and relevant contextual evidence (Sanderson, 2000). Basically, evidence based theory and practices potentially decrease a proliferation of projects and programs in society which are ineffective.

According to Sanderson (2000), there are two main forms of evidence required to improve the effectiveness of policies and programs. The first evidence is to promote accountability in terms of results, which means providing empirical evidence that the institution or the government is working effectively. The second evidence is the promotion of improvement through effective policies and programs which involves providing evidence of how well such policies and programs work in different circumstances. He further points out that these two forms are different in nature. The first evidence is primarily in the form of information on attributes of performance and it is reflected in the growth of performance management within an institution or government. This approach has been adopted widely by institutions and governments such as the Public Services Agreements (PSAs) and the Treasury (HM Treasury 2000).The second form of evidence is qualitatively different from the first. It emphasizes knowledge of how policy interventions achieve change in social systems. Conventionally, the second form of evidence provides a sound basis for effective action. It is explanatory, theoretical and provides an understanding of how policies work. This study will focus on both forms of evidence, using the role of evaluation in generating evidence.

Evidence collected assisted the researcher in making informed decisions about the program. The evidence gathered helped in identifying program issues, informing the design and

forecasting the future, all of which was used to monitor the program implementation and evaluate its impact. The aim is to improve relevance, efficiency and effectiveness of the program and its reforms. Gasman and Nguyen's (2014) study furnished practical evidence in which similar circumstances have existed and intervention strategies employed to create an environment that maximizes students' academic performance. These strategies can be suited to meet the goals of similar programs such as UNITE. It will also help to eradicate the culture of fear and self- doubt prevalent amongst all engineering faculties including UNITE, in creating and promoting a culture of endless possibilities and successes. The study participants, as people who are best positioned to highlight and come up with solutions to their own problems, made recommendations of their own and that evidence is incorporated among the recommendations made in this study.

2.3.2 Implications of Evaluation

Schneider (1986) defines evaluation as the analysis of a program or policy in terms of its level of performance meaning that, it seeks to answer a question of whether the program or policy is working or not. Weiss (1972) further asserts that evaluation is designed to yield conclusions about the worth of programs and in doing so, affects the allocation of resources. The rationale being that it provides evidence on which to base decisions about managing, expanding and modifying programs as well as for abandoning unsuccessful ones. There is also a common consensus among stakeholders that the basic purpose of evaluation is to allow decision makers an opportunity to make informed decisions (Colebatch, 1998; Parsons, 1995; Weiss, 1972). For example, Martin and Sanders (1999) argue that a substantial increase on research, evaluation of programs and greater use of pilot projects by the government and institutions can provide evidence of what works. This means that the above actions can consequently assist in determining what works and why, and what types of policy initiatives are likely to be most effective and will vastly improve the quality and sensitivity of complex and constrained decisions.

Thus, the rationale that underpins the use of evaluation is enhanced by being clear about the objectives of the program and by evaluating the extent to which the implementation of the policy or programs achieve these objectives. Whilst policy is goal driven, evaluation is goal-oriented as it provides feedback to improve the policy or program (Colebatch, 1998 and

Parsons, 1995). However, despite the general agreement on the effectiveness of evaluation to provide evidence that can be utilized in decision making to facilitate more efficient programs and policies, it has apparently not made much impact. This has been attributed to a number of reasons particularly the failure by decision makers to recognize the influence and relevance this process has, due to the existing political context or circumstances (Gray and Jenkins, 1995). For example, Behrman and Hoddinott (2005) state that in the Mexican Antipoverty and Human Resource Investment Program, advocators of that particular program had strong beliefs about the strength and weaknesses of prior similar programs and this greatly influenced the program's development. These beliefs however were generally based on selective anecdotal observations, conditioned strongly on prior beliefs and political positions regarding the efficacy of particular strategies. The other problem presented is that those who institute and advocate particular programs are often convinced that they are likely to be successful in attaining their stated objectives and therefore see no need for systematic evaluation (Behrman and Hoddinott, 2005).

A main restriction to efficient evaluation is the fact that many evaluation studies are commissioned either by governments or institutions. Kettunen (1994) argues that if evaluation research is commissioned, it is highly likely that it will seek to legitimize the goals of the client, thus restricting attention to the values and interests embodied in the formal official goals and objectives of policies and programs. He terms this kind of approach as top-down evaluation. He further argues that top-down evaluation is concerned with strengthening the prevailing politico-administrative and managerial structures. Those with vested interests in a program's continuation often fear the consequences of shortcomings that might be revealed by systematic evaluation.

Data collection also impedes systematic references of the questions meant to be answered by evaluations on policies and programs. Parsons (1995) argues that, only an evaluation based on explicit production and outcome functions will provide a framework for relevant evaluation. Good evaluations are likely to weaken the historical tendency for programs to thrive only as long as their advocates survive in government, even if from a social viewpoint they should have been curtailed, modified or even maintained longer. This study therefore focuses on the formative strategy and data collection methods which are congruent with it as suggested by Beer, Bloomer and Xerox Corporation (1986).

2.3.3 Formative Evaluation

The evaluation process involves gathering of evidence, which can be utilised to form bases from which decisions about policy and programmes are made. Therefore, the collection of evidence is one of the fundamental processes of evaluation. Commonly used models of collection of evidence can be classified into two categories, namely formative and summative (Patton, 1980). William and Black (1998) make a distinction between formative and summative evaluation. They define formative evaluation as the elicitation of evidence that yields construct-referenced interpretations that forms the basis for successful action in improving performance, whereas summative prioritises the consistency of meanings across contexts and individuals. This distinction according to Beer, Bloomer and Xerox Corporation (1986) has been a useful paradigm in that it draws attention to process the outcome. They however add that it does not provide guidance for the planning and conduct of the evaluation itself and proposes a model which is more appropriate to the practical enquiry concerns of the programme evaluator.

For the purposes of this study, the discussions are limited to formative evaluation which is defined as level two evaluation in Beer, Bloomer and Xerox Corporation's (1986) proposed model. Level two evaluation provides periodic monitoring of programmes that have been fully implemented. Programmes at this level are assumed to be still amenable to modification, depending on changes in the environment and in the student population. At this level, the evaluator compares groups of students in the same programme over time, to ensure that students achievements remain at acceptable levels and that their needs continue to be met, even if the programme is being revised. This level focuses on both the programme's needs and those of the students. Data collected at this level answers the following two evaluation questions:

1) Do the students achieve the programme's objective?
2) Is the programme meeting the students' objectives?
3) Data was collected through tests course critiques and individual interviews with students. This requires an on-going commitment from the programme's administrators for data collection and analysis, staff to keep course documentation updated and staff and resources to affect recommended changes (Beer, Bloomer and Xerox Corporation, 1986).

2.4 Rationale for using evidence based framework in an evaluation Study

Evidence based monitoring and evaluation is fundamentally based on principles which are supported by a substantial amount of research on practical designing, enactment and implementation of a policy or program intervention (Pawson and Tilley, 1997). Formative evaluation methods are therefore favored by this study as they are deemed to be the most appropriate methods to be utilized within the evidence based framework. The overall purpose of this study is to perform an evaluation process on the UNITE program. It uses qualitative enquiry to investigate the challenges which are experienced by the program particularly the high attrition rate. Evidence based framework allows for an assessment to be made as to whether all the necessary elements of a program are in place. In the context of evaluation, this type of analysis can be used to identify impediments to the effectiveness of a program's design or delivery (Pawson and Tilley, 1997).

Consequently, it makes a major contribution in improving the design of programs and maximizing potential effects. The implementation of effective interventions to resolve social problems requires that careful evaluations are made a priority. An evidence based framework to what works, therefore requires that these evaluations be gathered, appraised and analysed. The results should be made accessible so as to influence relevant decisions whenever appropriate and possible.

It could be argued that the policy transformation requires a strong evidence base framework. However, if this is derived solely from the accumulation of empirical evidence of effectiveness, there is a real danger of ending up with little more than a menu of *proven* interventions from which to select and without a rational base to guide that selection. Of more relevance to the practitioner are general principles together with an understanding of context-specific factors, which will allow adaptation to suit different situations.

2.4 Conclusion

The available body of research on issues pertaining to foundation programs demands different and special attention that is best tailored for the peculiar issues prevalent in these programs. Even though the CHE (2013) study acknowledges the poor output rate in foundation programs, it makes no attempt to investigate issues that specially contribute to that

phenomenon within these programs. Instead, the CHE (2013) study places more emphasis on the contribution that foundation programs have made in terms of affording opportunities to students who otherwise would not have qualified for enrolment in the university. The attrition rate in these programs are however huge, perhaps even more than in the mainstream. Statistically, they contribute to the overall attrition rate and the body of available literature does not pay sufficient attention to evaluating whether these programs are actually meeting all their projected goals and objectives and finding out why, if they are not. Gasman's (2014) study is fundamentally important as it provides credible empirical evidence on the efficiency of models, methods and interventions that could be used to enhance students' success in STEM schools. This study thus goes beyond the scope of previously discussed literature and includes peculiar issues affecting the UNITE program particularly. It also suggests models, methods and interventions as per Gasman's study, critically taking into consideration the practicality of implementation within the UNITE program context.

Chapter 3

Research Methodology

3.1 Introduction

For a research to be undertaken, it should have a research methodology and research method(s). These are important research components and they give meaning to a study. This chapter gives a clear description of the research methodology and methods used in the study as well as that of the study design and the population sample. It further describes the geographical area where the study was conducted, the instruments used for data collection and the methods used to validate the data. The rationale for the study and all ethical and institutional research requirements are also discussed in the chapter.

3.2 Research Approach and Design

Research methodology is the science of studying how research is done scientifically (Kothari, 2004). There are two main research methodologies and these are quantitative and qualitative. According to Myers (2009), qualitative and quantitative on one level refer to distinctions about the nature of knowledge: how one understands the world and the ultimate purpose of the research. On another level of discourse, the terms refer to research methods, which are the ways in which data is collected and analyzed and the type of generalizations and representations derived from the data. Research methods in general refer to those methods, researchers use in research operations (Kothari, 2004). Quantitative research methods were originally developed in the natural sciences to study natural phenomena whilst qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena (Brysman and Burgess, 1999). It is said that both quantitative and qualitative research studies are conducted in education. Neither of these methods is fundamentally better than the other and the choice of using any depends on the context, purpose and nature of the study in question. Some researchers prefer to use a mixed methods approach by taking advantage of the differences between quantitative and qualitative methods, and combining these two methods for use in a single research project depending on the kind of study and its methodological foundation (Brysman and Burgess, 1999).

Denzin and Lincoln (2003) assert that qualitative research involves an interpretive, naturalistic approach to its subject matter. In addition, qualitative research attempts to make sense of or interpret phenomena in terms of the meaning people bring to them which makes it useful to study educational settings and processes. According to Domegan and Fleming (2007) qualitative research aims to explore and discover issues about the problem at hand, because very little is known about that problem. There is usually uncertainty about the dimensions and characteristics of problems. It uses 'soft' data and gets 'rich' data. According to Myers (2009), qualitative research is designed to help researchers understand people, and the social and cultural contexts within which they live. Such studies allow the complexities and differences of worlds-under-study to be explored and represented (Philip, 1998).

In qualitative research, different knowledge claims, enquiry strategies, and data collection methods and analysis are employed (Creswell, 2003). Qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions (Myers, 2009). Data is derived from direct observation of behaviors, from interviews, from written opinions, or from public documents (Sprinthall, Schmutte and Surois, 1991). "An obvious basic distinction between qualitative and quantitative research is the form of data collection, analysis and presentation. While quantitative research presents statistical results represented by numerical or statistical data, qualitative research presents data as descriptive narration with words and attempts to understand phenomena in "natural settings". This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" (Denzin and Lincoln, 2000, p. 23).

Quantitative research on the other hand makes use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers and this allows the for a statistical analysis of the data (Hittleman and Simon, 1997). Quantitative researchers measure variables on a sample of subjects and express the relationship between variables using effect statistics such as correlations, relative frequencies or differences between means (Denzin and Lincoln, 2000). The authors add that the focus of quantitative researchers to a large extent is the testing of theories.

Stake (1995) points out that qualitative and quantitative emphasis differ in three major ways: explanation and understanding as the purpose of the inquiry; the personal and impersonal role of the researcher and knowledge discovered and constructed. Another major difference between the two is that qualitative research is inductive and quantitative research is deductive. In qualitative research, a hypothesis is not needed to begin research as it employs inductive data analysis to provide a better understanding of the interaction of 'mutually shaping influences' and to explain the interacting realities and experiences of researcher and participant (Lincoln and Guba, 1985). It allows for a design to evolve rather than having a complete design at the beginning of the study because it is difficult if not impossible to predict the outcome of interactions. This is due to the diverse perspectives and value systems of the researcher and participants, and their influence on the interpretation of reality and the outcome of the study. Quantitative research on the other hand requires a hypothesis before research can begin (Lincoln and Guba, 1985).

In qualitative research, according to Merriam (1988), the researcher engages the situation most often without an observation schedule, and plays a dynamic role in constructing an understanding of the research environment through self-interpretation of what happens. Thus, qualitative research produces a result which is 'an interpretation by the researcher of views of others filtered through his or her own'. In qualitative studies, the researcher is considered the primary instrument of data collection and analysis. The researcher engages the situation and makes sense of the multiple interpretations as multiple realities exist in any given context as both the researcher and the participants construct their own realities. She/he strives to collect data in a non-interfering manner, thus attempting to study real-world situations as they unfold naturally without predetermined constraints or conditions that control the study or its outcomes (Merriam, 1988).

Whilst Stainback and Stainback (1988) list three basic purposes of quantitative research which are to describe, to compare and to attribute causality, Maxwell (1998) lists five research purposes for which qualitative studies are particularly useful as seen below:

1) Understanding the meaning that participants in a study give to the events, situations and actions that they are involved with and of the accounts they give of their lives and experiences.

2) Understanding the particular context within which the participants act, and the influence this context has on their actions.
3) Identifying unanticipated phenomena and influences and generating new, grounded theories about them.
4) Understanding the process by which events and actions take place.
5) Developing causal explanations.

Merriam (1988) states that qualitative case studies in education are often framed with concepts, models and theories. An inductive method is then used to support or challenge theoretical assumptions. Although the research process in qualitative research is inductive, Merriam (1988) notes that most qualitative research inherently shapes or changes existing theory in that:

1) Data is analyzed and interpreted in light of the concepts of a particular theoretical orientation.
2) Findings are usually discussed in relation to existing knowledge (some of which is theory) with the aim of demonstrating how the present study has contributed to expanding the knowledge base.

Lincoln and Guba (1985) advice that in qualitative research, the biases, motivations, interests or perspectives of the inquirer should be identified and made explicit throughout the study. They point out that qualitative research can be disadvantageous and these disadvantages are listed below:

1) Researcher bias can bias the design of a study.
2) Researcher bias can enter into data collection.
3) Sources or subjects may not all be equally credible.
4) Some subjects may be previously influenced and affect the outcome of the study.
5) Background information may be missing.
6) Study group may not be representative of the larger population.
7) Analysis of observations can be biased.

Any group that is studied is altered to some degree by the very presence of the researcher. Therefore, any data collected is somewhat skewed (Heisenburg Uncertainty Principle)

It takes time to build trust with participants that facilitates full and honest self- representation. Short term observational studies are at a particular disadvantage where trust building is concerned (Lincoln and Guba, 1985).

Researchers should take note of these disadvantages so that they can minimize their effects during the course of the study. In support of qualitative research, Merriam (1988) argues that most writers suggest judgment should focus on whether the research is credible and confirmable rather than imposing statistical, quantitative ideas of generalization on qualitative research. In conclusion, qualitative research is a systematic inquiry into the nature or qualities of complex social group behaviors by employing interpretive and naturalistic approaches. Qualitative research lends itself to thick narrative description of the group's behavior in the group's natural environment. It attempts to be non- manipulative and takes into account the composed views of the participants as the purpose is generally to aim for objectivity. Qualitative research is appropriate when the researcher wants to (a) become more familiar with the phenomenon of interest, (b) to achieve a deep understanding of how people think about a topic and(c) to describe in great detail the perspectives of the participants.

3.3 Rationale for a Qualitative study

Many scholars (Denzin and Lincoln, 2005; Domegan, and Fleming, 2007; Henning, Van Rensburg and Smit, 2004) argue that human learning is best researched using qualitative methods. The context, purpose and nature of a study should however be the determinant as to whether it should employ a qualitative research methodology or not. This study for instance aims to,

1) Investigate significant challenges encountered by the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE) program and ascertain the level of influence thereof in the program's performance with regards to achieving its targets and goals.
2) Evaluate the causes and the impediments to finding interventions of the phenomenon within the UNITE program.

3) Provide an understanding of shortcomings and suggest possible interventions which can subsequently produce more engineers, meet the institutions' objectives and significantly contribute to the development of graduates that the economy needs, especially in the fields of science, engineering, technology and mathematics.

The above aims will be best achieved through an in-depth understanding of human behaviour and the reasons that govern such behaviour. Denzin and Lincoln (2005) affirm that qualitative research is most suited for studies with the above aims. Qualitative research method further investigates the *why* and *how* parts of decision making which is fundamentally useful in studying educational settings and processes within the context of this study. Qualitative research is therefore appropriate for this study because it intends to understand the issues that contribute to the attrition rate within the UNITE foundation program and suggest intervention strategies based on that understanding. A qualitative research methodology allows for the extraction of research subjects beliefs and values, ideas and experiments which best describes and gives an understanding of issues peculiar to the engineering foundation program. Furthermore, qualitative research according to Myers (2009) is designed to help researchers understand people and the social and cultural contexts within which they live. This in turn allows the complexities and differences of worlds-under-study to be explored and represented (Philip, 1998). The use of quantitative research methods obscure some of those insights and experiences of participants that the researchers need to understand in order to address the complexities of learning processes and the contextual factors required for the learning environment. Based on the above discussion, it is evident that qualitative research methodology/methods are the most suited for this study.

3.4 Geographical Area for the study

This research was conducted at the University of KwaZulu-Natal, Howard College Campus which is geographically situated in the City of Durban within the EThekwini Municipality in the Province of KwaZulu-Natal, in South Africa. The University of KwaZulu-Natal was formed on the 1st of January 2004, as a result of the merger between the erstwhile University of Durban-Westville (UDW) and University of Natal, with campuses in Durban (Howard College) and in Pietermaritzburg (UKZN, 2004) The University of Durban-Westville (UDW)

was established in the 1960s as a University College for Indians on Salisbury Island in Durban Bay. Student numbers throughout the 1960s were low as a result of the Congress Alliances policy of shunning apartheid structures. This policy gave way in the 1980s to a strategy of 'education under protest' which sought to transform apartheid institutions into sites of struggle. Student numbers grew rapidly and in 1971, the College was granted University status. The following year, the newly-named University of Durban-Westville moved into its modern campus in Westville and was a site of anti-apartheid struggle. UDW became an autonomous institution in 1984, opening up to students of all races (Pattman, 2007).

Founded in 1910 as the Natal University College (NUC) in Pietermaritzburg, the University of Natal was granted independent University status in 1949 owing to its rapid growth in numbers, its wide range of courses and its achievements in and opportunities for research. By that time, the NUC was already a multi-campus institution, having been extended to Durban after World War 1. The distinctive Howard College building was opened in 1931, following a donation by Mr T B Davis, whose son Howard Davis was killed during the Battle of Somme in World War I. In 1946, the government approved a Faculty of Agriculture in Pietermaritzburg and, in 1947, a Medical School for African, Indian and Coloured students in Durban (Pattman, 2007).

The two KwaZulu-Natal universities were among the first batch of South African institutions to merge in 2004 in accordance with the government's higher educational restructuring plans to reduce the number of higher educational institutions in South Africa from 36 to 21. Confirmed by a Cabinet decision in December 2002, the mergers were the culmination of a wide-ranging consultative process on the restructuring of the Higher Education Sector that began in the early 1990s. The institution now caters for thousands of students from different races and diverse backgrounds (Pattman, 2007).

3.5 Participants in the study

The subjects in this study included Ten (a) undergraduate students who were formerly UNITE program students that have completed the program and are now absorbed into the mainstream within the University, and four (b) former UNITE students who were excluded from the

program and are no longer at the University of KwaZulu-Natal. Interviews were also conducted with one UNITE lecturer and administrator and three students. This study used a non-probability sampling method, namely, purposive sampling for the interviews. Purposeful sampling takes place when the researcher selects a sample from which the most can be learned (Merriam, 1988). The researcher chooses the sample based on who they think would be appropriate for the study. This type of sampling is also used when the number of people that have expertise in the area being researched is limited. According to Williams (2006), purposive sampling is useful in allocating members of a specific population (William, 2006). This study used this sampling method as it is best suited to target the group that had been through the UNITE program as well as former and current lecturers and administrators in the program. This was done because the information gathered could not have been sourced from any other students or lecturers or administrator except respondents who meet the criteria to best provide this study with relevant data. According to Patton (2002), purposive sampling is more adequate when using qualitative methodology research as any common patterns that emerge from great variation are of particular interest and value in capturing the core experience and central, shared dimensions of a setting or phenomenon.

This study further applied a non-proportional quota sampling in which the minimum number of sampled unites in each category were specified. Here, the researcher was not concerned with having numbers that match the proportions in the population. The aim instead was to have a bigger sample size that will embody small groups in the population (William, 2006). This method was used in this study to assure that smaller groups were adequately represented in the sample. This therefore informed a decision to have one lecturer and administrator giving an educators and administrators' perspective of issues to be investigated. In accessing the sample group that falls within the aforementioned criteria, the researcher further approached the UNITE offices to request the list with contact details of all the students who were in the program from 2009-2013 and thus were contacted randomly from the list.

3.6 Data Sources

Evaluation is the process of systematically collecting data that represents the opinion and experience of participants or other stakeholders. The primary data sources include 20 undergraduate students who are former UNITE program students. They include those who

have finished the program, absorbed into the main stream and are still within the university and those who were excluded from the program and are no longer at the University of KwaZulu-Natal. A UNITE lecturer and a UNITE program Administrator were also interviewed. The main data collection techniques used in this study are interviews, questionnaires and documents.

3.6.1 Questionnaires

For the purpose of this study, a schedule of questions was drawn up which include a mixture of closed and open questions. This was done so that data would be manageable. The researcher used his discretion as to which responses he would like to limit and the ones he would encourage respondents to go in-depth with to reveal their ideas and experiences. This allowed for balance in the data analysis because closed questions could be quantified while open questions can reveal the research subject's beliefs, values, ideas and experiments in depth (Genise, 2002). In addition to the aforementioned data sources, other sources such as interviews, documents and texts were utilized. According to Sprinthall, Schmutte, and Surois (1991), data derived in this manner is useful in a qualitative research.

3.6.2 Interviews

Interviews are methods of gathering information orally using a set of pre- planned core questions. According to (Shneiderman and Plaisant, 2005), interviews can be very productive since the interviewer can pursue specific issues of concern that may lead to focused and constructive suggestions. The main advantages of the interview method of data collection as highlighted by Genise (2002) and Shneiderman and Plaisant (2005) are:

1) Direct contact with the users often leads to specific, constructive suggestions;
2) They are good at obtaining detailed information;
3) Few participants are needed to gather rich and detailed data.

Depending on the need and design, interviews can be unstructured, structured, and semi-structured with individuals, or focus-group interviews. This study used a semi structured interview approach. This method of interview has features of both structured and unstructured

interviews and therefore employs both closed and open questions. As a result, it has the advantage of both methods of interview. In order to be consistent with all participants, the interviewer had a set of pre-planned core questions for guidance so that the same areas were covered with each interviewee. As the interview progresses, the interviewees were given the opportunity to elaborate or provide more relevant information if they so desire. The lecturer, administrator and three students were interviewed for purposes of this study. The interviews were recoded then latter transcribed.

3.7 Data Analysis

Bogdan and Biklen (2003) define qualitative data analysis as working with the data, organising them, breaking them into manageable units, coding them, synthesising them and searching for patterns. The aim of analysis of qualitative data was to discover patterns, concepts, themes and meanings. In case studies research, Yin (2003) discusses the need for searching the data for 'patterns' which may explain or identify causal links in the data base. In the process, the researcher concentrates on the whole data first, then attempts to take it apart and re-constructs it again more meaningfully. Categorisation helps the researcher to make comparisons and contrasts between patterns, to reflect on certain patterns and complex threads of the data deeply and to make sense of them (Yin, 2003).

The process of data analysis begins with the categorisation and organisation of data in search of patterns, critical themes and meanings that emerge from the data. A process sometimes referred to as 'open coding' by Strauss and Corbin, (1990) is commonly employed. This involves the researcher identifying and tentatively naming the conceptual categories into which the phenomena observed would be grouped. The goal is to create descriptive, multi-dimensional categories that provide a preliminary framework. These emerging categories are of paramount importance as qualitative researchers tend to use inductive analysis.

In this study, the results of the interview material relevant to each broad study area and key study questions were presented. The results of the interviews were graphically represented and arranged under key themes from the study guided by the theoretical framework, the broad study issues, the key study concepts and the specific sample groups to draw conclusions. The interviews were recorded and transcribed. Participants were required to respond to questions

posed in the questionnaires in writing. During these processes, useful information closely linked to their experiences emerged. This whole process was done manually.

3.8 Validation of Research Findings

3.8.1Triangulation

To overcome the problem of biasness and validation, this research used multiple methods and measures of an empirical phenomenon called triangulation (Blaikie, 2000; Scandura and Williams, 2000). Triangulation arose from an ethical need to confirm the validity of processes and in case studies; it can be achieved by using multiple sources of data (Yin, 2003). It is an approach that utilises multiple data sources, multiple informants and multiple methods (e.g., participant observation, focus groups and member checking), in order to gather multiple perspectives on the same issue and gain a more complete understanding of the phenomenon. Triangulation is used to compare data to decide if it corroborates (Creswell, 2003; Patton, 2002) and thus, to validate research findings. It is considered as of the best methods to improve the trustworthiness of qualitative research findings.

Triangulation as a way of mutual validation of results can uncover biases when there is only one researcher investigating a phenomenon. Triangulation may incorporate multiple data sources, investigators, and theoretical perspectives in order to increase confidence in research findings (Painter and Rigsby, 2005). The use of results from one set of data to corroborate another set of data is also known as triangulation (Brannen, 2004). If the alternative methods do not share the same source of systematic error, examination of data from the alternative methods gives an insight into how individual scores may be adjusted to closely reflect true scores (Brannen, 2004).This maximises the richness and validity of the data and increases reliability

The triangulation approach is employed to evaluate the outcome of this study. Interviews were conducted with one UNITE lecturer and one program administrator, using an evidence based theoretical framework, the broad study issues and key study concepts. Other methods used are distribution of questionnaires to former unite students, interviews conducted with

three relevant students and clarification of biases. The outcome of the interviews was triangulated with the questionnaire responses completed by the students as well as reports from experts in the subject sourced from available literature. Thus, the triangulation exercises were done at various levels to focus on a final outcome based on various perspectives.

3.9 Ethical Considerations

As the study is of a qualitative nature, the researcher interacts deeply with the participants and the tutors, thus entering their personal domains of values, weaknesses and individual learning disabilities to collect data (Silverman, 2000). Consequently, several ethical issues that should be addressed during and after the research emerged. According to Creswell (2003), a researcher has an obligation to respect the rights, needs, values and desires of the informants. Miles and Huberman (1994) list several issues that researchers should consider when analysing data. They caution researchers to be aware of these and other issues before, during, and after the research had been conducted. Some of the issues include the following:

1) Informed consent (Do participants have full knowledge of what is involved?)
2) Harm and risk (Can the study hurt participants?)
3) Honesty and trust (Is the researcher being truthful in presenting data?)
4) Privacy, confidentiality, and anonymity (Will the study intrude too much into group behaviours?)
5) Intervention and advocacy (What should researchers do if participants display harmful or illegal behaviour?)

Appropriate steps were therefore taken in this study to adhere to ethical guidelines in order to uphold participants' privacy, confidentiality, dignity, rights and anonymity. The participants were informed of the purpose and nature of the study, data collection methods and the extent of the research prior to commencement of the study. In line with this, the researcher obtained their informed consent in writing. This study guarantees that no participants were put in a physical or psychological harmful situation because of their participation. Furthermore, the researcher ensured that the confidentiality and anonymity of the participants was maintained through the removal of any identifying characteristics before

widespread dissemination of information. The researcher made it clear that the names of participants were not used for any other purposes and that information shared did not reveal their identity in any way. In addition to the above mentioned precautions, it was made clear to the participants that the study was only for academic purposes and their participation in it was absolutely voluntary. No one was forced to participate.

3.10 Conclusion

In order to accomplish the research aims and due to the nature of the issues investigated, this study used qualitative methods to collect data by means of interviews, questionnaires and documents. The sample population was one UNITE lecturer, one UNITE program administrator and seventeen former unite students. Permission was requested and obtained from the University of KwaZulu-Natal (Howard Campus) as it is the study site. Consent was also obtained from the study participants. Anonymity, self-determination and confidentiality were guaranteed during administration of the questionnaires and report writing. Questionnaires were distributed to participants to ensure validity. In a nutshell, this chapter has described the research methodology, including the population sample, data collection instruments as well as strategies used to ensure the ethical standards, reliability and validity of the study.

Chapter 4

Data Analysis

4.1 Introduction

It is a commonly held perception that any study can become authentic and gain recognition because of its findings and the analysis of those findings. Analysis therefore is a very important stage in any study as it shapes the study. When all relevant data has been collected, the study proceeds to analyze and interpret it. The production of credible analysis mainly lies in the researcher's ability to eliminate bias and ensure that his/her own opinion minimally influences the findings of the study (Yin, 2003). In light of the aforementioned, the responses of the participants to questionnaires and interviews reflect common trends. The data generated was therefore categorised and discussed under commonly key identified issues guided by the theoretical framework, the broad study issues and the key study concepts in order to draw conclusions. The study used the key study questions listed in section 1.4 above, to generate data which aided the investigation of significant challenges encountered by the UNITE programme. It also ascertained the level of influence in the programme's performance with regards to achieving its targets and goals.

4.2 The findings and discussion

From the available evidence, it is clear that all the stake holders (students, administration and lecturers) have either a basic or a deep understanding of the aims and objectives of the UNITE program. They also appreciate the far reaching consequences for the country in keeping programs like UNITE efficiently performing.

Administrator: "This program (UNITE) over the last 25 years has been aimed at affording the students from the disadvantaged backgrounds an opportunity to become engineers and uplift themselves and their communities"

Lecturer: "In my understanding, the program is for students who did not meet the school's requirements for entry and the program is like giving them a second chance to fulfil their dreams of becoming professional engineers and help the country (South Africa) to develop as you may know engineers, black engineers in particular are scarce"

Student: "The UNITE program is a program which gave us an opportunity to study engineering at the university and potentially address the racial disparities within the engineering sector. It afforded us an opportunity to alleviate poor social conditions in which most of us come from and to contribute to the development of the South African economy"

This common understanding is expected to align the behavior and attitude of all these stakeholders to work towards the attainment of the same goals and ultimately the improvement of the program's performance. The students, lecturers and administrative staff are undoubtedly making an effort in this regard.

However, there is more evidence to suggest that there are intertwined challenges which greatly undermine the efforts meant to contribute towards making the UNITE program a success. These challenges have played a part in the poor performance experienced by the program over the recent years. These challenges emanate from (a) the effects of the curriculum structure upon the time table (b) lack of competent secondary educational background (c) exclusion policy (d) lack of funding (e) students' personal problems and lack of using support programs (f) language barriers (h) class sizes.These challenges have contributed to the significant failure rate within the programme between 2005 to date. According to a student's claim, only 12 out of 76 students who were part of the program in 2013 were successful, meaning that an average of 13% of students made it through the UNITE program in 2013. Below is an excerpt by the student:

Student: "Last year (2013), when we started the program there were 76 of us but from that only 12 of us passed the program."

This situation however is not in line with the objectives of the program. The low success rate definitely does not align with the aims and goals of the program. However, it must be noted that this was not always the case. It seems that the program performed well before the curricular readjustment in 2005. Apparently, students found it difficult to cope after this readjustment and it negatively affected their academic performance. This sentiment is shared by students who went through the program before the curriculum readjustments in 2005 as stated in the excerpt below:

Student: "Those of us who were in the program before 2005 never used to fail like students are failing now but it was because maybe we did not have some of the main stream first year modules which are included in the curricular now"

There seems to be a differing depiction of the status quo regarding the performance of the program from the administration. Although they acknowledge the challenges surrounding the program, they claim (as seen below) that it still performs well with minor or insignificant changes in the pass rate.

Administrator: "Even though I am not sure of numbers but over the past few years the numbers have been fluctuating. We will do well in other years but on the following year the pass rate will go down but not on significant margins"

Nevertheless, all parties acknowledge that there are challenges faced by the program, which if not resolved, will threaten its existence and relevance.

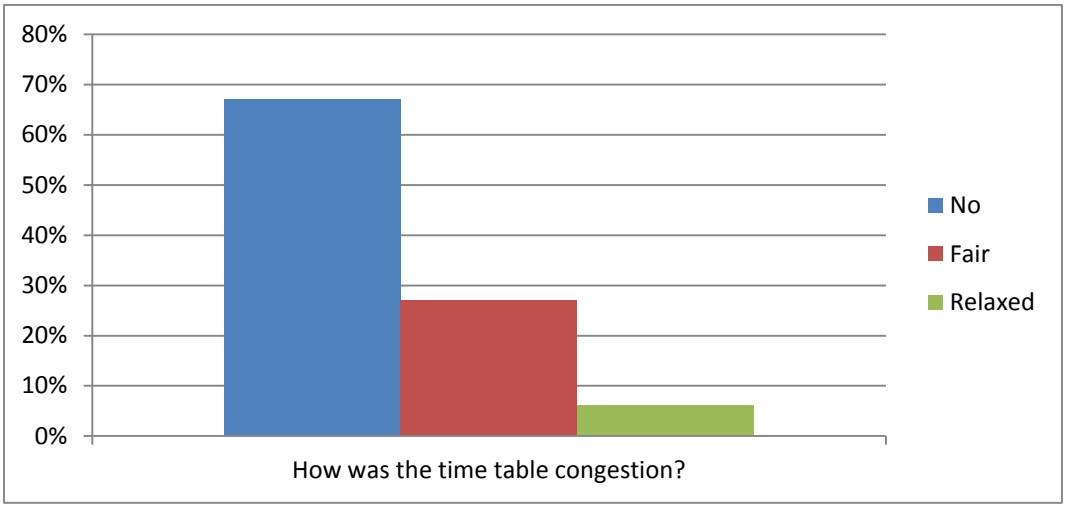
(a) The effects of the Curriculum structure upon time table

In agreement with the CHE study conducted in 1993, curricular structure is a systemic variable affecting students' performance. Therefore, upon design, contemporary conditions which affect students success need to be considered to make sure the curriculum structure and assumptions meet the program's needs. The curricular structure therefore, must be flexible. It must be coherently-designed to meet the needs of the majority.

The UNITE program curriculum structure plays a vital role in the program's quest to achieve its goals. UNITE students acquire full first year credits in Engineering Drawing and Math. Other non-credited subjects are Chemistry, Physics, Mechanics and Communication Skills plus practicals which technically amount to 8 modules per semester. It is commendable that students are offered an opportunity to attend first year mainstream modules while in the UNITE program, for which they are credited for when they progress into the mainstream.

Administrator: "…some modules are mainstream modules which we offer to students…"

(Table 4.2.1 congested time table)



However, this is a cause for concern in as it results in time table congestion or jamming which creates a difficult environment for students to manage their work load. When one considers the fact that about 90% of the students stay either at the university residences or private accommodations and are responsible for their daily and personal responsibilities, it is worrisome that the increased number of modules requires that the students attend classes from 07:45am-16:45pm without proper or adequate breaks in-between. The consequences in this case are that 67%of students find the time table congested and find it difficult to cope ***(see table 4.2.1).***This means that in order to create time for other activities such as cooking, studying, relaxing and participating in social integration programmes within the university, they will have to miss some classes. The students feel that this counterproductive approach was the only way that they could strike a balance between their academic and social life and cope within the programme. The following excerpt from a student captures this feeling:

Student: "I found it difficult to find time in between lectures as there was barely any time for a break, the only way to have a break at times was to not attend certain classes. I put together a study timetable to help get into a rhythm and to always be in line with the lectures. Didn't have much of a social life outside of the people I knew at UNITE"

Students therefore resort to missing classes as a way to create breathing space between lectures and other duties they need to perform. This has resulted in them losing out on some valuable information and clarifications they would otherwise have benefited from had they

attended their classes. These long lecture hours differentiate the current programme from that of before 2005. Prior to 2005, students were not subjected to long lecture hours because they had fewer modules to attend unlike after 2005. The following excerpt explains this:

Student: "The number of modules were manageable and we used to finish attending at 2:30pm and we will have all the time in the world to relax, do what we had to do, meet as groups and study…UNITE was easy…only those who wanted to fail will fail and there were very few of those…people never used to fail at UNITE like now…."

This present environment does not allow students to take up other forms of learning outside the class environment. For example, they could hardly find enough time to meet as groups to further study or assist each other, discuss the challenges they experience with the modules or participate effectively in other student support programmes offered within UNITE. The evidence suggests that the curricular structure for the UNITE program in this regard, ignored some of the diverse factors which directly affect students' ability to cope within the program. To facilitate constructive learning rather than 'cramming', a curriculum must provide adequate room for teaching or meditation in various forms as well as for private study and reflection, singly or in small groups. The absence of sufficient curriculum space for key forms of learning in the UNITE program is a major structural impediment to students success. This calls for a review of the UNITE program curriculum structure and approach particularly its alignment with reality to improve the success of students.

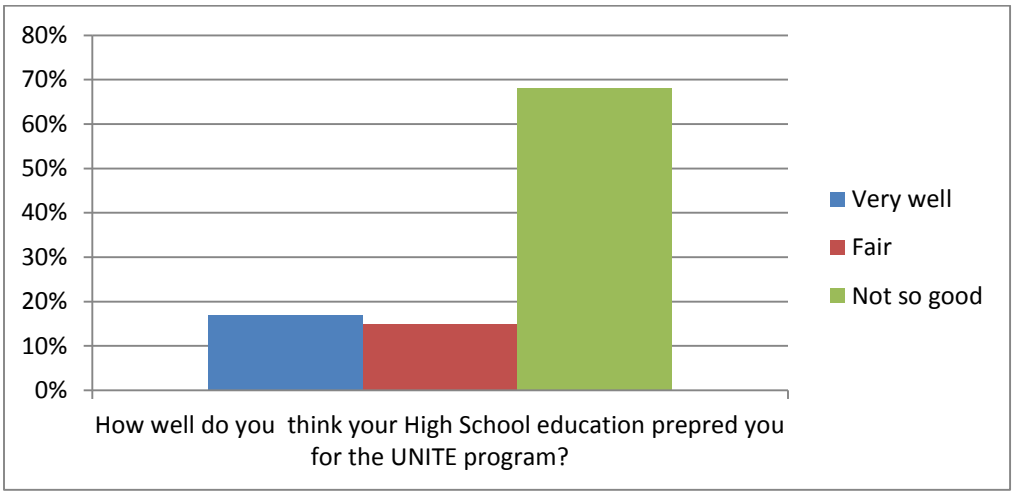
However, extra time does not necessarily facilitate learning unless constructive use is made of the time. Whilst it will reduce the workload and provide for a relaxed time table, it will certainly not address the fundamental problem of mismatch between assumptions about prior learning and students' actual educational backgrounds.

(b) Lack of competent secondary educational background

The lack of competent educational background to equip and prepare students with necessary background skills and knowledge in math and science remains a challenge that is affecting the UNITE programme. Even lecturers acknowledge that this is one of the issues that affect the performance of the programme:

Lecturer: "We (lecturers) do not take things for granted as we understand that some of these students lack basic understanding of some mathematical concepts and it's not their faults but that of the education background in which most of them come which did not equip them with necessary knowledge or knowledge which we will expect of them to possess at this level. That becomes an issue as they cannot grasp certain lessons as expected and which results to unpleasant results."

(Table 4.2.2 preparedness for the programme)

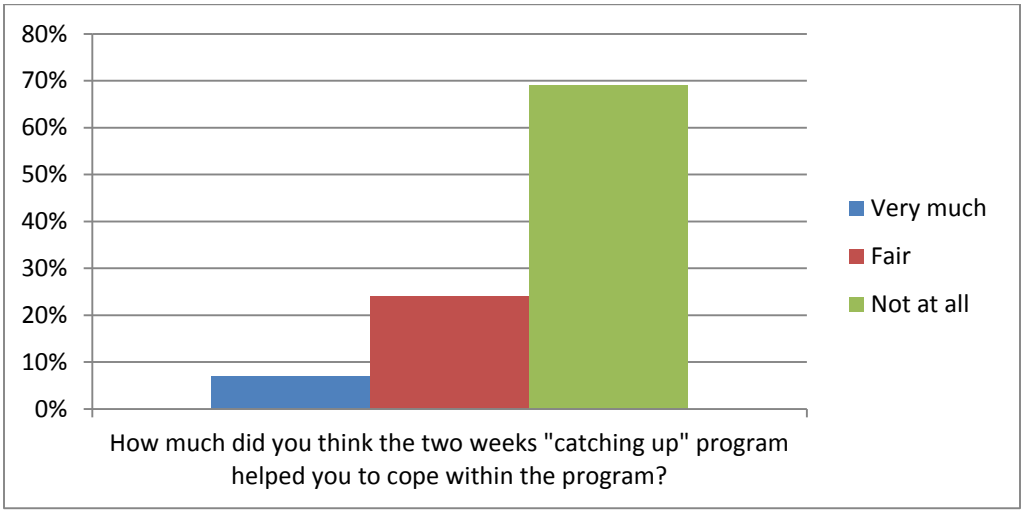


The available body of evidence affirms the lecturer's view as it points out that 68% of the interviewed students believe that their education background did not prepare them well enough to cope within the program ***(see table 4.2.2)***. This claim is supported by the immense underperformance of students in engineering education. This is a challenge that has been in existence for years and it is clear that this is a country-wide phenomenon which cannot be ignored or underplayed and it warrants the development of serious, adequate and sufficient intervention strategies by institutions. However, the issue still persists among institutions with little effort made to find strategic and effective interventions. Rather, there has been a tradition of heavy reliance on ineffective and out-dated strategies. The UNITE programme has for years relied on its inadequate two weeks 'catch- up' programme meant to bring students up to speed with the standard of university education. The 'catch- up programme' is a common practice in most institutions as primary and secondary education does not prepare the students well for university science and math courses. Two weeks of catching up by any

standard imaginable is not sufficient, thereby contributing to the underperformance of students in the UNITE program. The students themselves attest to this:

Student: "I attended the first two weeks of math and science catching up program but it was a lot to grasp in a short space of time and I do not think it made any difference and if it did at all it was very minimal to such that I couldn't even notice. But maybe it did not help me but helped others."

(Table 4.2.3 catching up intervention)

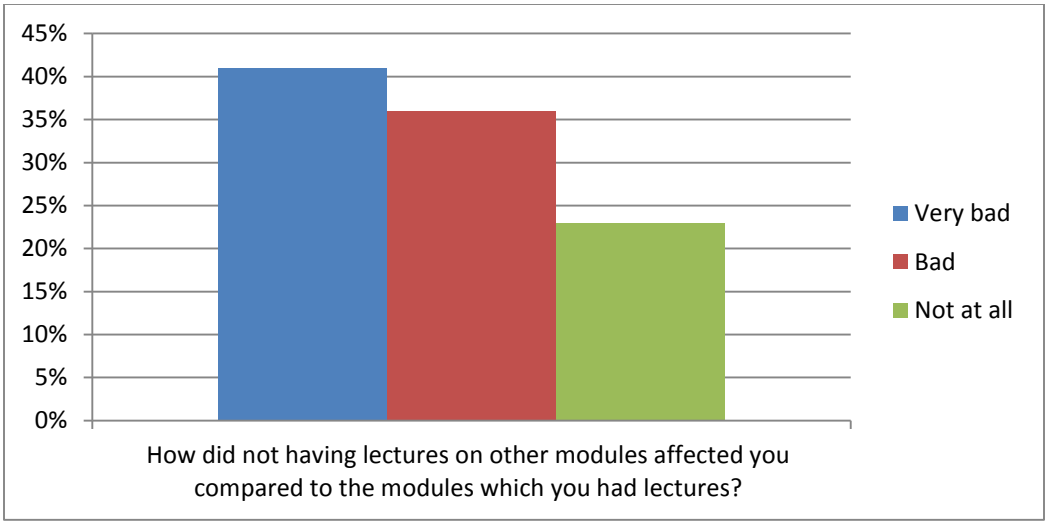


Even though the commitment of the lecturers and demonstrators to assist students in the UNITE programme is evident and can as Gasman and Nguyen (2014) note, invaluably assist students to provide necessary supplemental learning support so that all students could be academically successful, it is clear that there is a need for more than just two weeks of 'catching up'. The above graph show that 68% of students feel that the two weeks 'catching up' program did not assist in any way **(*see table 4.2.3)*.** This is a true reflection of its ineffectiveness. There is a need therefore for the implementation of more meaningful programs which will produce realistic results. For example, there should be an intensive program aimed at making up for past deficiencies that starts at least a month before the start of the regular university program. In 2009, the American Medical Association avers that meaningful programs to immerse students in the STEM curriculum can generate positive results.

Apart from inadequate 'catch-up' classes, there were no lecturers for some modules.This affected the students badly as they found it difficult to understand the content of those modules as opposed to other modules which had lecturers.Table 4.2.4 below shows that 41% and 37% of students claim to have been very badly or badly affected respectively. The following excerpt also attest to this:

Student: "Having lectures helped us a lot and I became aware of this because in classes which did not have lectures most of us did very badly and some not as good as in other classes. For example, If there was a UNITE class for Materials, the content would've been easier to consume as was the case with Maths and Physics".

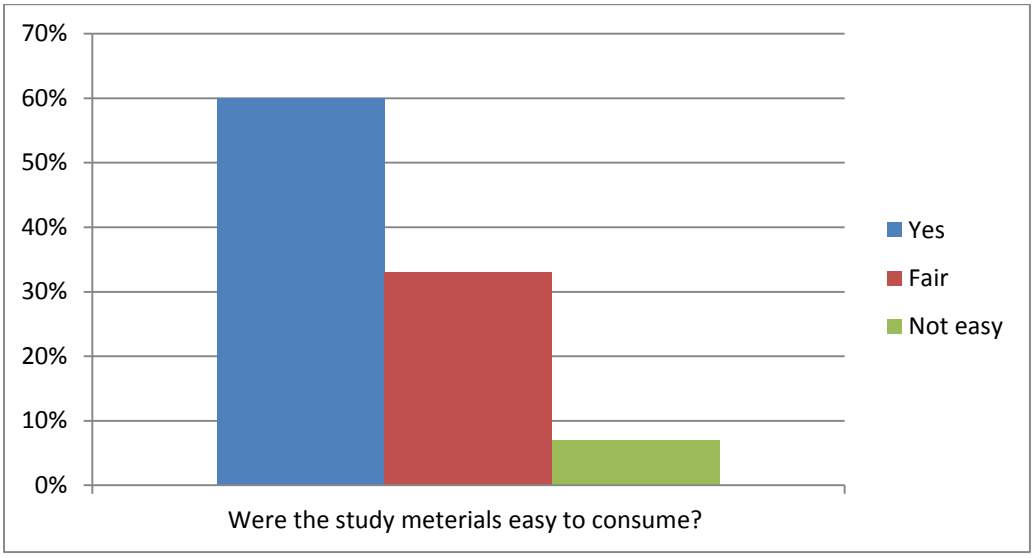
(Table 4.2.4 Lecturers in class)



It is evident that having lecturers helps students to better understand the content of their academic material. This is the kind of support students need, and by not providing such support, more students will struggle and possibly fail the program. Furthermore, the decision to have no classes for certain modules clearly display a lack of understanding of the inferior educational background from which these students come from and the fact that these students would not have had a chance in getting into the university because their results did not meet the minimum requirements. Based on the statistics on secondary education with regards to math and science and the experiences of students at this level, more precautionary measures should be adopted. It therefore follows that all modules should have lectures.

About 60% of the students state that the quality and the appropriateness of work books and other materials is student friendly. This means that students are highly appreciative of the quality and appropriateness of the study material.

(Table 4.2.5 consumption of study materials)



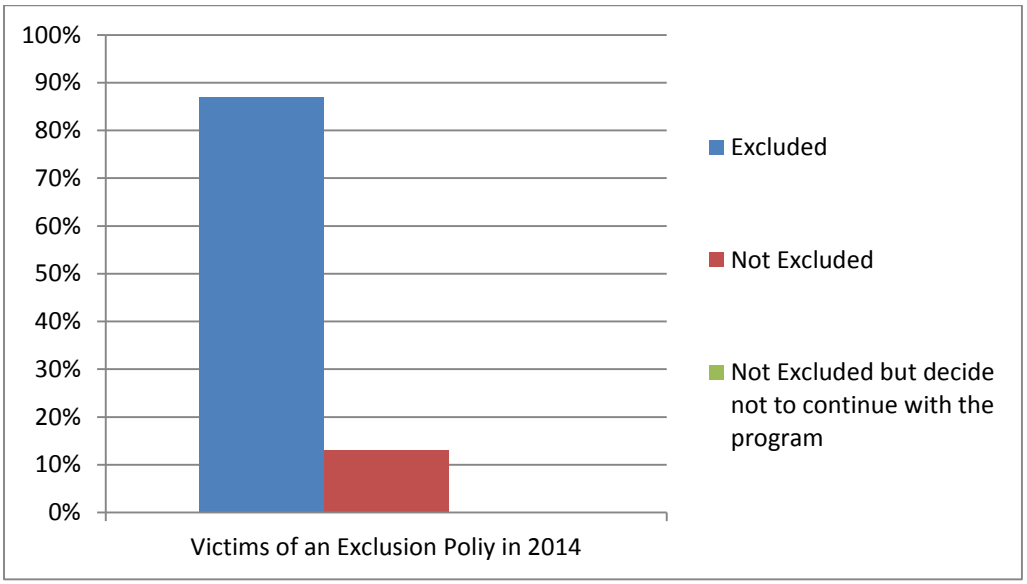
This supplements lectures, the same way lectures supplements the content of the course material. Moreover, students can rely on the course material as another source of knowledge. This makes it easier for them to understand the module and may improve their academic performance.

(c) Exclusion policy/sink or swim culture

Considering the fact that students within the UNITE Program did not meet the minimum requirements for entering into the mainstream, it should be assumed that they cannot cope with university standards. They therefore cannot be subjected to main stream modules and be expected to do better than mainstream students. To expect such is prejudicial and contributes to the high attrition rate within the program. Evidence in this research suggests that the exclusion policy adversely affects the attainment of the possible goals of this program. The strict and rigid approach only adds undue pressure and stress on students which adversely affects their academic performance as explained in the following excerpt:

Student: "The rule (Exclusion Policy) should be changed, especially if you passed everything in the first semester. The rule makes the whole process akin to walking the plank because of the pressure, mainstream students didn't have nearly as much stress as we had and that helped them flourish".

(Table 4.2.6 exclusion policy)



The evidence indicates that about 87% of the excluded students in this program are victims of this policy ***(see table 2.4.6)***. The exclusion policy therefore creates an environment which is not conducive for students and the attainment of the program's goals.

The situation is further perpetuated by the negative attitudes of some lecturers which are reflected through their utterances. One student recounted a story about one particular lecturer, on their first day in class as follows:

Student: "He told everyone to look at anyone seating next to him or her. After that, he said "" You see one of you will make it through this program and the other one will not, so the question you should ask yourself is; which one are you?"

The culture of lecturers making negative 'prophetic' comments to students on their first day of class is discouraging and promotes failure within the program. Through this practice, lecturers seem to suggest to students that they have little belief in their ability to complete the program and therefore it serves no purpose to be diligent in teaching because students will

not succeed. Even if this is not the case, students believe it to be so and feel discouraged and less confident in leaning for support from lecturers.

Student: *"What they usually said to us cast the feeling that the program was difficult and there was a greater chance that we might not progress to the main stream. I felt like I was being set-up to fail and when I was not doing well sometimes I will think of what was said that day and feel like giving-up. Such statements in an already highly pressured environment served to amplify the pressure instead of culming me down and motivating me to do well in the program.*

Gasman and Nguyen (2014) argue from the empirical research on HBCUs and STEM education, that the success of HBCU students is attributed to a classroom and campus culture predicated on communal success (interdependent) as opposed to a 'weed out' culture based on competitiveness and individual progress (independent). Working together, as opposed to against each other is the key to these institutions' success. For example, belief in the ability of students to succeed if necessary support is provided creates a culture of success and support that promotes retention and confidence among students and an environment that is likely to promote success in STEM fields.

Gasman and Nguyen (2014) further elaborate that at many HBCUs the high aspirations of Black students were cultivated rather than torn down or discouraged. This positive attitude sieves down to inspire and motivate students to succeed. Faculty members at many HBCUs for instance hope that their students will go to graduate school as placement in graduate school was a goal achieved. Students were therefore groomed for graduate school and given the tools needed to achieve it. Early identification of underperforming students' and working with them to ensure that they have the support they need to succeed can count as a viable and efficient intervention in the creation of a conducive environment (Perna et al., 2009).

The culture prevailing within the UNITE program is in total contrast with the culture that Gasman and Nguyen (2014) propose which has been put into practice and proved to be a success for STEM faculties in HBCUs. There is no reason whatsoever to prevent the adoption of the same culture within the UNITE program if it is to reinvent itself to improve its efficiency and performance and do away with the bad culture that is presently prevalent within it.

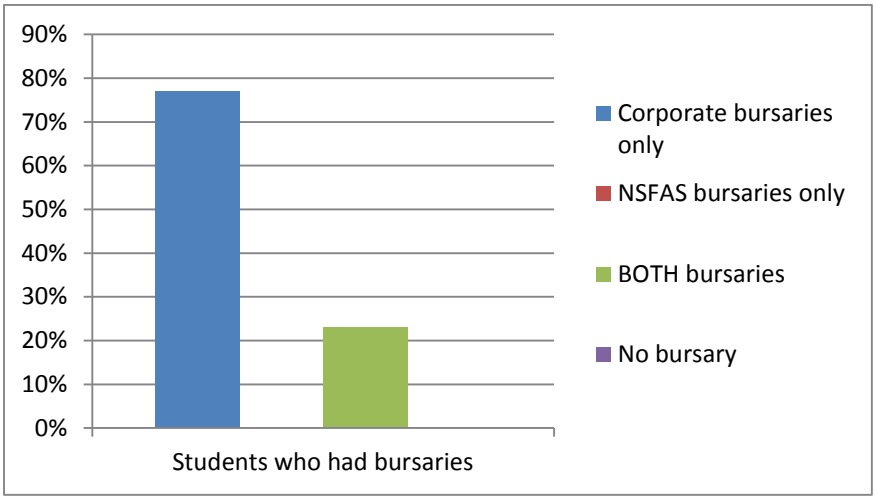
(d) Lack of funding

The commitment by the administration to acquire funding (even though not enough) invaluably assists the students to higher heights. It provides students with tuition fees, accommodation and the academic material they need to succeed. The UNITE Programme is no doubt valuable as it has over the last 25 years produced over 1,800 engineers, thus uplifting many young lives including their families and communities. It has also contributed to the development of engineering skills among the previously marginalised population in the country. A number of corporations have lent a helping hand, mainly, in the form of bursaries. As an administrator states:

Administrator: "The programme has been very successful, more than 1 800 students have become engineers through this programme…the success of the programme has invited big corporations like Eskom, Telkom and Nedbank to sponsor the programme with bursaries"

However, evidence also shows that even though there has been student funding support to the programme, there are still funding challenges which contribute to difficult circumstances which the programme finds itself engulfed by.

(Table 4.2.7availability of bursaries)



According to the evidence presented on table (4.2.7), about 77% of students within the programme had corporate bursaries which only provides for tuition fees, accommodation, and academic material excluding meal allowances and pocket money. About 23% of the students have both corporate and National Student Financial Aid Scheme (NSFAS) as they need beyond what the corporate bursary can cover such as meals. The NSFAS dispensation covers meal allowances. Most of the students come from poor families who are unable to provide them with the money to buy food, toiletries and other essentials. This means that 77% of students often go to class without eating anything and this adversely affects their performance in class. The two excerpts below highlights this:

Administration: "...Even though there is funding but funding does not cover everything, like it does not cover meals and that somehow is the problem because most of these students come from poor backgrounds. Students spend the whole day attending lectures and sometimes without having eaten anything so I think that might have a negative effect on their concentration in class and so forth"

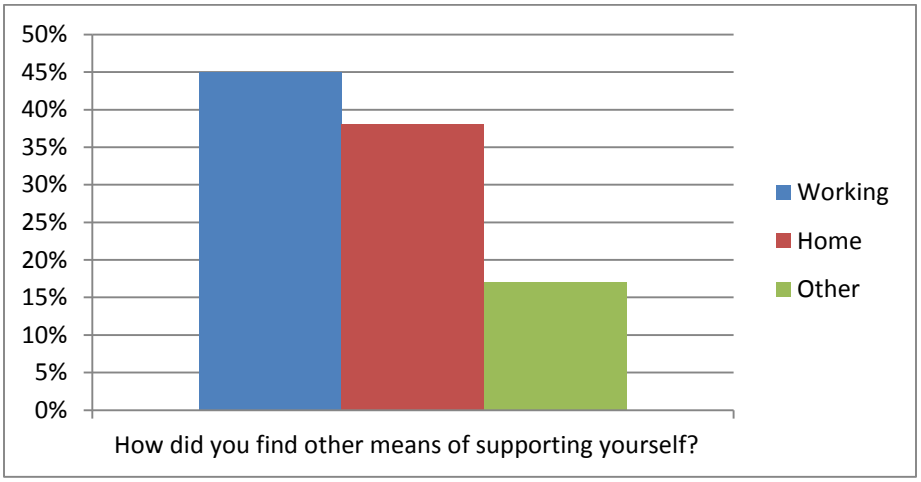
Student: "I did have a bursary which did not pay for food and other things like clothes and toiletries and at home they found it difficult to support me as well but I did what I can to survive even though it affected me in school sometimes"

The program administration is aware of the problem and is restlessly trying to solicit funding for these students to remedy the situation. The effort made by the UNITE program to come

up with sound solutions and their achievements so far are highly commendable. They have shown high levels of attentiveness and sensitivity in dealing with the adverse impacts which may result from the lack of funding.

According to Gasman and Nguyen (2014), having such a nurturing faculty is a strong point of many HBCUs and plays a key part in young STEM students becoming successful. HBCUs are aware of the financial constraints of their African American students pursuing degrees in the STEM fields and faculty and staff members consistently watch out for their students, making sure that students have money for food, books, and to travel home to see their families. The UNITE program and the lecturers may possibly not be in the position to provide money for food and travel to home for students but they are aware that lack of food is one of the issues that affects students performances and the entire program. As such, new or complementary strategies should be urgently devised to circumvent the dire consequences of this issue. Furthermore, the university should assist by prioritizing these students for any other available grants so as to assist them with buying food, toiletries and other essentials.

(Table 4.2.8 other means of support)



The above graph ***(table 4.2.8)*** shows that about 45% of students work part-time during weekends to ease the financial burden of their families and to support themselves and their life styles. This diverts the attention of these students from their academic work, increase their stress levels and adversely affect their academic work. The following excerpt encapsulates this:

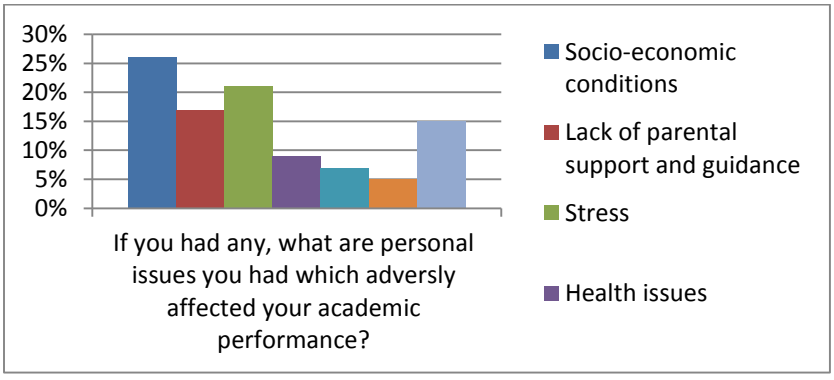
Student: "Me and some many other students I am friends with, we worked on weekends and for some their working days used to start as early as Thursday nights. I was trying to support myself as it was difficult for my family to do. I was hoping that the following year I was going to get a sponsor of which I did and things were much better and it made realize how very difficult it was to juggle both (studies and work) as a matter of fact I was struggling with my school but I recovered even though I was worried"

It is clear that with lack of funding, more students will seek other sources of funding. This however can adversely affect their academic performance. It is of paramount importance that a program is implemented that will give the most needy students employment opportunities within the program or anywhere else within the university. Such program should take into consideration students' busy academic schedule while at the same time providing financial assistance for them. This will help to promote a culture of support.

(e) Students' personal problems and lack of using support program

The impact of personal issues on students' academic performance cannot be underplayed. The students state that socio-economic conditions at home, lack of support and guidance from parents and stress are the three main personal issues that affect their academic performances ***(see table 4.2.9).***

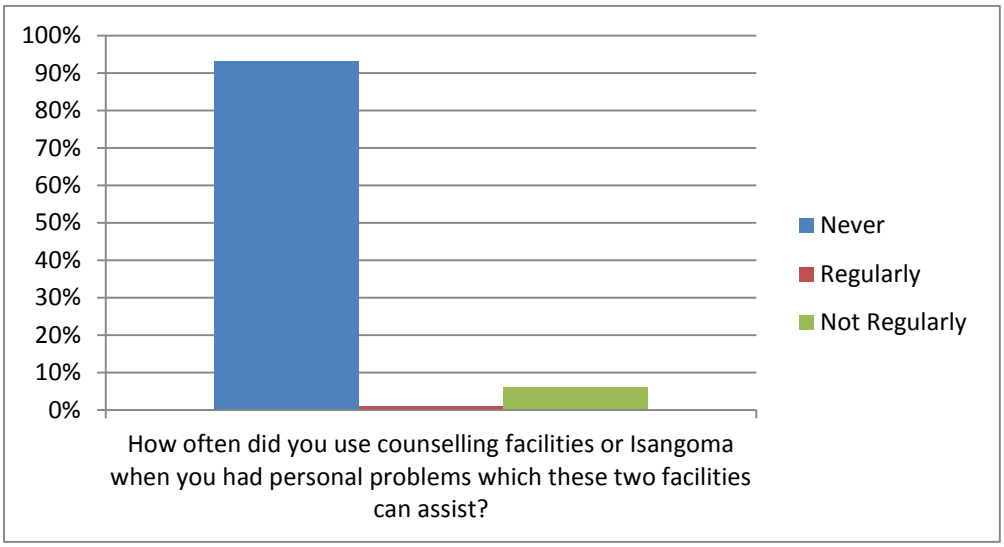
(Table 4.2.9 students' personal issues affecting academic performance)



The table below ***(table 4.2.10)*** shows that although there are many institutions and programmes within the University for Students to approach for help, a mere 1% use them

regularly. The UNITE programme cannot be blamed for this, because there is a clear indication that the students are well informed about these institutions and programmes.

(Table 4.2.10 attendance on counselling and alike programs)



Cultural up-bringing, background and the stigma of being seen in attendance have kept students from using these facilities. These are the reasons given by students as to why they find it difficult to attend student counselling and other support programmes despite the many personal issues they face. The excerpts below attest to that:

Student: "...like sometimes I did want to go (Isangoma) but yoh!! ndoda I was afraid of what people will say when they saw me go there. You know when you are seen attending people look at you funny like you are a witch or something and you were there for potions to bewitch them, something like that"

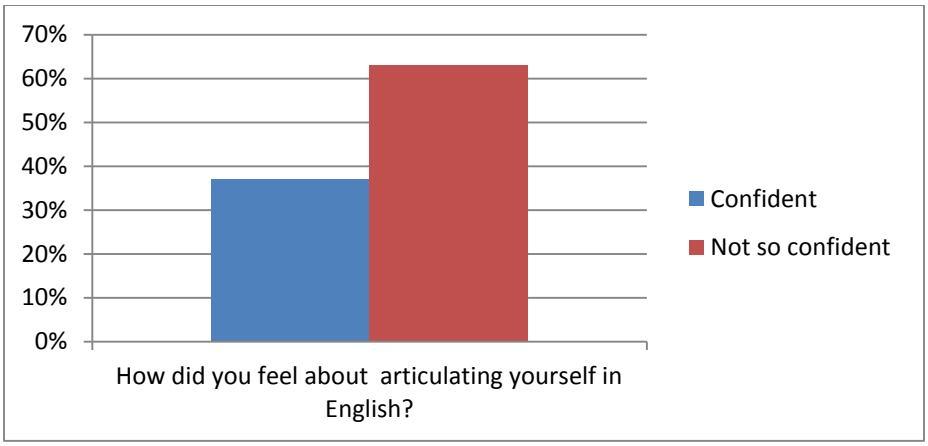
Student: "Counselling is not our thing mfethu (brother) that is not how we were brought up. Ja so I guess that is why most of us do not attending counselling"

About 58 % of UNITE students are from the rural areas and they have not been exposed to the benefits of going for counselling and the like. They therefore do not appreciate the benefits of counselling or feel comfortable relaying their personal issues to a stranger. The university has brilliantly acquired Isangoma services to provide an alternative to students who might be experiencing cultural problems. However, the students are not entirely comfortable with being seen consulting Isangoma due to the stigma attached to it. Students feel that if

they are seen going to consult Isangoma, they will be viewed as either primitive or demonic. This reluctance to attend these supportive structures has resulted in the persistence of their personal problems and the negative role it plays in their studies, affecting the programme as a whole.

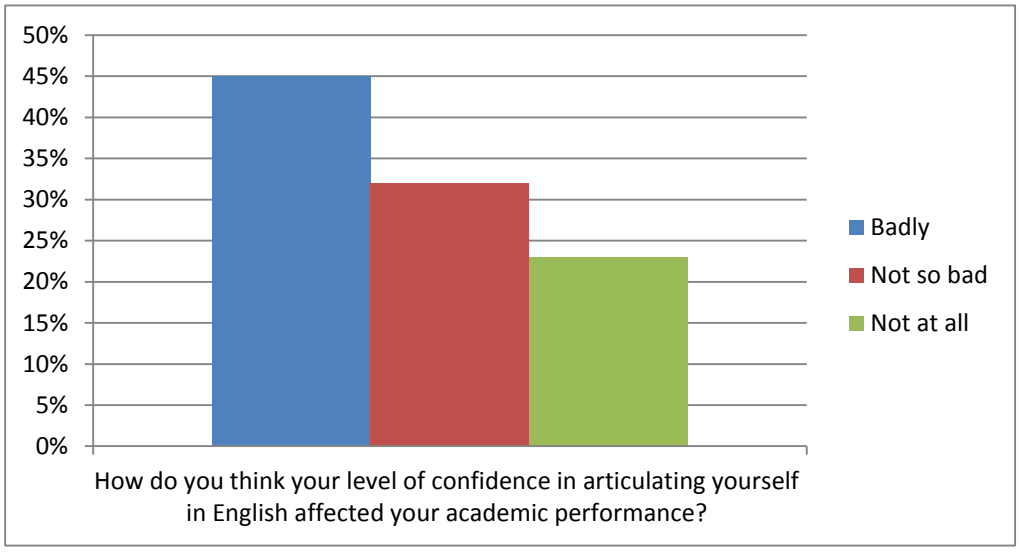
(f) Language barrier

(Table 4.2.11English as medium of instruction)



Even though students are expected to have acquired at least a 50% matric pass in English studies to be considered for the programme, communicating in English for the students is still an issue. On one hand, about 63% of students lack confidence in articulating in the English language whilst on the other hand, English is the main medium of communication for the majority of lecturers. This hinders effective communication between lecturers and the students. About 45% of students claim to be badly affected by this issue ***(see both table 4.2.11 and 4.2.12 respectively).***

(Table 4.2.12 relationship between the use of English and academic performance)



Students claim that they feel uncomfortable to approach the lecturers and demonstrators when they need help on a particular module despite acknowledging that lecturers and demonstrators are friendly.

Student: "It is difficult to go to one on ones because even though you needed help but you don't know how you going to present your problem in English and you end up not going but convincing yourself that there has to be one of your class mates who knows and the lectures and demonstrators are super friendly during consultation times, so I hear because I had never been."

Both students and lecturers claim that language negatively affects student's assessment and tests which results in them not performing well.

Student: "Essay questions or report writing was a problem to us, even though you could understand and know the answer but the problem will be to write it down in English"

Lecturer: "Even though language is not that much of an issue but there is a certain level of proficiency which students are required to at least reach and that has been a challenge which might have adverse effects on students' academic work…"

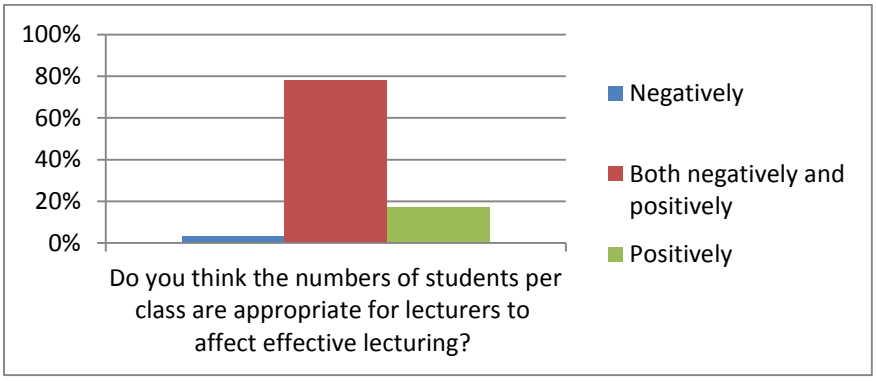
This means that language is a hindrance in communication between students and lecturers. It is an issue that cannot be ignored or left unresolved as it directly affects the performance of both lecturers and students. It also reduces the impact of intervention strategies like one-on-one consultations and consequently adversely affects the UNITE program.

Gasman and Nguyen (2014) suggest that a meaningful contribution can only be brought about by altering the climate in the STEM disciplines. Developing programming and learning around peer mentoring and hiring more woman and Blacks will improve the gender and racial concordance between students and faculty mentors. There are effective methods and interventions to increase the number of Black graduates in STEM. Taking into account the fact that over the years more than 90% of students within the UNITE program are blacks, most of whom understand or speak isiZulu, an increase in the number of women and black staff members within the program could assist students to gain more confidence. It will also assist them to better articulate their academic problems and increase interactions with the lecturers, thus improving the program's performance.

(h) Class sizes

Evidence indicates that students feel that the class sizes affect them both positively and negatively ***(see table 4.2.13).***

(Table 4.2.13 the effects of the class size)



This was explained based on the fact that class numbers in the modules that are exclusively offered to UNITE programmes students are manageable because of their small sizes in student numbers as opposed to other classes which were not exclusively for UNITE students. This is explained by a lecturer below:

Lecturer: "The classes were very manageable due to their small student numbers…the bigger sizes are not unmanageable but are rather difficult to manage and that to a certain extent affect the performance of students because, as a lecturer it becomes difficult to attend to all students who need your attention"

In exclusive UNITE classes; the students are so few that if one misses a class, it will be easily noticed. There are also more contact or interaction between the lecturers and students. Concentration levels are high and students cannot get away with sleeping or any unfocused behaviour during the lecture. Such acts however tend to go unnoticed in overpopulated lectures. The small number of students in the exclusive classes also makes it possible for lecturers and students to have adequate time during one-on-one consultation hours.

In contrast to this, first year main stream courses which the students also attend have a higher number of students in class and there is never adequate time for one-on-one consultations. Students have limited interaction with the lecturers during lectures and consultation hours. Time is limited and the lecturer has to accommodate other students during consultation period resulting in students only discussing just a few of their problems with the lecturers.

Student*:" In other classes we were small in sizes, so few that if one missed the class they could easily be noticed. You had to keep your concentration levels high coz you wouldn't get away with sleeping or any unfocused behaviour during the lecture. The lecturer will call out your name and ask a question so really you had to be focused during lectures".*

Gasman and Nguyen (2014) state that this has also been the case with black students in STEM at HBCUs they have also benefited from the small class sizes and low faculty to student ratio, resulting in more access to faculty. He claims that at many historically White institutions, the introductory STEM courses enrol large numbers of students, a practice that make it difficult to ask a question or have much personal interaction with the lecturer (Gasman and Nguyen, 2014). In contrast, at most HBCUs the environment is similar to a small liberal arts college

(Perna, 2009). Similar inferences can be drawn from the UNITE programme, in that the students undoubtedly benefits from the small size in exclusive UNITE lectures. This though is not the case for the mainstream modules.

Student: *"I think it assisted us that we were few in class because during consultations you would hardly find a queue like in other modules that we used to attend in large numbers. In those classes you'll sometimes feel discouraged to even go and see if there's a queue or not".*

There is no doubt that small size classes do create an environment to nurture talents. Case studies at HBCU's attest to this. Their lecturers get to know students' by their first names as well as be in a position to provide advice and recommendations for graduate school and professional opportunities (Perna et al., 2009).UNITE lecturers also find it easier to go above and beyond their teaching responsibilities when their classes are small.

Chapter 5

Conclusion and Recommendations

5.1 Introduction

Over the years, there has been a paradigm shift from the conventional ways of finding solutions to address societal problems and improving policies and programs which relied on ideology, costs, social back-ground and expert opinion to evidence based approaches (Lipton 1992). Guided by the evidence based approach, this study used evidence from its findings and from available literature to give a proper analysis that answers the key study questions. It also makes it easier to come up with recommendations. This section gives the concluding remarks and recommendations of the study.

5.2 Recommendations

This study has based its recommendations on both the evidence provided from the field work and on what Gasman and Nguyen's (2014) study presents as evidence of efficient and adequate intervention strategies. This study therefore recommends the following:

1) The exclusion policy should be strategically reviewed to accommodate the realities within the UNITE program and refrain from being prejudicial, demoralizing and putting undue stress and pressure on students. It should rather find strategic ways to encourage and motivate students.

2) The implementation of a vigorous and meaningful 'catch-up' program that should start a month before the start of the regular program for mainstream students in the university. This will provide necessary supplemental learning support for the students that will aid them in becoming academically successful. In relation to the poor educational background of most students within the UNITE program, all modules within the program should have lectures to maximize the level of academic support given to students and where possible, extra alternative lectures be provided for further understanding of the academic material content.

3) The one-on-one consultations and tutorials should be further supplemented by the implementation of peer mentoring and other support program. This can serve as an alternative to those who lack confidence to approach lecturers when they are experiencing problems as it might be easier to approach peers. It will also create a culture based on communal success and encourage a culture of support which promotes retention and confidence among students.

4) UNITE program should review its equity policy to improve the gender and racial concordance between students and school mentors as this may be an effective method or intervention to increase the number of graduates within the program. This stands to bridge the gap in terms of communication and increases confidence between students and lecturer interaction.

5) There should be a systematic development of programs aimed at developing life skills, balancing the personal and academic life and students should be educated about the importance of using these programs. This will be beneficial to students as it will help them to develop their capacities, balance their hectic academic and personal life and have the confidence to approach any institution within the university if they have personal problems.

6) First year mainstream modules should not be offered at the UNITE program's level. This will reduce the counter-productive high levels of stress and anxiety that comes with too much work load. It will also allow for a more flexible time table schedule that will give students a balanced academic and social life, increase class attendance and maximize students' performance in the program. Finally, it will create space and time for other forms of leaning.

7) The UNITE program in collaboration with the University of KwaZulu-Natal should find avenues to provide funding that goes beyond tuition, learning material and accommodation to meal allowances for all students within the program. For example, the program should consider making a special application to NSFAS to provide students in this program with quarterly meal grants or solicit sponsors (Spar Group,

Pick n Pay, Shoprite, Checkers, Boxer, Glenmore KFC and Nandos.) that can provide food relief to all the students within this program. The engineering alumni can also be coaxed to pledge annual donations in assisting students with meals. All possible avenues should be exploited to this end.

8) The role of dysfunctional schooling and the socio-economic conditions of students within the program should be researched and fully acknowledged so as to develop proper, efficient and strategic interventions which can be aligned with the realities of the majority within the program.

5.3 Conclusion

The aim of this study is to investigate significant challenges encountered by the UNITE program and ascertain the level of influence thereof in the program's performance with regards to achieving its targets and goals. The key study questions posed were:

1) How complex and manageable are modules offered within the curricular structure of the UNITE program taking into account the environment in which students were subjected to perform under, and their educational background? (Duration of hours attended a day? how many modules undertaken per semester? How ready the students were to deal and manage those modules?)

2) To what extent did the lack or availability of funding affect the UNITE program in realizing its goals and objectives?

3) Did the stringent strategy of excluding students based on failing one module promote diligence on both students and lecturers in the assumption of their respective roles within the achievements of goals and objectives of the UNITE program or is it a case of students being victimized?

Using qualitative methods to gather and analyze data and guided by evidence based theoretical framework, this study found that the program has been facing a number of challenges which have contributed to the lackluster performance by the program. The effects of the curriculum structure upon time table; lack of competent secondary educational

background; exclusion policy; lack of funding; students' personal problems and lack of using support programs; language barrier and class sizes have all been cited as contributing factors which have been insufficiently attended to. The responsibility to deal with this seems to be ignored by the administration and this is evidenced by minimal achievement in the development of strategic interventions within the UNITE program.

The lack of informed intervention strategies to deal with existing challenges within the UNITE program have hindered the effective performance of the program. For example, even though the UNITE program offers relevant modules to prepare students for mainstream entry, they are immersed in an environment that makes it difficult for them to academically perform well and achieve the program's goals. The social, economic and political factors are not always taken into account during the planning and design of training and development programs. This has had a number of far-reaching adverse consequences. The exclusion policy as an intervention strategy has proven to be prejudicial, demoralizing and stressful to students. This tends to victimize the students rather than encourage and motivate them.

The UNITE program is undeniably important and relevant. Its implementation has benefited many young previously disadvantaged aspiring engineers and given them an opportunity to fulfill their dreams. The UNITE program requires thorough research and informed strategic planning to develop the right kind of contingencies. The complexities of issues surrounding this program calls for a need to intensify research and formulate new strategic interventions. This will subsequently modify and align the UNITE program with the institution's objectives and significantly contribute to the development of graduates that the South African economy needs, especially those in the STEM fields.

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Appendix A

Informed Consent Document

Dear Participant,

My name is Ndlovu Kevin Ayanda (*202521957*). I am a Master's degree candidate studying at the University of KwaZulu-Natal, Howard College .The title of my study is, "An Evaluation of the University of KwaZulu-Natal Intensive Tuition for Engineers Program (UNITE)". The aim of this study is to investigate significant challenges encountered by the UNITE program and ascertain the level of influence thereof in its performance with regards to archiving its targets and goals. This study will evaluate the causes and the impediments to finding interventions of this phenomenon within the UNITE program. This study is of paramount importance because it provided an understanding of the shortcomings and suggested possible interventions which may subsequently enhance, modify and align the UNITE program with the institution's objectives and significantly contribute to the development of graduates that the economy needs, especially in the STEM fields. I am interested in interviewing you so as to share your experiences and observations on the subject matter.

Please note that:

- The information that you provide will be used for scholarly research only.
- Your participation is entirely voluntary. You have a choice to participate or not to participate or stop participating in the research. You will not be penalized for taking such an action.
- Your views in this interview will be presented anonymously .Neither your name nor identity will be disclosed in any form in the study.
- The interview will take about (*10-15mins*).
- The record as well as other items associated with the interview will be held in a password-protected file accessible only to me and my supervisors .After a period of 5 years, in line with the rules of the university, it will be disposed by shredding and burning.
- If you agree to participate please sign the declaration attached to this statement (a separate sheet will be provided for signatures)

I can be contacted at: School of Social Sciences, University of KwaZulu-Natal, Howard College Campus, Durban. Email: a y a n d a k e v i n n d l o v u @ g m a i l . c o m
Cell: 0847076932
My supervisor is Sargie Narsiah who is located at the School of Social Sciences, Howard College Campus, Durban of the University of KwaZulu-Natal. Contact details: email: narsiahi@ukzn.ac.zaPhone number: 0312602470/ 0822022524

The Humanities and Social Sciences Research Ethics Committee contact details are as follows: Ms Phumelele Ximba, University of KwaZulu-Natal, Research Office, Email:ximbap@ukzn.ac.za,Phonenumber+27312603587.

Thank you for your contribution to this research.

DECLARATION

I…… *(full names of participant*) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.Iunderstandtheintentionoftheresearch.Iherebyagreetoparticipate.

I consent / do not consent to have this interview recorded (if applicable)

SIGNATUREOFPARTICIPANT DATE

……

Appendix B

Please tick on the appropriate box below

Questionnaire

1. What do you understand about the goals and objectives of the UNITE program?

   ……

   ……

   ……

   ……

2. Which year were you in the UNITE program?
3. How did you find the program?

   Easy □

   Manageable □

   Difficult □

4. Do you think a work load from the number of modules per semester was manageable?

   ……

   ……

   ……

   ……

5. How well do you think your High School education prepared you for the UNITE program?

   ……

   ……

   ……

   ……

6. How much did you think the two weeks "catching up" program helped you to cope within the program?

   ……

   ……

   ……

   ……

7. Were the study materials easy to consume?

   Yes □

Fair □

Not easy □

8. Did you wish for any changes to improve the quality of work books, lecture notes, and other material?

……

……

……

……

9. How did not having lectures on other modules affected you compared to the modules which you had lectures?

Very bad □

Bad □

Not at all □

10. How did you structure your day to balance between lectures, study time and social time; and how did you think that contributed on your academic performance?

……

……

……

……

11. Did you have any funding?

Corporate bursary □

NSFAS bursary □

Both bursaries □

No bursary □

13 How did you find other means of supporting yourself?

Working □

Home □

Other □

14 What kind of effect do you think funding or lack thereof had on your studies?

……

……

……

……

15 How did you feel about articulating yourself in English?

……

……

……

……

16 How do you think your level of confidence in articulating yourself in English affected your academic performance?

……

……

……

……

17 If you had any, what are personal issues you had which adversely affected your academic performance?

……

……

……

……

12. How often did you use counseling facilities or Isangoma when you had personal problems which these two facilities can assist and why?

Never □

Regularly □

Not Regularly □

13. How were the attitudes of lectures towards students?

……

……

……

……

14. What type of support did you get from the lecturers, if any?

……

……

……

……

15. How often did you consult with the lecturers?

……

……

……
……

16. On average, how many classes did you miss per semester and why?

……
……
……
……

17. How do you think the number of students per class affected your performance in the program?

……
……
……
……

18. What do you think of the exclusion policy from the program?

……
……
……
……

19. What would you change about the program to make it more effective in achieving its goals?

……
……
……
……

Appendix C

Interview for Program administrator

1. How long have you worked as a Program administrator?

   …….

2. Could you elaborate on the aims and objectives of the UNITE program?

   ……

   ……

   ……

3. How have the curriculum structure for the UNITE program been designed to achieve the goals and objectives of thereof?

   ……

   ……

   ……..

4. What are some of the issues you consider upon the design of the program's curriculum structure in order to allow the program to reach or go beyond its full potential?

   ……

   ……

   ……

5. Could you elaborate on the support programs offered for engineering students?

   ……

   ……

   ……

6. Do you think the study material (handbooks, lecture notes and other material) are appropriate for the students enrolled in this program?

   ……

   ……

   …….

7. Do you think the numbers of students per class are appropriate for lecturers and demonstrators to affect effective lecturing and practicals?

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8. Could you please elaborate on an exclusion policy within the UNITE program?

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9. What are the challenges which the UNITE program faces?

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Appendix D

Interview for Lecturers:

1. Gender: Male □ Female □

2. How long have you been a lecturer within the UNITE program?

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3. Could you please elaborate on the goals and objectives of the UNITE program.

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   …….

4. Describe your relationship with your students.

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5. Do students consult with you on a regular basis?

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   ……

6. How do you think that affects your performance as a lecturer and their performance as students?

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   …….

7. Do you think the study material (handbooks, lecture notes and other material) are appropriate for the students enrolled in this program?

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   ……

8. What are some of the main issues you consider when preparing your lectures?

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9. Do you think the numbers of students per class are appropriate for lecturers to affect effective lecturing?

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   …….

10. Are the students committed enough to their studies from what you can tell?

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11. How are students encouraged to attend and not miss lectures?

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12. How are students encouraged in lectures and beyond to achieve the objectives of the program?

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13. What are challenges facing the UNITE program?

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Appendix E (Gatekeeper's Letter: separately attached)

Appendix F (Ethical Clearance Letter: separately attached)

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

10 September 2014

Mr Ndlovu Kevin Ayanda
School of Social Sciences
College of Humanities
Howard College Campus
UKZN
Email: 202521957@stu.ukzn.ac.za

Dear Mr Ayanda

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN) towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"An Evaluation of the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE)".

It is noted that you will be constituting your sample by randomly handing out questionnaires and performing interviews with students on UKZN's Howard College Campus.

Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

MR MC BALOYI
REGISTRAR

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

06 October 2014

Mr Kevin Ayanda Ndlovu (202521957)
School of Social Sciences
Howard College Campus

Protocol reference number: HSS/1249/014M
Project title: An evaluation of the University of KwaZulu-Natal Intensive Tuition for Engineers (UNITE)

Dear Mr Ndlovu,

Full Approval – Expedited Application

In response to your application received on 18 August 2014, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr Sagie Narsiah
Cc Academic Leader Research: Professor Sabine Marschall
Cc School Administrator: Mr N Memela