Comparing Engineering lecturers and students' explanations for performance in mathematics at a TVET College

By

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DECLARATION

I, Fikile Cynthia Linda (951048666), hereby declare that this dissertation is my original work to the best of my knowledge. The dissertation has not been published or submitted for the award of any degree or qualification and contains no materials previously published; sources used from other scholars are acknowledged in the text and list of references.

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DEDICATION

I dedicate this study to my loving husband, Mluleki Elvis Linda; I cannot thank you enough for all the love, financial support, and personally driving me to and from university when I could not do it anymore. Without you, I would have dropped out. To my precious daughter, Yolanda and my dear son Asanda, for the love, patience, and support you gave me through this journey. Please forgive me for being more absorbed in my work, for that we have achieved this Masters together. To you, my beloved children, I pray that my academic achievement will motivate you to work hard for something that you love and encourage you to reach greater heights.

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ABSTRACT

Various studies have reported numerous reasons on how mathematics performance among South African students is affected. This study aimed to explore the Engineering lecturers’ and students’ explanations for performance in mathematics at a TVET College. The Attribution theory (1958;1970) underpinned this study and was useful in interpreting and providing insight to the participants’ explanations on the reasons for poor performance in mathematics.

The case study method was employed in a qualitative approach to gather data. Semi-structured interviews with four lecturers and four students on one campus from one of the TVET Colleges in the KwaZulu-Natal province were used to generate data. The data collected were analysed and discussed in the following themes: poor performance in mathematics, factors linked to poor performance, challenges in improving mathematics performance and improving students’ performance in mathematics. This study's findings revealed a lack of standardised admission criteria for students to study standardised subject content, reflecting significantly at the end of the year in the throughput rates and certification. This study also revealed that there is a need for the professional development of lecturers.

The study recommends: proper screening at admission; TVET College, in collaboration with DHET, must review the recruitment policy to improve throughput rate; TVET colleges should organise periodical specialised training workshops to capacitate lecturers with mathematics content knowledge to improve student performance in mathematics.

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ABBREVIATIONS

DBE- Department of Basic Education

DHET- Department of Higher Education and Training

DoE- Department of Education

GET- General Education and Training

LTSM- Learner-Teacher Support Material

NCV- National Certificate in Vocational

NQF- National Qualifications Framework

NSC- National Senior Certificate

SAGs- Subject Assessment Guidelines

SAQA- South African Qualifications Authority

STEM- Science, Technology, Engineering and Mathematics

TIMSS- Trends in International Mathematics and Science Studies

TVET- Technical and Vocational Education and Training

TVETMIS- Technical and Vocational Education and Training Management Information System

UNESCO- United Nations Educational, Scientific and Cultural Organisation

UNEVOC- International Centre for Technical and Vocational Education and Training

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The Department of Higher Education faced with the main constraints of the high failure rate in Mathematics NQF L4 NCV which consequently affect College throughput and certification rates at NQF L4.

The Department of Education (DoE, 2011) highlights that the quality of teaching and learning in South Africa has been a concern for teachers, parents, education officials, and ordinary citizens. Spaull and Enterprise (2013) found that the resulting poor performance of South African learners in several Trends in International Mathematics and Science Studies (TIMSS, 2003, 2011, 2015) is evidence that there is a crisis in South African mathematics education. Likewise, Venkat and Spaull (2015) contended that mathematics performance amongst educators and students in South Africa is far below comparable countries in the world.

According to DoE (2015), the under-achievement in mathematics by students is particularly problematic. Furthermore, the DoE (2016) confirms that South Africa has been struggling for many years to deliver acceptable results in mathematics, science, and technology subjects. The Science, Technology, Engineering, and Mathematics (STEM) fields are crucial for sustainable development in finding solutions to threats posed by global challenges such as climate change, global health epidemics, and increased income inequality (UNESCO, 2016). The STEM subjects also serve as a robust set of tools to understand the world. These disciplines are the foundation in almost all aspects of academics, given their importance in education and careers. Mathematics forms the foundation of scientific and technological knowledge that is vital for any nation's socio-economic development. Achievements in science and technology largely depend on the broad mathematical discipline (Frith et al., 2004).

Moreover, among other subjects, mathematics is one of the critical requirements for entry into tertiary level education in any part of the world. Mthembu (2016) confirms that mathematics is one of the subjects that demand and promote higher-order thinking, which involves creativity and critical thinking. Brijlall (2019) found that mathematics students' performance is recognised as a problem in schools and higher education institutions, especially at the undergraduate level. Despite the importance of mathematics for South Africans, most students' performance in the subject has always been poor at both secondary and tertiary levels; this results in a decline of mathematical skills possessed by the students as applicants in engineering and science degree programmes.

Many studies reported several reasons on how mathematics performance among South African students is affected. For examples, a study conducted in South Africa by Visser et al. (2015) found that the students' mathematics performance was affected by a shortage or inadequacy of general school and mathematical resources. Another study conducted by Ngoveni (2018) showed that fear and negative attitude towards Mathematics was a contributor to the failure rate of the students in the TVET sector (p. 86). Teachers continue to be traditional in their teaching by being central to both content and interaction (Machaba, 2018). A similar condition in South Africa, a study conducted in Kenya by Mbugua et al. (2012) concluded that students' mathematics performance is persistently low due to understaffing, inadequate teaching and learning materials, lack of motivation, and poor attitudes of both lecturers and students.

According to Khumalo (2013), students who cannot gain admission to these institutes generally enrol at TVET colleges. In the present study, mathematics is a compulsory subject for students who enroll in Engineering Report 191 and National Certificate in Vocational (NCV) programs. Therefore, some students who do not qualify in these programs enroll in the Business, Hospitality, Transport, and Logistics programs. Furthermore, Khumalo (2013) confirms that TVET colleges are the institutions of choice where students have a wider choice of courses they can enroll in.

1.2 Problem statement

South Africa requires suitably qualified teachers, doctors, scientists, and many other scientifically oriented professionals. Mijs and Makgato (2006) agree that with the status of mathematical and scientific literacy being generally poor in the entire schooling system, it is conceivable that such a system will not produce enough learners who qualify to enrol in universities to pursue further STEM studies. Woodfield (2014) found that most STEM disciplines recorded higher than average percentages of students leaving due to academic failure. High academic failure rates were seen to plague mainly black minority ethnic students.

Salau (2017) emphasises that students need a strong foundation in the abovementioned subjects to function properly in the 21st century. However, performance in mathematics at TVET colleges is low, especially within the Engineering field. Ngoveni and Mofolo-Mbokane (2019) found that poor performance in mathematics at colleges has not yet been resolved. Extant literature reveals some reasons that lead to poor mathematics performance; however, it is difficult to find and predict these causes. Incorrect assumptions are often made on which students are most likely to fail. Therefore, to understand the issue within the South African context, this study sought to explore the Engineering lecturers and students' explanations for performance in mathematics at a TVET College.

1.3 Rationale of the study

The motivation to pursue this study stems from the researcher's observations as a TVET college lecturer for six years. The observations showed that many students' performances in mathematics are relatively low each year; therefore, the current study was conducted in a TVET college campus to explore what contributes to poor performance in mathematics through Engineering lecturers' and students' explanations. Furthermore, college results analysis reflects poor performance trends in mathematics, which prevents students from being certified, consequently affecting the college's certification. Therefore, this study can contribute to the TVET improvement strategy, including teaching and learning, improving lecturers' capabilities, and student pass rates.

1.4 Objectives of the study

i. To explore Engineering lecturers' explanations for performance in mathematics.
ii. To explore Engineering students' explanations for performance in mathematics.
iii. To compare the similarities and differences of lecturers and students' explanations for performance in mathematics.

1.5 Research questions

i. What are Engineering lecturers' explanations for performance in mathematics?
ii. What are Engineering students' explanations for their performance in mathematics?

iii. What are the similarities and differences in lecturers and students' explanations for performance in mathematics?

1.6 Delimitations of the study

The study was conducted in a TVET college, focusing on NCV Engineering lecturers and students at one campus.

1.7 Overview of Methodology

This study is a case study of four Engineering lecturers and four Engineering students. The study employs a qualitative approach to research within an interpretive paradigm to gather in-depth data on the Engineering lecturers and students' explanation for in mathematics. These participants were selected as to gather the findings of this study using semi-structured interviews.

1.8 Structure of the study

This dissertation is divided into five chapters:

Chapter 1 presents an introduction to the study, including the background, rationale, objectives, and research questions. The delimitations, synopsis of research procedures employed in this study, and structure of the study are further provided in this chapter.

Chapter 2 provides a review of the literature by various scholars on performance in mathematics. The theoretical framework of this study, which is Weiner's Attribution theory, is discussed in this chapter.

Chapter 3 provides the research methodology, the paradigm, research design, selection of participants, data generation, and instruments. Furthermore, data analysis, ethical issues, validity, and trustworthiness of the study were discussed.

Chapter 4 presents the data gathered through semi-structured interviews and focus group discussions of four TVET College Engineering lecturers and students. The findings were analysed and interpreted using Weiner's Attribution theory as indicated in the study's theoretical framework.

Chapter 5 summarises the findings, provides conclusions and recommendations for further research based on the findings of this study.

1.9 Summary

This chapter introduces the study through the background, problem statement, and rationale that directed the research on the exploration of Engineering lecturers and students' explanations of performance in mathematics at a TVET College. The chapter further presented the objectives and research questions, delimitations, synopsis of the research methodology employed, the definition of key concepts, and an outline of the study.

The next chapter presents a review of the relevant literature and the theoretical framework that underpins this study.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

The previous chapter provided an introduction to the study, covering the background of the study, the problem, and the critical research questions that guided the study. This chapter presents relevant literature on emerging explanations of performance in mathematics from Engineering lecturers and students. This chapter also presents the Attribution theory as a theoretical framework underpinning this study.

2.2 Review of Literature

The literature review serves to clarify key concepts, terms, and meanings of concepts (Cohen et al., 2011). According to Silverman (2013), the literature review represents agreements and disagreements between a present study and previous studies. Creswell (2014) asserts that the literature review provides a framework that establishes the importance of a study. Based on these interpretations, a detailed discussion of the key concepts (mathematics teaching strategies, Students misconceptions and errors in mathematics, lecturers' subject content knowledge, lecturers' mathematics teaching experiences, lecturers' qualifications, students' motivation towards achievement, and students' fear and negative attitude towards mathematics) were provided by reviewing the theoretical definitions presented by various researchers.

2.2.1 Mathematics teaching strategies

Lecturers are more concerned with using teaching methods and learner supporting materials when presenting the lesson. Shulman (1986) states that without a doubt, lecturers must be able to intelligently select and manipulate curricula appropriately to meet the needs of the individual student, (p.10). However, Tshabalala and Ncube (2016) and Njagi (2013) claim that lecturers use teaching methods that students do not easily follow when teaching mathematics, such as teacher-centred instead of student-centred methods.

According to Tella (2007), lecturers need to use methods and materials to make learning mathematics active, investigative, and exploratory. Furthermore, these methods should cater to the student's differences and attitudes towards mathematics as a subject. Ndlovu (2011) confirms Tella's view that teaching strategies should vary to sustain teacher motivation and interest. Additionally, Kelly (2013) found that a lecturer can conduct remedial lessons to cover material the student might not understand if they do not have the required prerequisite knowledge. Similarly, Marcus and Fey (2003) agree that students should be exposed to problematic tasks to practice and consolidate mathematical sense-making. Therefore, the above indicates that lecturers must use different interventions until students show a level of understanding of the concept.

Lecturers must use teaching strategies that eliminate the existing gap to improve students' performance in mathematics. For example, a study conducted by Lessard et al. (2020) concluded that teaching strategies that emphasised classroom discussion and support fostered student motivation, particularly for those placed in a basic sequence (moderating effect). Thus, lecturers should act professionally and always be aware of the alignment between teaching practice and their curriculum by reflecting on their teaching strategies (Khoza, 2014).

Mukucha (2012) in Malawi proposed that lecturers facilitate second language mathematics students using a combination of practices to define mathematical terms. For instance, in black African Schools, mathematics is taught in English, which is the second language; this indicates that language is a barrier to teaching mathematics in black schools and compels the lecturers to use bilingual practices. In support of this, Hannafin et al. (2001) believe that lecturers prefer to lead the lesson because students do not want to learn if they do not understand mathematics concepts. Also, it advocates for the argument that lecturers prefer teacher-centred approaches to control the class instead of learner-centred in teaching and learning.

According to Michael (2015), some lecturers claim that they use student-centred methods in their classrooms and participatory methods to improve learning. However, performance by their students does not indicate that their methods are successful, despite having attended several workshops and seminars. Makonye (2017) agrees that using different representations helps students realise that mathematics makes sense.

Furthermore, Nts'asa and Machaba's (2019) findings reveal that teachers indicated the traditional ways of imparting knowledge to the students. Similarly, most lecturers do not make mathematics practical and exciting since they do not have the competencies to teach dynamically, leading to negative attitudes amongst pupils, implying improper guidance by the teachers (Sa'ad et al., 2014).

It appears that mathematics is the base of all science subjects; hence, it demands systematic and exciting teaching and learning methods that will gear up the students.

2.2.2 Students misconceptions and errors in mathematics

According to Hiebert and Carpenter (1992), misconceptions can quickly develop when students acquire only procedural knowledge in the classroom. A similar view by Rittle-Johnson et al. (2001) expresses that great attention should be given to conceptual knowledge strongly linked to procedural actions to achieve a goal as they are almost inseparable in mathematics. Correspondingly, Van der Sandt and Nieumwoudt (2003) propose lecturers should help students overcome their misconceptions to advance their conceptual understanding. At the same time, the studies conducted by Karue and Amukowa (2013) and Tshabalala and Ncube (2013) in South African secondary schools reveal that improper use of teaching methods and teaching aids creates confusion and misconception of mathematics principles. According to Makhubele (2014), misconceptions and errors result in emotions like fear, anxiety, frustration, and rage, which often threaten mathematics participation and performance. Additionally, Ngoveni and Mofolo-Mbokane (2019) support that Engineering students have misconceptions in mathematics.

Makonye and Khanyile (2015) conducted a study comparing the differences in performance prior and post probing. Their findings revealed that probing students regarding their errors help them dispel misconceptions, leading to errors, such as finding answers using the wrong mathematical rules and careless mistakes. Likewise, a study conducted by Bohlmann et al. (2017) highlighted that there is a problem in the conceptual understanding and mathematical skills of the candidates.

Ndlovu et al. (2017) suggest that future mathematics lecturers can be inspired to acquire specialised knowledge to operate as master craft persons who can teach and work with students in school settings through using error analysis pedagogy. Ndlovu *et al*. (2017) further emphasise that lecturers should combine common content knowledge and subject knowledge to solve and diagnose mathematics students' misconceptions and errors for effective teaching.

Misconceptions and errors are serious because they may impact students' ability to do advanced mathematics topics in the TVET Level 3 and Level 4 curriculum, which require deep mathematical thinking and conceptual understanding. In support of this, Naicker (2017) believes that a balance between conceptual and procedural knowledge should co-exist to reduce the severity of conceptual and procedural difficulties that students experience. The above discussion suggests that TVET college lecturers should use more interactive methods to help students grasp concepts well and take a central role in their mathematical learning.

2.2.3 Lecturers' subject content knowledge

Lecturers' content knowledge is essential in impacting students' mathematics achievement (Kanyongo et al., 2007). The green paper for Post-School Education and Training (DHET, 2011) states that the single most significant contributor towards underachievement in the TVET sector is the lack of lecturers' subject content knowledge and expertise; this confirms that the lack of lecturer competency is a factor contributing to poor performance in mathematics. Carnoy et al. (2012) and Modiba (2011) argue that even the best teachers need adequate subject matter knowledge and that lecturers caused the 'low mathematics achievement trap' in South Africa.

Adler (2017) confirms this view by pointing out that attention to mathematical content is vital among other aspects of teaching. Lecturers play a crucial role in students' acquiring mathematics knowledge. According to Shulman (1986), those who understand knowledge develop in teaching. Shulman viewed content knowledge as the mother of all knowledge bases that a lecturer must have to be effective. Similarly, lecturers need to know the content they teach and that students are expected to master (Ball et al., 2008). Meanwhile, Luneta (2008) advises that mathematics lecturers should reflect on their connected mathematical knowledge bases and fluidly combine that with their experience and understanding of content when teaching. Effective mathematics instruction requires that lecturers develop sound approaches and knowledge of valuable resources and activities (Ding & Jones, 2006).

On the other hand, Crowley (1987) suggests that lecturers should understand how students operate to match instruction to their thinking, which means lecturers must know their socio-cultural backgrounds.

A study conducted by Tsanwani et al. (2014) concludes that changing school climate and improving the learning strategies in mathematics is easier to achieve than changing the background factors affecting students' performance. The authors argue that lecturers use other methods that can help students learn and understand mathematics easier. Moreover, Makonye (2019) emphasises that deep mathematical knowledge is necessary for lecturers to support students when teaching mathematics, which indicates that subject content knowledge is critical in teaching and learning.

2.2.4 Lecturers' mathematics teaching experiences

According to Young (2007), interactions between experienced and novice lecturers, how they comply with school policies, and differences in their opinions mirror their perceptions. The good communication between the experienced and novice lecturer, school policies and procedures, provides students with valuable teaching abilities, and their professionalism is further developed. (Spooner *et al.,* 2008). Similarly, Barnett and Hodson (2001) believe that experienced lecturers have more accessible, valuable, and organised knowledge than novice teachers. Hence, they can transfer their professional knowledge to inexperienced lecturers.

Teaching experience can help lecturers learn from their behaviour and use the knowledge from their previous experiences. Likewise, Van der Walt and Maree (2007) posit that in exploring previous experiences, a lecturer's identity and three experience levels such as technical, practical, and critical must be used, suggesting that these can shape the lecturer's identities in teaching and learning.

Kardos and Johnson (2010) state that lecturers' experiences are the conflict within themselves regarding teaching strategies to use, content to teach, resources to use for the lesson design that will draw students' attention, and meeting the requirements of the standardised tests.

The literature suggests that the struggle within the lecturers and educational policies can help them learn from their experiences to reflect on what they have experienced during their teaching progressions. This clarifies that mathematics lecturers who are inadequately qualified struggling with educational policies and it is through the experience that they can reflect on what and how to make progress as professionals. Similarly, Berkvens et al. (2014) agree that lecturers should make education an exciting adventure for students by utilising different teaching strategies and bringing real-life situations into the classroom. Meanwhile, Etkind and Shafrir (2013) found that teaching strategies are various teaching techniques or methods used by lecturers to improve students' learning.

Kamoru and Ramon (2017) conducted a study to investigate the relationship between self-concept and Mathematics achievement. The authors suggested that lecturers develop a positive self-concept of the students towards mathematics and provide a pleasant teaching experience to enhance students' self-concept and performance in mathematics. Lecturers should find their own identity and gain self-confidence to motivate students towards better performance in mathematics.

2.2.5 Lecturers' qualifications

The shortage of suitably qualified mathematics lecturers is experienced by students from low socio-economic backgrounds in developing countries, resulting in poor opportunities for learning (McConney et al., 2010)**.** The poor academic quality of TVET students, is a mathematics lecturer at a TVET College (Barry, 2014). Meanwhile, Tshabalala and Ncube (2016) assert that some mathematics lecturers are not competent enough to teach mathematics. Likewise, Naicker (2017) discloses that most lecturers at TVET College had not completed formal training in mathematics education. The findings from Naicker's study revealed that one of three lecturers who teach the NCV Level 4 students possessed a qualification in mathematics education, and only two out of ten who teach NCV mathematics had attained such qualifications. It can be argued that lecturers come unprepared to class and teach content directly from the textbook without further explanation; they assign lengthy mathematics homework without review and move quickly to other topics to finish the syllabus. Thus, the underqualified and unqualified lecturers are the majority in TVET colleges, highlighting the lack of pedagogical content knowledge affecting students' performance in mathematics.

Kilpatrick et al. (2001) found that teaching capabilities are not automatic but develop through experience and continuous professional development. Similarly, Low (2011) agrees that lecturers are not static and continue to learn, mostly passing this knowledge onto other lecturers and their students. Furthermore, Msibi and Mchunu (2013) maintain that professional teachers should be qualified and continue to improve themselves concerning teaching, learning, and technology. Therefore, lecturers must develop their interests to achieve the best indicators of their abilities. In turn, this might elevate the qualified mathematics lecturers worldwide. This means that lecturers should develop their professional abilities such as mathematics content knowledge, teaching strategies, plan and organise, students involvement, linking knowledge and give feedback to students.

2.2.6 Lecturers motivation towards student achievement

According to Tella (2007), students' background practices, lecturers' teaching styles, and communication patterns affect students' attributions. This clarifies that students attributed their failure in mathematics to the lecturers' styles of communication and their communication patterns as well as their own backgrounds where they come from. Those who come from the poverty stricken that had poor mathematics lecturers and had now come into higher education and certainly going to have challenges, they try to attribute the problem they are facing to their background and to teaching.

Meanwhile, Ryan and Deci (2000) found that having a connection with the person requiring the task to be executed could increase motivation to complete a challenging task. Likewise, Sardiman (2011) alludes that giving feedback, knowing the results, and giving the score can accumulate student learning motivation. When lecturers are caring, supportive and emphasise the teaching and learning process over the performance outcomes giving feedback, students tend to be motivated and expect to perform better. When Lecturers give incentives or appreciation to students such as awards, competition, and recognition, to mention a few, it can stimulate the students' motivation towards mathematics achievement. In support, Hamid (2006) affirms that a reward is a tool in education that can encourage students to do better.

In addition, Arifin (2011) maintains that awarding is a stimulus to students to strengthen a response. Botty et al. (2015) note that students require motivation to develop positive attitudes. Appreciation significantly affects student learning motivation and mathematics achievement (Syahrul, 2017; Aziyuza & Kusrini, 2014). The good attitude and interest students display in mathematics serve as encouragement even to the lecturer. Learning interest should be enhanced because it influences learning achievement (Djamarah & Zain, 2002). Interest in mathematics symbolises students' willingness and enjoyment in learning the subject. Students with high mathematics interest engage more in mathematics-related activities. For instance, they spend more time on mathematics homework than on television, thus getting higher mathematics grades (Singh et al., 2002).To enhance the students’ interest and positive attitude towards mathematics, lecturers should disseminate their teaching to the best of their ability and knowledge, using all available resources rather than teacher-centred approaches.

The use of varying teaching methods helps students realise that mathematics makes sense (Makonye, 2017). In addition, lecturers can use different pictures or images to deliver the mathematics content knowledge, stimulating students’ motivation and enabling their construction of new knowledge. Adequate instructional mathematics knowledge combined with students' interest in the subject and displaying a positive attitude are good motivating factors that may result in better student performance in mathematics.

Additionally, Tsanwani (2014) found that the application of sound teaching and learning principles promotes an atmosphere where students are inspired to achieve their full potential. To enhance students’ self-esteem, which will improve students’ attitudes in learning mathematics, lecturers should use various mathematics problems ranging from simple to very difficult.

Motivation indicators consist of determined, loving, happy, diligent, and eager to learn (Sardiman, 2011). The study conducted by Sumantri and Whardani (2017) revealed a significant relationship between motivation and learning achievement. If the lecturer enhances students' motivation towards mathematics, students become eager to learn and score high in mathematics. Moreover, they realise the importance of mathematics in other subjects and attend every lesson. Motivation can also encourage students to study either alone or in groups to achieve goals.

When autonomous behaviour (e.g., enjoyment, freedom of choice) is encouraged in the classroom, the student is more likely to be autonomously motivated to learn and persist (Garon-Carrier et al., 2016). Similarly, Deci and Ryan (2016) assert that the students’ performance is enhanced, and the positive effects of the action are long-lasting than those who do not receive autonomous support. Lecturers provide autonomous support by giving students supportive feedback and structure by organising the classroom to promote competence, offering choices to develop students’ intrinsic motivation. However, Deci and Ryan (2016) argue that external rewards tend to undermine autonomy and cause students to revert to controlled forms of motivation as external and introjected regulation work against self-regulation.

2.2.7 Fear and negative attitude towards mathematics

Schwarzer and Jerusalem (1992) discovered that students suffering from high test anxiety may experience attention distraction towards given tasks or find it challenging to identify the range of possible cues, allowing incompatible thoughts to distract them, affecting their performance on the respective test. The researchers suggest that students' performance will be affected by their inability to control their negative thoughts, including worrying about bad outcomes, comparing their abilities with peers, and being unprepared to sit for tests or exams during the evaluation process. Thus, it indicates that many other factors could predict students' mathematics achievement, such as self-efficacy and self-regulation (Sins et al., 2008; Marsh et al., 2007).

A case study conducted by Mohd (2014) showed that mathematics anxiety affects students' mathematics achievement through cognitive interference experienced by the students. Also, Tshabalala and Ncube (2016) observed that most students trust that mathematics is naturally a difficult subject, which means they fear the subject**.** This interference could occur during mathematics lessons or when writing mathematics tests or examinations. When this happens, students find it hard to retrieve or remember the work they have already learnt. Consequently, they are unable to give their best answers to assessment tasks resulting in poor performance. Furthermore, Naveh-Benjamin et al. (1987) found that students who experience test anxiety and face difficulty in the stage of processing information are incapable of coding, organising, and retrieving information.

Botty et al. (2015) mention that lecturers should help build students' positive attitudes (in and outside the classroom). Also, Mazana et al. (2019) conducted a study that recommends lecturers appropriately adapt instructional techniques that consider students' diversities or barriers to learning, minimise fear, enhance active interest, and allow students to enjoy what is being taught and learned. Lecturers should apply correct procedures to lessen tension and support their students where necessary, creating a shared understanding in a non-threatening teaching and learning environment. Gitaari et al. (2013) suggested that to maintain good performance: lecturers must complete coverage of the syllabus, encourage student involvement in practical activities, acquire and use appropriate textbooks, and ensure thorough mastery of the subject content.

Although, most of the participants in the literature reviewed above were not the TVET, but it resembles the very same problems that are emerged them. Since the current study sought to compare explanations of engineering lecturers and students on performance in mathematics at a TVET college, the reviewed literature highlights the factors affecting student performance. These include mathematics teaching strategies, students misconceptions and errors in mathematics, lecturers' subject content knowledge, lecturers' mathematics teaching experiences, lecturers' qualifications, students' motivation towards achievement, and students' fear and negative attitude towards mathematics. Moreover, the attribution theory provides further insight into the phenomenon under study.

2.3 Theoretical framework

Weiner's (1970) Attribution theory was employed as the theoretical framework that guided the current study on exploring engineering lecturers and students' explanations of performance in mathematics. Attribution theory is concerned with how individuals interpret a particular situation and its relation to their experiences and behaviour (Heider, 1958, Weiner, 1970).

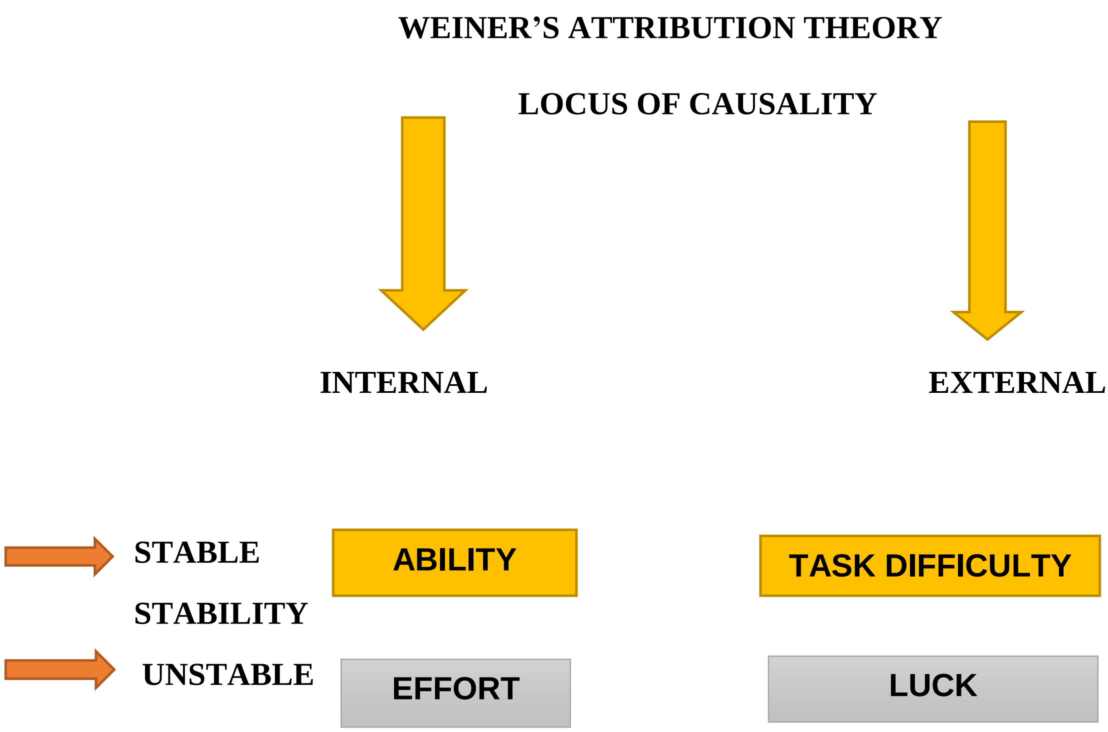

Figure 2.1: Weiner's Attribution Theory (Source: Weiner, 1972, p. 96)

Heider (1958) was the first to propose a psychological theory of attribution and discovered that in achievement, success might be attributed to high ability or effort, while failure was perceived as due to low ability or lack of effort. Weiner (1974) developed the Attribution theory as a theoretical framework that has become a significant research paradigm of social psychology. Weiner (1970) found the theory as centred on causes and seeks to attach the results of specific actions to factors. The theory also accounts for the causes individuals ascribe to an event or action, which are invoked to explain outcomes such as success and failure (Weiner, 2010).

According to Heider (1958), the theory is characterised by internal and external attributions. Likewise, Weiner et al. (1972) proposed a two-dimensional classification scheme, with causes being cross-classified in terms of stability (stable-unstable) and locus (internal-external).

2.3.1 Locus of causality

Locus of causality means that an event could be internally caused or externally caused. That is, the behaviour may be due to personal deposition or due to situational factors. In this scheme, the ability is internal and stable, while luck is external and unstable. The remaining causes in the classification are effort (internal and unstable) and task difficulty (external and stable). Moreover, Miller and Ross (1975) and Zuckerman (1979) constantly maintained that attributions for success are usually relatively internal, while failure is usually relatively external. However, Weary (1979) stated that it has constantly shown that people tend to take credit for success and blame others for failure. Finally, Piszczek and Berg (2020) found internal attributions occur when an event or action is ascribed to a person and their disposition, while in external attributions, they are ascribed to the environment or situational context.

On the other hand, external attributions happen when a student performs poorly in mathematics. For example, students attribute this poor performance to external factors, such as lack of competence and motivation from lecturers, mathematics being a difficult subject, or lack of resources. Meanwhile, lecturers' failure to complete the syllabus because it was very long might not give students a chance to perform better next time. In contrast, if the external factor changes, the student will improve the level of achievement.

Weiner's theory (2005) classifies students' attributions as internal when they perform well and relate good performance to their ability and hard work. According to Khedhiri

(2016), when a student obtains low marks in mathematics, they attribute lack of achievement to a specific cause such as personal confidence about mathematics, the usefulness of a subject's content, perceiving a subject as a male domain, and perception of the lecturer's poor instruction methods among others. Thus, internal attribution involves the information and biases from individuals' past experiences and learning. In contrast, external attribution is the feedback from others that may influence one's attributions for success or failure.

Booth-Butterfield (1996) perceived that internal attributions lead to feelings of confidence. These attributions leave room for improvement and may lead to increased lecturer and student self-efficacy and more desired. Consequently, the lecturers and students foresee success in mathematics by planning to work harder and continue striving for better mathematics achievement. Students with high mathematics self-confidence believe that they can do well and make an effort to learn the subject by taking advanced math courses (Marsh et al., 2006). However, Abramson et al. (1978) argue that an internal attribution is hypothesised to lead to depressed affect and lowered self-esteem, while attribution to a stable cause would reduce expectancy for future reinforcement.

2.3.2 Stable and Unstable

A stable attribute refers to the degree to which a factor is permanent and unchanged, while an unstable attribute is temporary and can be changed. Weiner et al. (1972) classified (a) ability as internal and stable, (b) effort as internal and unstable, (c) task difficulty as external and stable (d) luck as external and unstable. In other words, if students complete a task successfully, their attributes are their effort and ability. Alternatively, if students experience failure, they attribute it to the task's difficulty. If students use internal attributes, then the student will attribute failing a test to, for example, not studying enough or using the wrong learning strategies. Alternatively, lecturers not using various teaching strategies in mathematics might be attributed to failure.

Hiebert and Carpenter (1992) confirm that lecturers reveal conceptual knowledge when they demonstrate various methods to accomplish a task or link different concepts to uncover or form a new option.

Strong internal control enables the lecturer and student to work hard and dedicate themselves to future success. If there is external control, the student will attribute failure to the difficulty of the test or bad luck. If students attribute success on a task to a stable cause such as skill, they will expect to do well in upcoming tasks. On the contrary, students will not automatically expect success in future tasks if success is attributed to unstable causes such as luck or a simple task.

2.3.1.1 Ability

Ability is related to internal and stable locus, which the student does not exercise much direct control in the short term. It involves the students' attribution of their capacity or lack of ability in mathematics tasks. Passing mathematics indicates that students have the required ability. Similarly, well-prepared lectures in mathematics content knowledge will lead to success in mathematics. Shulman (1986) affirms that elementary teachers should have a deep understanding of the concepts and principles that govern mathematics, know what relevant topics should be taught, and how to teach them.

Kilpatrick et al. (2001) indicate that proficiency in teaching mathematics is parallel to that of students, implying that improving their proficiency in mathematics depends on the capabilities and proficiency of the mathematics lecturer. Weiner (1992) states that the challenges of a mathematics lecturer could be ascribed to the student's lack of ability associated with intelligence. Furthermore, students may believe that mathematics performance is linked to the methods and strategies used during teaching and learning. Individuals having low achievement motivation ascribe failure to a lack of ability. The lack of motivation is followed by failure to achieve a goal, then disinterest in striving for success. As such, failure is attributed to causal factors which influence the expectancy of future success.

2.3.3 Effort

An effort is an internal and unstable locus characterised as personal, and a great deal of control is exercised. For example, if a student exerts more effort to regularly attend classes, meet the required submission dates, and self-study, they are more likely to succeed. On the other hand, a student who puts in little or no effort has poor commitment, and poor attendance is likely to lead to failure. A lecturer using a teacher-learner-centred approach is more likely to be successful in content delivery than using a one-sided approach. Students lack confidence within themselves, as they believe they are not good at mathematics.

As an unstable causal attribute, effort is volitional control and can be dynamic on future occasions (Weiner, 1970). The student with low motivation and another with high achievement can anticipate future success after failure by planning to work harder and striving for previously unattained goals. Also, the lecturer can change teaching strategies and use various resources to accommodate students' ability for better performance. A student can raise their self-confidence by exerting more effort to succeed. Self-confidence in mathematics is a consequence of students' beliefs and abilities to succeed in mathematics (Lester et al., 1989).

2.3.4 Task difficulty

Task difficulty is an external and stable locus that is largely beyond the student's control. It is external because it is outside the students' ability. Suppose the lecturer does not use different methods and strategies for teaching mathematics. In that case, the student might not be able to cope with differences when solving complex mathematics tasks. Some students believe that they are not good at mathematics and incapable of performing positively no matter their effort; hence, they lack self-motivation towards the subject. For other students, mathematics is complex because of failure to attempt some questions due to the lack of understanding of some topics or badly set examinations. As a result, students receive poor results, hence disliking mathematics.

In support, Skemp (1987) affirms that if mathematics is not learned relationally, students do not analyse and make new connections; the rules bind them. Skemp states, "If the lecturer asks a question that does not quite fit the rule, of course, they will get it wrong" (p. 90).

2.3.5 Luck

Luck refers to an external and unstable locus over which the student exercises very little control. For example, students believe that their success or failure is because they are lucky, implying that the outcome is based on something out of their control. Also, the student may believe that mathematics performance is due to good or bad luck. For instance, a student may believe that more effort has been used for a particular task, whereas little effort has been made, or an easy task was a difficult task (bad luck). Alternatively, a student can pass a difficult task, but with little effort (good luck), which indicates that failure does not affect their self-confidence, but success builds their pride and confidence. Students doubt their ability and assume that their success and failure are related to luck or other factors beyond their control, such as poor presentation of a lesson, time allocation of a lesson, to mention a few.

2.4 Reasons for selecting the framework

The reason the researcher chose Weiner's Attributional theory (1972) as the framework for this study is that, it is proposed in terms of internal-external and stable-unstable attributions which categorises factors that could be linked to poor performance in mathematics. This idea behind this theory was to help researcher to categorise the factors that emerged from the interviews with students and lecturers into internal and external attributions. The theory was also used in analysing and interpreting the research findings. Moreover, will provide an understanding of how Engineering lecturers and students explain the reasons for mathematics performance.

2.5 Summary

This chapter draws on the key concepts concerning the factors affecting the performance of mathematics. First, the chapter highlights some factors affecting mathematics performance to bring awareness to colleges and understand the attributes and challenges from a broader context. Literature on how lecturers and students respond to these factors was further reviewed. Lastly, the Attribution theory that underpins the study was used to analyse both Engineering lecturers' and students' subjective experiences and articulate reasons for poor performance in mathematics. This was done to establish the influence and interchanges of mathematics performance at an exit level. Furthermore, differences and similarities of engineering lecturers and students' success or failure in mathematics were compared.

The next chapter discusses the research design and methodology employed in this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the research process that led to generating the data used to answer the main research questions regarding students' poor performance in mathematics at a TVET college. The methodology is discussed under the following sub-topics: research design, research paradigm, case study approach, data generation, data analysis, trustworthiness, and ethical considerations. Lastly, a summary of the discussion is provided.

3.2 Research design

The study adopted a qualitative research approach because it involves exploring a phenomenon through participants' experiences to understand their real-life world. According to Maree (2007), a research design is "a plan of how one intends to accomplish a particular task, and in research, this plan provides a structure that informs the researcher as to which theories, methods, and instruments the study is based on". Moreover, Merriam (1998) asserts that "reality is not an objective entity; rather, there are multiple interpretations of reality" (p.22). In other words, qualitative researchers are intrigued by how people make sense of their world and their experiences in this world. Also, Maree (2007) explains that a qualitative approach attempts to produce descriptive data regarding a particular phenomenon.

Similarly, Burns and Grove (2003) describe a qualitative design as a "systematic subjective approach used to describe life experiences and situations to give them meaning" (p.19). Each person has experiences that constitute their reality. Vishnevsky and Beanlands (2004) assert that truth is never viewed as objective reality in qualitative research but rather subjective and experienced differently by individuals. Therefore, this approach was suitable for this study because data was generated from participants with different views, opinions, and beliefs.

This study aimed not to seek the truth but interpret and understand each individual's experiences and events (Flick, 2007). Therefore, reality is negotiating truths through subjective accounts from participants in qualitative research (Winter, 2000). Brown (2008) affirms that multiple realities through which one can make sense of the world as reality are constructed from one's own experiences. This study discusses the different and similar realities that Engineering lecturers and students experience during teaching and learning mathematics.

This approach allowed the researcher to acknowledge an interactive relationship with participants and between participants and their experiences and how they constructed reality based on those experiences. In support, Maree (2007) posits that a qualitative approach focuses on how individuals and groups view, understand the world, and construct out of their experiences. In addition, Lee (2012) states that qualitative research is more appropriate since it uses multi-methods and practices and traverses several disciplines. Thus, this study employed both semi-structured and focus group interviews for generating data.

According to Caruth (2013), qualitative research offers greater depth in understanding than quantitative research. Hammarberg et al. (2016) add that the data collected is usually not amenable to counting or measuring, commonly found in quantitative research. In the current study, the researcher engaged with the participants to comprehend their explanations regarding performance in mathematics to obtain the desired data. Descriptive information such as thoughts, feelings, and information relating to teachers' perspectives is best represented in the form of words in transcripts and observed instead of numerical data (Cohen et al., 2011). Therefore, a qualitative design was appropriate in understanding poor performance in mathematics at a TVET college through the explanations of Engineering lecturers and students.

3.3 Research paradigm

A research paradigm is about reflecting on how people perceive the world related to the phenomenon under study. According to Bertram and Christiansen (2014), a research paradigm represents a world view that explains how the research must be done and what is acceptable for the researchers who hold a view.

Terre Blanche et al. (2006) highlight that a paradigm is an all-surrounding system of interrelated practice and thinking that defines the nature of inquiry along three dimensions: ontology, epistemology, and methodology. They further identify three types of paradigms as positivist, interpretive and constructionist. This study employed an interpretive paradigm that seeks "to understand the subjective world of human experience" (Cohen et al., 2007, p.21).

Interpretivists have relativist ontology, meaning that the reality as we know it, is constructed through social and experiential meanings and understanding. They also have subjectivist epistemology, which means that we cannot separate ourselves from what we already know. The Engineering lecturers and students already had knowledge of the performance in mathematics. They lived and experienced that life style. This meant that they had informed knowledge about the phenomena. Moreover, Cohen et al. (2011) emphasise that interpretivist researchers begin with individuals and set out what the world means around them.

According to Lewis (2015), the interpretive paradigm underpins the understanding that reality is multiple, contested, and negotiated in human experiences and perception. Likewise, Budden (2017) asserts that "research paradigms, in essence, reflect the multiple views, perceptions, and assumptions about how the world is understood and perceived" (p.140). In this study, data was generated from eight participants whereby multiple realities were justified using their explanations of performance in mathematics at a TVET college. Also, Scotland (2012) supports that reality is individually constructed in the interpretive paradigm; therefore, there are many realities as individuals. The current study confirms the above notion as each lecturer and student individually constructed their realities about performance in mathematics.

The researcher viewed Engineering lecturers' and students' explanations as equally significant and valid, believing the truth is multiple. However, Hammersley (2007) points out that "one of the criticisms of interpretivism is that it does not allow for generalisations because it encourages the study of a small number of cases that do not apply to the whole population" (p.104). Nevertheless, the in-depth understanding gathered from an interpretive inquiry is only possible using a small number of participants.

3.4 Case Study Approach

Bertram and Christiansen (2014) define a case study as a plan of how the researcher will generate the data needed to answer the research questions. Meanwhile, Noor (2008) states that case studies are not to study the entire institution but only a single subject, piece, or unit of analysis. Likewise, Stake (2013) refers to case study as the focus on a single event with a small sample size.

According to Hencock and Algozzine (2017), there are three types of case studies, which they differentiate in terms of the end product of the research that might be explanatory or descriptive, exploratory, illustrative, and critical instance case study. For any study, a case study follows a single or multiple case. Therefore, an exploratory case study approach was suitable for the current study. The researcher chose the field as she worked as a TVET college lecturer, that is why she sought to explore the explanations of the Engineering lecturers and students for performance in mathematics. The idea was not to find out about what was happening throughout the country or in all TVET Colleges, because South Africa is a country of diversity, there is wealth and there is poverty, there is rural and there is urban, there is suburban and shanty towns. Thus where the researcher draws the students from a different experience of teaching and learning, so that is why the researcher only chose one in order to understand deeply in this particular case study about the attributions of failure. Rule and John (2011) point out that "the singularity of focus of a case study can make it more manageable than a large-scale survey" (p. 8).

In addition, Denzin and Lincoln (2011) assert that a case study allows for specificity and boundedness and an in-depth understanding of the case without generalising findings to a larger population. According to Leung (2015), generalisability is when the study's findings are applied to a broader population. The current study was limited to four Engineering lecturers teaching mathematics NCV and four mathematics Engineering students in level 4 who were selected as participants. The specificity of one single institution and the limited selected participants' boundedness helped keep the study focused on the research topic.

A case study approach is applied to understand the realities of a situation in its uniqueness (Patton, 2005), which means that every individual is different, and their responses are likely to differ or, in some cases, be similar. Simon (2009) described a case study as one that allows deep exploration from multi perspectives. Hence, the current study's data was collected from both Engineering lecturers' and students' narratives of their experiences and realities of students' performance in mathematics. According to Henning et al. (2004), a case study is used to understand the environment and meaning of those involved. The current study generated data using semi-structured and focus group interviews for detailed information. In accessing the rich data and taking into account the complex contexts that the participants are situated in, semi-structured interviews and focus group will be the preferable data collection method (Yin, 2016).

Creswell (2009) confirms that these methods include semi-structured interviews, video recordings, and stimulated interviews. Similarly, Maree (2007) posits that multiple sources and techniques are used in the data gathering process.

3.4.1 Location of the Study

The study was conducted in one Technical and Vocational Education and Training (TVET) college situated in the Northern coastal region of KwaZulu-Natal. The college has five campuses, but the study was conducted on one campus. The location was conveniently selected since it was within the proximity where the researcher works and lives. Moreover, the selected campus offers National Certificates in Vocational (NCV) programmes, and mathematics is a compulsory subject in Engineering studies. Lecturers from this college are professionals with different qualifications ranging from Diplomas to Masters degrees. This study aimed at exploring lecturers' and students' explanations for performance in mathematics.

3.4.2 Selection of participants

Palys (2008) asserts that the general principle in choosing participants could be to "think of the person or place or situation that has the largest potential for advancing your understanding and look there" (p.3). Cohen and Manion (2011) highlight that the purposive selection of participants is a feature of qualitative research. Also, Bertram and Christiansen (2014) state that purposive selection only focuses on one school or few lecturers when generating rich, in-depth qualitative data. Therefore, this study employed a purposive sampling method for the selection of participants.

Eight participants were selected for the study, consisting of four Engineering lecturers with different professional experiences and four Engineering NCV Level 4 students. All participants were contacted through telephone to request their consent to participate in the study. Thereafter, emails were sent explaining the intention of the research study and an invitation to participate. A participant information sheet and a consent form were also attached to the emails. Permission was sought from parents of the student participants with the assistance of the college administrator, Technical and Vocational Education and Training Management Information System (TVETMIS). The contact details of the students' parents were retrieved through the college information system, and they were contacted for permission to grant their children consent to participate in the study. McMillan and Schumacher (2001) assert that qualitative research is conducted to increase the value of the information from a small sample. Buthelezi (2014) further adds that a qualitative researcher usually works with a small group of participants.

All Engineering lecturers that participated in this study were mathematics specialists teaching Engineering NCV mathematics. The student participants were studying mathematics in the engineering NCV level 4 programme. Thus, it is necessary to choose the appropriate, relevant participants that would provide in-depth information. The choice of participants who were teaching Engineering NCV mathematics and studying Engineering NCV mathematics level 4 were relevant because this was the most critical part of a student's education at their exit level. The selection of the participants was adequate to gain insight into students' poor performance in mathematics through in-depth interviews and a focus group discussion.

Table 3.1 and 3.2 present the participants' information.

Table 3.1: Lecturers' Biographic data

No	Pseudonyms	Gender	Age	Years teaching mathematics at TVET College
1	Joel	Male	47	7
2	Pat	Male	30	1
3	Zack	Male	35	4
4	Sam	Male	59	10

Source: researcher's compilation

Table 3.2: Students' Biographic data

No	Pseudonyms	Gender	Age	Years of study at TVET College
1	Alex	Male	25	3
2	Penny	Female	21	3
3	Shaun	Male	23	3
4	Judy	Female	24	3

Source: researcher's compilation

Joel

He had been in the industry for four years and had been at the TVET College for seven years. He was a lecturer in the NCV- Engineering related design Department. He was lecturing Materials Level 3, Plant and Equipment Level 3, and Mathematics Level 4. He has a National Diploma in Chemical Engineering, a PGCE qualification and MBA degree.

Zack

He had been in the industry for three years and had been in the TVET College for five years at the time of this study. He was a lecturer in the Engineering Report 191- Electrical Department subject and was lecturing Industrial Technics, and NCV mathematics level 2 and 4. He holds a National Diploma in Mechanical Engineering S4 and a PGCE qualification.

Sam

He had been in the industry for five years and had been at the TVET College for ten years. He was a lecturer in Engineering Report 191 and the NCV- Engineering related design Department. He was lecturing Mathematics N5-N6 and NCV mathematics level 4. He has a degree in Mathematics and Physical Science, PGCE qualification and honours degree.

Pat

He had been at the TVET College for four years. He was a lecturer for in the NCV-Civil Engineering department. He lectured Mathematics Level 4, Plant and Equipment Level

2, 3 and Level 4 and Construction Planning Level 2 and Level 3. He has a National Diploma in Civil Engineering S4, and a PGCE qualification.
Alex is a 25-year-old male, originally from Empangeni, King Cetshwayo District Municipality area, KZN. His home language is isiZulu. He registered for NCV-engineering in 2018. He obtained financial assistance through the National Student Funding Scheme (NSFAS) from 2018 to completion. He stays at an off-campus residence and commutes by bus to campus.

Penny is a 21-year-old female, originally from Mtubatuba, located in uMkhanyakude District Municipal area, Northern KZN. Her home language is isiZulu. She registered for the NCV- Engineering related design department in 2018. She was a member of students' representative council (SRC). She funded by NSFAS and stays at a campus residence.

Shaun is a 23-year-old male, originally from Esikhawini, King Cetshwayo District Municipality area, KZN. Her home language is isiZulu. He registered for the NCV-Civil engineering in 2018. The NSFAS funded his studies to completion. He stays at an off-campus residence and commutes by bus to campus.

Judy is a 25-year-old female, originally from Hluhluwe, located in the uMkhanyakude District Municipal area, KZN. Her home language is isiZulu. She registered for the NCV-Engineering (Process Plant and Operation) in 2018. She was a member of students' representative council (SRC). Judy stays at a campus residence and obtained financial assistance through the National Student Funding Scheme (NSFAS) from 2018 to completion.

3.5 Data generation

Cohen et al. (2011) posit that a qualitative researcher can use different data-generating instruments. Bertram and Christiansen (2014) add that data-generating methods can be questionnaires, interviews, observation, testing, artefacts (photographs, drawings, and documents), and using secondary data. The current study employed semi-structured interviews and a focus group interview to collect data. Due to the coronavirus pandemic, there were nationwide calls for self-isolation and social distancing of all citizens. Therefore, semi-structured interviews were conducted telephonically to adhere to rules and regulations, avoiding close contact with the participants; the focus group discussion was conducted through Zoom meetings.

3.5.1 Semi-structured interviews

This study adopted semi-structured interviews with open-ended questions. According to Koshy (2005), semi-structured interviews are conducted with an open-ended questions that allows for focus, conversational, and two-way communication. Similarly, Whiting (2008, p.35), an interview is a method of data collection in which one person asks questions to another, face-to-face or telephonically. Usually, interviews are conducted telephonically, by e-mail or skype. Likewise, Cohen et al. (2011) state that a semi-structured interview is a verbal face-to-face or telephonic interchange where an interviewer has a prepared set of open-ended questions and allows new views to emerge from the discussion. Thus, questions in a semi-structured interview are formulated to allow explanations for clarity.

Maree (2007) states that the aim of qualitative interviews is for the researcher to see the world through the participants' eyes; interviews can be a valuable source of information, provided they are used appropriately. In the current study, rich, in-depth information was collected through telephonic semi-structured interviews with Engineering lecturers and students from a TVET college using open-ended questions. Semi-structured interviews are flexible and allows the researcher to ask other questions for clarification. Opdenakker (2006) supports that telephonic interviews are conducted over the telephone. Similarly, Johnson and Christensen (2006) agree that a qualitative interview consists of open-ended questions that a researcher will personally pose to participants in a study.

Christiansen et al. (2010) and Creswell and Poth’s (2017) parallel views echo that a researcher must explore the participants' experience, perceptions, feelings, emotions, and ideas in the study rather than imposing their own understanding about the phenomenon. Thus, the researcher made appointments with the current study participants according to their busy schedules before collecting data. Participants were provided ample time to narrate their experiences while the researcher listened to their accounts (Bryman, 2015; Ritchie et al., 2013). Pre-planned open-ended questions did not confine participants’ responses but gave them a sense of flexibility. The participants were also provided with a copy of the guiding interview questions.

Individual telephone interviews were conducted with each participant to ensure their confidentiality. The duration of each interview was a maximum of forty-five minutes for a one-off session. The interviews were scheduled according to each participant's availability. Cohen et al. (2011) explain that semi-structured interviews are "standardised open-ended interviews" where all participants are given the "same basic questions in the same order" (p.353). In support of this, the current study's participants were given the same questions in the same sequence to compare their responses and generate themes from the data.

While conducting the interviews, the researcher probed the participants with follow-up questions to further elaborate their explanations where necessary to gather more data for the study. Wahyuni (2012) emphasises that the critical aspect of an interview is to help the interviewees to tell their stories, experiences, and perspectives regarding a particular social occurrence being witnessed by the interviewer. All interviews were audio-recorded using a smartphone and laptop with permission from the participants, as Yin (2011) suggested. Diary notes were used as additional tools to ensure that all the data is captured and thereafter transcribed. Similarly, McMillan and Schumacher (2006) state that audio-recording ensures completeness of the verbal interaction and provides material for reliability checks. However, De Vos et al. (2011) argues that a tape recorder allows a much fuller recording than notes taken during interviews.

3.5.2 Focus group discussion

Krueger (2014) define a focus group as a special type of group for data generation in terms of purpose, size, composition, and procedure. According to Cohen et al. (2011), a focus group discussion is created around a set of predetermined questions. In this study, the discussion was rooted in the specified individual semi-structured interview questions. Meanwhile, Padgett (2016) states that participants in the focus group share similar feelings and backgrounds yet are usually unaware of each other. Thus, focus groups allow participants to interact with each other freely. In the current study, to gain understanding, in-depth information was collected through focus group discussions with Engineering lecturers and students from a TVET college using open-ended questions. According to Ayrton (2019), focus groups are useful in generating a rich understanding of participants' experiences and beliefs.

The researcher contacted participants to confirm their availability and schedule a zoom meeting. Each participant received a Zoom link via emails or WhatsApp for easy access, followed by a telephone call reminding them about the emails. The link indicated the date and time the Zoom meeting was scheduled, and participants were informed that the meeting would be recorded. The recording function on a laptop was used to record the interviews. The students focus group discussion was conducted separately from the lecturers focus group discussions.

The participants engaged in a focus group discussion and shared their experiences, views, and beliefs of performance in mathematics. According to Bell (2010), a focus group discussion is another powerful qualitative data collection method that is undoubtedly effective when in-depth information is needed about peoples' experiences and perceptions. Thus, through their expressions and emotions, it was evident how participants incorporated the viewpoints of others in structuring and understanding their explanations.

3.6 Data analysis

Flick (2013) describes data analysis as a typical process that is implemented after data is generated. Qualitative data analysis tries to determine how participants construct meanings of a specific phenomenon by ensuring that participants' opinions, experiences, feelings, understanding, and knowledge are analysed (Taylor et al., 2015; Wahyuni, 2012). In addition, Mouton (2001) found that data is organised to establish any emerging trends through typing, studying, presentation, and comparison within categories to identify variations.

This study applied inductive thematic content analysis to analyse qualitative data guided by the analytical themes from attribution theory. Thematic analysis is defined by Braun and Clarke (2006) as identifying, analysing, and reporting patterns within the data, which organises and describes the data. Further, thematic analysis was chosen to ensure the rich description of the data generated. Braun and Clarke's (2006) has six steps of thematic analysis which include: These include familiarisation with the data, creating first codes, formulating themes among the codes, reviewing themes, naming themes, and lastly producing the final report (Braun & Clark, 2006).

The information recorded from semi-structured and focus group interviews was transformed through transcription into written text during the data analysis process. The researcher repeatedly listened to the recordings to accurately capture the words of the participants verbatim, which was done manually using Microsoft word and saved on the computer. Mero-Jaffe (2011) supports that transcription is the transfer of spoken words with a particular set of rules into written text accompanied by a different set of rules. Thus, through the analysis process, data were read, and themes were identified and categorised into headings. Cohen et al. (2011) affirm that data analysis involves organising, accounting for, and explaining data from the participant's perspective. Meanwhile, Creswell (2009) states that the main process in data analysis is making meaning of the data. Finally, data were interpreted using reviewed literature in relation to the Attribution theory that underpinned this study.

3.6.1 Data coding

Data coding entails assigning codes or labelling themes by going through responses to the same question to identify commonality in meaning and assigning codes of data to particular themes (Kumar, 2018). Coding was used to make sense of the collected raw data categorising it into different themes and patterns. In addition, Pseudonyms were used to preserve the anonymity of participants. Data coding was done using coloured marker pens, making copies of responses, and sorting responses into smaller sections, categorising them in groups. Finally, keywords, names, and numbers were assigned to themes according to the source.

<u>Data generation plan</u>

Table 3.3 presents the data generation plan used in this study.

Table 3.3: Data generation plan (adapted from Vithal & Jansen, 2012)

Question	Explanation
Research question	What are engineering lecturers' and students' explanations for poor performance in mathematics?
What is the research strategy?	Semi-structured and focus group interviews.
Why is the data generated?	The data was generated to answer the research questions. To explore the engineering lecturers and students' explanations for poor performance in mathematics.
Who are the sources of data?	Engineering lecturers teaching mathematics and NCV level 4 Engineering students.
How many data sources?	Four NCV Engineering lecturers and four students.

How often is data generated?	Each participant was interviewed twice (semi-structured interview and a focus group discussion) at a venue and time agreed by both researcher and participants.
Justification of plan for data collection	The interviews provided the most direct account of the participants' explanations for poor mathematics performance. A semi-structured interview allowed for probing to obtain more information. Participants shared their views openly, which was fundamental for this study. The focus group enabled the verification of data generated during the semi-structured interview since participants' feelings and emotions changed frequently based on their surroundings at that time.—The selection of participants in this study allowed for a focus group interview.

3.7 Trustworthiness

Trustworthiness is a term associated with qualitative procedures (Boudah, 2011). Boudah (2011) mentions that trustworthiness is how a researcher convinces the audience that the findings described are credible and provide appropriate conclusions for the study. Creswell and Poth (2017) state that trustworthiness means that an informed reader should be able to trust that the way the researcher conducted his or her study was free from bias. All participants were asked the questions, but for some participants the researcher went deeper by asking them probing questions. For consistency, questions asked was on all the key issues that mattered for the study and that were in line with the research questions. Four principles of trustworthiness (credibility, dependability, confirmability, and transferability) were applied in this study to ensure the quality of data was not compromised by the indirect number of participants.

3.7.1 Credibility

Credibility deals with the accuracy of data in reflecting the detected social phenomena. In simple terms, credibility is concerned with whether the study measures or tests its intended purpose (Wayhuni, 2012). Bertram and Christiansen (2014) state that the study must show credibility during data generation; this may be achieved using mechanical methods. An example of such methods is audio-recording using a smartphone during an interview conversation to ensure respondents' opinions are not misrepresented and making a transcript, usually accompanied by notetaking.

According to Cohen et al. (2011), the study must ensure validity (concurrent validity) using multiple sources and different kinds of evidence to address research questions and yield (convergent validity) triangulation of data, investigators, perspectives, methodologies, and instruments. The researcher used triangulation by utilising two data gathering methods, transcribing data, and checking themes to make sure that they are coherent and consistent. A semi-structured telephone interview and focus group interview via Zoom were the methods of data collection used in the current study. Furthermore, all interviews were audio-recorded with permission from participants, as suggested by Cohen et al. (2011) and Yin (2011). The interpretation of data was conducted through the assistance of a peer researcher to enhance trustworthiness

3.7.2 Transferability

Guba and Lincoln (1994), in agreement with Cohen et al. (2013), describe transferability as the applicability of the research findings to another context. In this study, transferability can be ensured as findings are beneficial, applicable, and exemplary to other TVET college lecturers and students from a different context with similar features.

3.7.3 Dependability

Dependability refers to reliability as the consistency in detecting the same finding under parallel circumstances (Merriam, 1998). Dependability focuses on giving accurate and direct information about the study. Dependability was ensured in this study through the audio-recorded interviews with verbal and written permission from participants. The recording function on a laptop and an Android smartphone were used to record the interviews. Participants were later requested to listen carefully to the audio recordings to confirm the accuracy of recorded information during the interview.

3.7.4 Confirmability

Confirmability refers to how research findings can be confirmed by others and the data generated (Guba & Lincoln, 1994). The current study was presented to other professionals for critical comments which would then be use to refine the analysis. Gerryts (2013) discloses that checking for members assists participants in confirming the elucidations expressed by the researcher. According to Creswell (2009), member checking is defined as a process where "the final report or specific description or themes are taken back to the participants" (p.191). Therefore, participants were granted opportunities to indicate if the researcher's initial interpretations were in line with their contributions during the interviews by verifying transcriptions.

3.8 Ethical considerations

Bertram and Christiansen (2014) assert that ethics has to do with a behaviour that is considered right or wrong. To observe ethical procedures, permission to conduct the study was sought through an application for ethical clearance from the University of KwaZulu-Natal Research Office. Thereafter, consent to conduct the study in the college was requested from the college principal and the campus manager of the TVET college. The researcher also approached participants who were issued with a consent form explaining the nature of the study, that participation was voluntary, and they were free to withdraw from the study at any time and stage, as suggested by Creswell (2013). Similarly, Cohen et al. (2011) highlight that the principle of informed consent arises from the participant's right to independence and autonomy. Permission letters and informed consent forms were sent to the parents of student participants through emails to request permission for their children to participate in the study.

Confidentiality was also observed to protect the identity of participants, campus and safe storage of shared information. Pseudonyms were used for anonymity. During the data collection process, participants were provided with a consent form prior to the semi-structured interview for permission to record interviews. All participants were informed that data would be kept in a safe cabinet at the University and destroyed after five years. They were also informed of their right to withdraw from the study when they felt confidentiality was compromised. Moreover, due to the nationwide call for self-isolation and social distancing of all citizens because of the Corona pandemic, supplementary letters were sent to participants for data provision. The purpose of the letters was to avoid any interruptions in the study due to data shortage since the telephonic and online interviews (Zoom meetings) were employed.

3.9 Delimitations of the study

Delimitations are the parameters made by the researcher which describe the boundaries that are set for the study (Simons & Goes, 2014). The TVET College has nine campuses in Northern KwaZulu-Natal and has nine campuses. The study was conducted in one TVET College focused on the NCV Engineering lecturers and students of one campus.

3.10 Conclusion

This chapter discussed the methodological procedures that were applied in this study. A qualitative case study approach was applied driven by the interpretivist paradigm that focused on the narratives of four engineering lecturers and four NCV Level 4 students regarding performance in mathematics at a TVET college in Kwazulu-Natal. A purposive sampling procedure was employed for the selection of participants. Furthermore, a data generation plan was used to guide the data collection process. Finally, semi-structured and focus group interviews were described in detail concerning the researcher’s role in the data collection process.

Moreover, the credibility, transferability, dependability, and confirmability of the data that contributed to the study's trustworthiness were discussed. The ethical protocol, including confidentiality and anonymity of participants’ identity and information, was also discussed.

The next chapter presents the data and analysis based on themes from the Attribution theory related to the reviewed literature and research questions.

CHAPTER FOUR

DATA PRESENTATION

4.1 Introductions

This chapter presents the findings derived from the interviews with Engineering lecturers and students of the NCV programme at a TVET college on mathematics performance. The data extracted from the individual semi-structured interviews and a focus group discussions are presented and interpreted. Each sub-section below outlines how data was organised and analysed, highlighting the similarities and differences in participants' explanations.

The themes have sub-themes that emerged from the semi-structured interviews as students' and lecturers' explanations of student failure, factors affecting performance in mathematics, challenges in improving mathematics performance, and possible ways to improve performance in mathematics.

4.2 Students' explanations

4.2.1 Theme1: Failure

Failure may be attributed to many reasons, such as poor investment of time and effort in mathematics. Some students' responses were as follows:

> *My mathematics performance is not that good, reason being I am not a good student but simply a hard worker, and for a hard worker, it becomes more difficult to adapt or quickly master the subject. My lecturer failed to provide a link between me and the subject. A lecturer must also have techniques and strategies to unpack every chapter concerning the subject. (Alex)*

Alex saw himself as a slow learner who did not adapt to the subject content quickly. The participant strongly believed it is the lecturer's responsibility to use different teaching approaches in delivering the subject content. He observed that the lecturer did not create a link between him and the subject content, adding that lecturers did not spend enough time teaching each chapter.

My performance in mathematics is not impressive; more effort with the help of the lecturer will be highly recommended. As a student who is doing mathematics, I did not *receive the support necessary to function optimally. When it comes to mathematics lesson, the lecturer sometimes gives us one or two sums in a period and called it a lesson of the day. (Penny)*

Penny confirmed Alex's statement that the time allocated to teach each chapter is insufficient. The participant claimed if they invested more time and effort in mathematics, there would be better development, recommending that lecturers' support would enhance students' performance. They can provide support through problem-solving tasks and homework followed by feedback to students.

> *I think that my performance is not very good as compared to past years. Changing mathematics lecturers has affected my performance, but I believe I can do better at the end of the year. (Shaun)*

Shaun's perception is that his mathematics performance was not good. The student compares their previous performance to the present and attributes the poor performance to changing lecturers. Also, it implies that the student's performance was impacted negatively; however, the student believes there is a chance for improvement.

> *My mathematics performance varies from good marks to bad; this tells me that as the level increases, it is harder, though it differs from the previous levels. College maths has been similar from Level 2. I can say I got that very well and understood. I adopted my knowledge and use all skills flexibly, not only for solving problems but also learning new skills and conceptual knowledge, this includes relations and patterns. (Judy)*

Judy shared a similar view with Shaun on the change in performance when progressing to the next level. The student claimed that Level 2 and Level 3 at TVET college are almost similar to the school-based curriculum. Still, when progressing to the next level, the content in mathematics becomes extensive and complex. However, the student ignored self-awareness and exerted less effort to study, depending only on the lecturer to teach everything rather than finding an urgency to learn.
The student further added:

> *from level three, that is where it got even harder being introduced to the new chapters and methods of instruction. I always have a positive attitude towards mathematics subject though now it has never loved me. (Judy)*

Apart from having a positive attitude towards mathematics, Judy pointed out that the experience with mathematics in level two was clear, but level three content knowledge became more complex. The above excerpt implies that the student currently has a negative attitude towards the subject because of being exposed to new chapters and instruction methods that result from changing lecturers.

In summary, it seems that all student participants had a common understanding of the phenomena. They attributed their failure to reasons such as lack of effort from the student in the learning process, lack of adequate support from lecturers in problem-solving techniques and feedback, lecturers have insufficient time to teach subject content, new content and changing of lecturers. Students proclaimed that attitudes developed through past and present experiences in the mathematics classroom. However, the efforts that guaranteed good results in the past cannot continue to sustain such results as the student progresses to the next levels.

4.2.2 Theme 2: Factors affecting student performance in mathematics

Interviews with students revealed that they attribute their failure to the following factors: self-irresponsibility, attitudes towards mathematics, absenteeism, teaching strategies and motivation towards mathematics.

4.2.2.1 Self-blame

Students blamed themselves for their poor mathematics performance. Their responses were as follows:

> *"I am not giving much practice in mathematics, as I should. Often, not even doing some sort of a research in chapters that I do not fully understand so that I can master them." (Alex)*

Alex admitted to not giving more time to practice mathematics daily, adding that searching for more information on chapters for clarity would have improved performance.

> *"I take mathematics for granted, forgetting that it is a challenging subject; it needs my attention and inspiration." (Penny)*

In Penny's case, mathematics is not an easy subject. Still, the student pays less attention, implying that mathematics needs students to invest more time, dedication and self-esteem to perform better.

> *'My performance is changing negatively. Here at college, the environment is not the same as at the high school level. Changing the lecturers allocated for each level has a huge impact on my performance, and I did not give myself extra time to practice mathematics. '(Shaun)*

Shaun agrees with Alex on the lack of mathematics practice, highlighting the change brought about by the transition from the school to a higher institution. The student attributes the shift in their performance to changing lecturers at each level. The student also compares their current experiences to those from the previous school. For example, the same teacher would teach the subject in grade 11 and 12 for continuation and consistency, whereas at TVET college, lecturers change at every level. This implies that students are unable to adapt to new people, different teaching styles and new pedagogy.

> *'Worse, I never give myself enough time to study and practice mathematics. I do one sum and find it difficult. Then I tell myself that I cannot do it and not to create my own rational study. I rely only on the lecturers' information, not researching and find more information but fully rely on what my lecturer has taught me'. (Judy)*

Like Shaun and Alex, Judy admits to not spending time practising mathematics. She had negative self-talk that demonstrates a lack of urgency to take charge of learning and a lack of confidence. The student admitted to relying only on the lecturer's information during lesson presentations, suggesting that compiling a personal study timetable and researching some mathematical problems would be of great assistance.

The excerpts indicate that students presented self-blame as a factor affecting their performance. The self-blame is due to lack of practising mathematics; dependence on the lecturer's information; believing the subject is difficult; transition from general school level to higher institution level; and change of the mathematics lecturer at each level.

4.2.2.2 Lecturers’ attitudes towards mathematics

Students attributed their performance to the lecturer’s attitude, which corresponds with an increase in their interest and motivation towards the subject. They also claimed to display good attitudes about their previous performance and beliefs.
Some of the students' responses were as follows:

> *I saw Mathematics as a difficult and confusing subject. The positive attitude of my Mathematics lecturer towards the subject creates a positive attitude and love of the subject. He tries to use different methods of teaching in explaining mathematical concepts and solving problems. Presently I have seen mathematics as an easier and understandable subject, but it needs more practice and hard work. (Alex)*

Alex expressed that mathematics is a confusing and challenging subject, meaning it is abstract, and number-based making it difficult for students who prefer concrete, relatable material. However, Alex believed that the lecturers’ attitudes enhanced the confidence towards mathematics, adding that the lecturer uses various teaching styles to explain mathematical concepts and their application. Thus, the student’s exposure to the lecturer and the teaching strategies influenced their attitude towards mathematics.

> *I have a positive attitude towards mathematics that creates curiosity and interest in investigating and solving problems. My mathematics lecturer motivates and enhances my self-confidence towards mathematics. He used to tell us that mathematics is a challenging subject, but it needs our inspiration and attention. He creates interest by giving the fact that mathematics is related to the real-life situation. (Penny)*

Penny confirms that positive attitudes towards mathematics develop through the lecturer’s motivation. Penny’s lecturer recommended that more time be invested in mathematics, dedication, and self-esteem, developing a positive attitude towards the subject. The student pointed out that connecting mathematics to real-life situations shape a positive attitude towards the subject. However, it contrasts with the idea that mathematics is abstract.

In previous two years my performance was very good, the lecturer was having a positive attitude towards mathematics as a subject. To us, he unpacked the chapters, making sure that no one is left behind, before starting the new chapter. In Level 4, my mathematics is taught by another lecturer. My performance and attitude towards mathematics have changed completely. (Shaun)

Shaun has a positive attitude towards mathematics based on experiences from Level 2 and Level 3. However, the student expressed that their performance in level four changed due to the mathematics lecturer's existence, indicating lecturers influence attitudes towards the subject.

The student further added:

My lecturer sometimes gives us assessment tasks to cover some chapters which we do not understand without doing them previously with us. Now I see mathematics as a difficult subject and hate mathematics, not to pay attention because I was not going to get it anyway. I see myself as a person who is not capable to do it, and I see mathematics as the impossible thing for me to do. (Shaun)

Shaun perceives mathematics as a complex subject and has developed negative feelings towards the subject. The student further expresses that lecturers were fast to complete the syllabus without considering whether students understood the content; therefore, perceiving mathematics as a subject that everyone could not do and pictured himself as a person who lacked ability. The above suggests that lecturers should consider students' abilities and integrate them with what was being taught by the lecturer at the previous level. Meanwhile, a foundation can be established for them concerning what needs to be taught and learnt in the future.

In the previous year, I had a positive attitude in mathematics. Our first lecturer was able to find tutors from another programme (Report 191) and used a tutor software programme(learnscape) to see how other students are doing mathematics and how to apply other methods to solve problems. At present, mathematics is being taught by another lecturer, and this brings confusion to me. Now I see mathematics as a difficult subject because I used my previous lecturer's *instructions and methods in solving problems. I find it difficult to familiarise myself with the new lecturers teaching methods. (Judy)*

Judy shared the same view as Shaun about the previous lecturer, who influenced her positive attitude towards the subject. The lecturer used different teaching styles and other resources for lesson presentations. She revealed that the changing of lecturers causes instability in their studies. Furthermore, Judy explained that she was more familiar with the teaching style of her previous lecturer, and when the lecturer is changed, she struggles to adapt. The previous statement suggests that students are familiar with a teaching style and do not quickly adapt to another, indicating resistance in changing their learning habits.

The above excerpts indicate all student participants believed that lecturers' positive attitudes towards mathematics created motivation and love towards the subject, ultimately contributing to good performance. Lecturers enhanced students' motivation, self-confidence, and interest, emphasising self-dedication in practising mathematics daily and solving mathematical problems related to real-life scenarios. The lecturers' use of various teaching methods, presentations from tutors, and audio-visual lessons to clarify and simplify the lesson improved students' attitudes towards mathematics. Two students felt that annually changing mathematics lecturers brought misunderstanding and confusion, causing them to not adapt to the new teaching styles of the existing lecturer.

4.2.2.3 Lecturers' absenteeism

Students also attribute their failure to lecturers' absenteeism.

> *"We sometimes attend mathematics lectures, only to find that the classroom door is locked, the lecturer is not in the classroom. Sometimes the absence of the lecturer disturbs and affects the students' learning."(Penny)*

Penny revealed that sometimes lecturers are absent from mathematics lectures, which impacts mathematics teaching and learning. Moreover, it affects the delivery of content, leading to the incompletion of the syllabus.

> *'My lecturer has her personal problems; she is always absent. If the lecturer is absent, we are not going to class because we find that the classroom is locked. We have nowhere to stay and may do practice or even do corrections because we have students who are likely to understand clearer because they have created*

their study groups. These students can help others, but how can they do that if we find the classroom locked? Skipping lectures and other students are going forward because we have different lecturers and you cannot attend with them, you can get confused and find that they are on par with the syllabus.' (Judy)

Judy and Penny agree that lecturer's absenteeism has affected their teaching and learning in mathematics. Sometimes students cannot access classrooms for self-directed learning because they are locked, implying that at the TVET college, all lecturers hold the keys to the classrooms. Judy further expressed that even when students tried to attend other lectures, they could not because they were not on the same chapter. Students believed that if the classrooms were open, they would assist each other to improve their understanding of problem-solving in mathematics.
In a way, students become demoralised knowing while their lecturer is absent, teaching continues in another class, and they are on schedule to complete the curriculum.

4.2.2.4 Teaching strategies

Some students attributed their poor performance to a lack of various teaching strategies that meet individual needs.

'I have noticed that there is a shortage of skilled mathematics lecturers in South Africa, especially in TVET sectors that will ensure the effective services in students. I also looked at the facts that they are no traded capacity systems of mathematics. In some cases, the lecturer fails to deliver or bring a full understanding of the subject when teaching. I believe that as a student and a lecturer, sometimes we become an ideal when it comes to mathematics only to find out that the lecturer gives one or two sums at a given period and it finalises as a lesson.' (Penny)

"I agree with Penny when you say we are in a shortage of skilled lecturers. So that becomes a problem to us as students because you cannot have someone with less skills, he will not meet the requirements to bring about the understanding of the subjects as a student.' (Alex)

Yes, I agree with you too. we need lecturers who are skilled and got heart for mathematics, lecturers who have various methods of answering different mathematics *questions not just one method because we as students are not the same and never understand the same way. That means that we need lecturers who will be able to explore the questions, explore the answers so that all students would get all the answers and have various methods to answer the questions in mathematics. (Judy)*

> *"My Lecturer likes to teach maths, but he fails to use different methods to solve problems in mathematics." (Shaun)*

Four students (Penny, Alex, Judy, and Shaun) expressed their concerns about insufficiently skilled mathematics lecturers at the TVET college. In addition, they were concerned about the effective use of appropriate teaching methods to make learning more meaningful. Furthermore, the student participants explained that they did not understand the mathematical concepts in solving problems, claiming that the lecturer did not explore them effectively. They also viewed the lecturer's subject knowledge as an essential aspect of teaching and learning; without it, students experience difficulties understanding. Therefore, a lecturer needs to be prepared for the lesson to teach mathematical concepts effectively.

Judy further explained that:

> *"Lecturers use one method of teaching about 50 students, but we are not equal; our level of understanding cannot be the same. Lecturers need to accommodate all students from fortunate to those who are not fortunate." (Judy)*

The above excerpt shows that students have different thinking levels; thus, the lecturer is responsible for equipping students with appropriate skills to help them adapt to their learning. The students unanimously agreed that some factors affect mathematics performance, such as insufficiently skilled mathematics lecturers, a lack of lecturer's subject content knowledge, and a lack of different teaching styles. One student was concerned about the lecturer's use of one teaching approach for many students in the same class. Such methods of teaching do not guarantee the students' understanding of the subject content.

4.2.2.5 Motivation towards mathematics

Students pointed out that the lack of lecturers' motivation negatively impacted their performance.

'I lose confidence in myself when I see my assessment marks, that they are dropping, and I begin to tell myself that maybe I cannot do it or I am not capable. if I fail mathematics assessment, our lecturer will pay attention to those who pass the task; and to us who failed, it is our own business.' (Shaun)

The above excerpt shows that students may lose confidence in their ability to perform when they do not receive attention and support from the lecturer regardless of their performance. The excerpt highlights the importance of the role of the lecturer in motivating students. The student expressed a need for the lecturer's attention and affirmation. In a way, this shows that learning is inspired when students are affirmed, noticed, and their needs addressed; meanwhile, being ignored can lead to learning problems.

'Lack of motivation and interest in the subject, nobody encourages me to love mathematics. I have to see for myself what to do; even if I fail, no one can motivate me to do better next time. Lack of interest is the cause of my not pleasing performance because once you fail test one, you now become discouraged. '(Judy)

In the excerpt above, it appears that interest in a subject is driven by a lecturer's interest in motivating students. Students may become discouraged after a poor performance and need to be motivated. A lecturer has the power to break the cycle of failure and boost the students' self-confidence through support and motivation.

One of the students added that:

'My home background, from [the] older generation does not support and motivate me because nobody attended a college in a family and they do not care about the results I get; only they ask, did you pass? The pass mark you get, to them, means nothing. The good is that you have passed.' (Judy)

The excerpt by Judy indicates a lack of cultural capital from families to motivate students, especially when the family members do not have an educational background. Also, it limits the ability to get sympathy from the family, which demotivates the student. Therefore, a good educational background in families plays a significant role in students' performance.

Another student added:

> *'My lecturer is ugly when it comes to teaching and learning. The lecturer gives us the question papers and memorandum and tells us to go and practice the sum, check from the memorandum, and find out that we have done the sums correctly. That one really affects my learning and creates anxiety in mathematics.'(Penny)*

The excerpt by Penny indicates that students are discouraged and demotivated when they receive an assessment and memorandum first-hand from the lecturer without a chance to attempt the tasks on their own. Also, it seems they are not rewarded marks commensurate to their efforts. Therefore, it is evident that the lecturer gives students the answers to exam papers to pass. Perhaps, it explains why students understand mathematics as easy in the lower levels and challenging as they progress to the higher levels. Tests are not used to assess student learning but rather as an indicator of the lecturer's performance.

Penny further revealed:

> *There is a lack of regular assessments system in the TVET sector, unlike in high school level where we used to have classwork and homework every day and the quarterly common assessments; this helped us to see where we need to be assisted. (Penny)*

The above excerpt indicates that there is a lack of regular and systematic monitoring of learning. Based on Penny's comparison of the functioning system in general schools and the TVET sector, it is fair to assume that student performance would improve if regular assessments are scheduled at the TVET sector. Furthermore, homework and classwork test students' ability to apply what they have learned and may enhance their interest, curiosity, and love of mathematics.

The data shows that students attribute their poor performance to the lecturers' lack of motivation and support, issuing of question papers and memorandum simultaneously, and lack of family support due to their parents' illiteracy. Students believed that the provision of regular assessments tasks that are compulsory may improve their performance in mathematics.

4.2.3 Theme 3: Challenges in improving performance in mathematics

4.2.3.1 Lack of supporting materials

Students pointed out that lack and not having access to the college learning resources contributed to their poor performances.

> **“***We do not have enough learning materials that helps in breaking down the subject content, even the slow learner can easily understand.” (Alex)*
>
> *“Lack of teaching and learning materials in our college.” (Judy)*

Alex and Judy had a similar belief that if the college could provide students with more supporting material it could be useful in clarifying and simplifying the mathematical concepts.

> *‘In the college there is only one mathematics laboratory which can provide students with the learnscape. But students do not have access to log in. If the college can grant students access, it will be easier for us to prepare ourselves with assessment tasks and examinations effectively”. (Penny)*

Penny mentioned the shortage of mathematics laboratories that can strengthen their performance in mathematics, claiming that the availability of these could support students in their preparation for mathematics assessments and tasks.

Data shows that students lack learner supporting material that can assist them to prepare for assessments. Thus, the unavailability of such resources affects learning in a negative way. Also, the lack of access to log in to *learnscape* program in the laboratory hinders their learning. Therefore, the provision of learning materials besides textbooks can easily unfold students’ content knowledge in mathematics.

4.2.3.2 Time allocation

Students revealed the time allocation of mathematics in a composite timetable negatively impacts their performance.

'Not enough time/hours to learn mathematics on the timetables provided, mathematics needs focus and more time. On the timetable, mathematics should be the first periods in the morning when all students are still fresh- and should be allocated two hours/periods each day. I believe we can do much better.' (Alex)

' Our timetable needs to be revised- most of our mathematics classes are allocated during midday when all students are becoming exhausted. We all failed to concentrate, even our lecturers. They just do two sums and call it a day, and most of the students do not attend mathematics period during mid-day.' (Shaun)

Alex and Shaun were determined to make a difference in their performance. They strongly believed that they could have done better if mathematics lessons were the first periods of the day, as mathematics needs focus and concentration. Thus, more lesson periods should be allocated in the timetable so to get enough time to practice. Alex further suggested that 2 hours per day could be sufficient for students to learn mathematics. Shaun also observed that midday mathematics lessons promote the students' absenteeism. Moreover, lecturers also become exhausted to present an appropriate lesson. Therefore, time allocation for mathematics lessons negatively impact students' performance.

4.2.4 Theme 4: Improving Students' mathematics performance

Students were also requested during interviews to suggest ways in which performance in mathematics may be improved. Responses indicated participants believe that the students, lecturers, college management and curriculum all have a collective role to play in improving mathematics performance. Some of the students' responses were:

4.2.4.1 Additional problem-solving exercises

The students indicated that working through examples and solving more mathematical problems could give them high levels of preparedness and confidence in mathematical problem-solving.

"I need to believe in myself to spend more time in practising mathematics and solve more difficult problems." (Alex)

Alex believes having confidence in oneself and sufficient time in practising and solving mathematical problems may improve performance.

> *'I have to love and think positively towards the subject. I must focus on understanding mathematical concepts so that I can be able to memorise formulas, regulations to complete many mathematical problems that includes change in world problems and also applying mathematics to real life. I must create the study timetable to practice more mathematics problems, attend extra classes and join a mathematics study group to master the subject.' (Penny)*

Penny unlike Alex believed that having a positive attitude towards mathematics would develop interest and motivation, adding that understanding mathematical concepts can assist in solving real-life problems when applying the relevant formula. Furthermore, applying mathematics in real life, drawing a personal study timetable, attending extra classes and joining study groups would help to improve performance in mathematics.

> *"To use more effective strategies, attend my lecture classes regularly, ask for help from my lecturer and peers. I have to use more different textbooks to strengthen my knowledge." (Shaun)*

Shaun believes that using more different textbooks, and learning strategies effectively would enhance his mathematical content knowledge. He also expressed the importance of constant engagement with his studies, classmates, and the lecturers as the methods that enhanced his performance.

> *'Focusing on understanding mathematical concepts, memorising formulas and rules to complete many mathematical problems. I should focus on solving extra problems, starting from easy questions to difficult problems as I become more comfortable with finding solutions. I should apply mathematics to real-life situations. I need to watch many videos to see how to articulate different questions, joining study groups and always be with students who share positive attitude towards mathematics to avoid negativity towards the subject. '(Judy)*

Judy shared similar views with Penny that understanding mathematical concepts, memorising formulas, and instructions to solve various mathematical problems could contribute to good performance. She further explained that solving simple to complex problems would help her feel relaxed and able to relate mathematics to real-life situations. Also, watching videos, joining study groups and peers with positive attitudes about the subject can enhance her interest and motivation towards mathematics.

The data shows that students believed that changing their approach in learning can improve their performance. Students agree that mathematics needs more time and to be practised daily to understand mathematical concepts, formulas, and different methods in solving problems. Furthermore, constant engagement with subject content, peers and lecturers; and watching videos, having extra classes, joining study groups, and solving mathematical problems related to real life, ranging from simple to complex could improve their performance.

4.2.4.2 Lecturers' use of diverse teaching strategies

Students believed that their lecturers could bring changes in their mathematics performance.

> *" If my lecturer should make use of different teaching strategies to explain mathematical concepts and solving problems, mathematics performance can improve. (Alex)*

> *"Lecturers need to use different teaching strategies to explore mathematics concepts." (Judy)*

Alex and Judy agree that if lecturers could use various teaching methods when teaching mathematics, students' performance could improve.

> *'Lecturers must have a link between new and previous mathematical concepts. Lecturers should also develop a positive attitude and build self-confidence, encouraging questioning and space for curiosity towards mathematics. The limits of using memorandum when marking, they should also consider other options of solving mathematics problems. Lecturers must also use visual learning because, it is the easiest way to recognise the sum.' (Penny)*

Penny assumed that lecturers' positive attitudes and motivation would enhance students' self-confidence and arouse interest in mathematics. Furthermore, she believed that lecturers should not restrict students to using a memorandum as marking guideline in mathematics, they should bear in mind that, different methods can be used to solve mathematical problems and produce the same results. Penny suggested that visual learning should be used in mathematics during teaching and learning to simplify other mathematical concepts.

> *'Lecturers should always be able to encourage and motivate students to study their work and continuously practice mathematics every day. Lecturers must be provided with the training to know and understand how to tackle the chapters so that the student will understand.'(Shaun)*

Shaun agreed with Penny that motivation and encouragement from their lecturers to study and practice mathematics regularly and lecturers' training workshops are paramount to developing teaching and learning in the classroom.

The Data shows that students believed that various teaching methods when teaching mathematics such as visual learning, lecturer motivation and encouragement to students and lecturer training workshops could contribute towards improving performance in mathematics. It could be inferred, that when lecturers are not trained with appropriate mathematical teaching strategies, they use their own teaching style, which could leave students feeling uncertain.

4.2.4.3 College management

All participants felt that college management could contribute towards improving mathematics performance.

> *'Management should employ more than one lecturer for the same subject and must work hand-in-hand so that they break down a subject in a way that students clearly understand. Mathematics lessons should be the first period in the morning in the timetable before students get tired' (Alex)*

Alex suggested that the college management team can employ more lecturers for mathematics to assist one another on different topics to improve subject performance. For example, one lecturer may teach paper 1 and another paper 2. He also added that mathematics lessons should be allocated for the morning sessions on the timetable before students become exhausted during the day.

‘The management must ensure that the lecturer and student receive the support necessary for lecturers and students to perform optimally in technical and vocational programs of mathematics. They should strengthen workplace integrated learning for both students and lecturers’ opportunities. Management should also increase the number of skilled lecturers and expand to access the education and training for the lecturer’. (Penny)

Penny recommended that college management should provide support to lecturers and students on teaching and learning to be implemented effectively, adding that the team should reinforce the relationship with companies in developing students and lecturers. She further suggested that more skilled lecturers must be employed and provided with the opportunity to develop their profession.

‘Mathematics classes should start early in the beginning of the year and the timetable designed where mathematics lessons will be early in the morning to accommodate syllabus completion. Management must decrease the load of the lecturers- the overloading of the lecturers leads to exhaustion of the students and lecturers and promote absenteeism of students in the mathematics lesson. For the effective implementation of mathematics, management must provide support of all necessary study materials to students and lecturers.’ (Shaun)

Shaun agrees with Alex that mathematics lessons must be allocated early in the morning, suggesting that mathematics lectures should start early at the beginning of the year to complete the syllabus. Furthermore, Alex agreed that decreasing the duty load of the lecturer will eliminate high rate of student absenteeism and lecturers’ tiredness in the classroom.

‘Management must provide lecturers with support, provide workshop for them to meet with others and share their experience about mathematics. Students and lecturers must be provided with the necessary supporting materials, equipment to perform better in mathematics.’ (Judy)

Judy asserted that college management should provide enough teaching and learning support to the lecturers through training workshops that will assist them in networking with other mathematics lecturers, thus improving performance in mathematics.

The Data shows that students believed the college management team can contribute towards improving their performance. They recommended that mathematics lessons be allocated in the mornings on the timetable to reduce student absenteeism. In addition, students suggested that employing more mathematics Level 4 lecturers within the campus, provision of lecturers' training workshops, provision of learner – teacher support material, collaboration with companies for work-based integration and commencement of mathematics teaching at the beginning of the academic year for syllabus completion would contribute towards improving performance in mathematics.

4.2.4.4 College curriculum development

Participants anticipated that the developments on the curriculum could enhance their performance.

> *'The geometry chapter which is for paper2 in mathematics and is added in Level4 program needs enough time as it needs the content background of the subject. Mathematics is given an hour period per day so we fail to finish the syllabus. Mathematics curriculum needs to be revised by adding the basics of all chapters that need to be covered in mathematics as a subject.' (Alex)*

'To perform better in mathematics Level 4, curriculum should include all chapters from the basic entry Level (L2) in TVET sector in order to acquire the basic knowledge of each chapter- not starting the new chapters in our exit level which is Level 4 without having the background of the chapter. This leads to the incompletion of the syllabus resulting in poor performance in mathematics. (Shaun)

Alex and Shaun shared similar explanations that in Level 4 mathematics, a new chapter which is geometry paper 2 is added. Students lack background basic content knowledge in this chapter. Furthermore, mathematics is given one hour per day which is five periods per week; this means that time is too limited for integration and syllabus completion. Therefore, students suggested that all mathematics chapters must have a basic content knowledge from their entry Level 2.

The data shows that both students (Alex and Shaun) unanimously agreed that the curriculum should include basic content chapters from Level 2 for students to acquire basic knowledge of the content as they progressed to different levels. They expressed that the time allocated to mathematics periods was not enough to complete the syllabus on time, since new chapters are added without having the basic knowledge at the entry level. Students suggested that the curriculum should be revised to include the basic knowledge of all chapters within the mathematics curriculum.

4.3 Lecturers' explanations

This section presents a summary of the telephonic semi-structured interviews conducted with the NCV Engineering mathematics lecturers. The lecturers reflected on what they discovered about students' mathematics performance based on their mathematics teaching experience. They were able to make conclusions on what they saw and believed.

4.3.1 Theme 1: Student performance in mathematics

Lecturers expressed their feelings about students' mathematics performance. One lecturer said:

> *"Well, I think performance in mathematics is starting to climb now, but it was very bad when I arrived in 2013- 2015." (Joel)*

Joel felt that mathematics performance was terrible during the years 2013 to 2015. However, after those years, he is convinced that mathematics performance was improving.

> *"NCV engineering level 4 mathematics performance leaves much to be desired in terms of students' participation in teaching and learning the day-to-day mathematics lecture room activities and examination results."(Sam)*

Sam views performance in mathematics as promising based on the students' participations during teaching and learning, activities done in the classroom, and improvement in examination results.

> *'To be honest, performance is not satisfactory if I can reflect over the previous years, mathematics was really achieved below 50% in overall performance. Only last year were improved at least above 50%. Mind you, mathematics is the only*

subject at NCV with a low pass mark which is 30% average, even those students who manage to pass mathematics, but most are below 50%, of which to me is not satisfactory.' (Zack)

Zack shared similar views with Joel that mathematics performance was poor during past years with a pass rate below 50%. The increase in pass rate above 50% last year shows performance improvement, although the mathematics pass percentage was low at 30%. The requirement is that most students should pass the subject with good marks; nevertheless, none of them was above 50%. The above excerpts provide evidence that the two lecturers believed that performance in mathematics in the past years was not satisfactory. However, at present, mathematics performance improves when the lecturer sees students' involvement in teaching and learning, classroom activities, and improvement in examination results. One of the lecturers expressed that mathematics average pass percentage is 30% which means that more students could pass mathematics but failed. Although those who managed to pass obtained marks below 40%. The above suggests there are areas in mathematics that need improvement during teaching and learning.

4.3.2 Theme 2: Factors affecting Students' performance in mathematics

Lecturers outlined different factors contributing to mathematics performance. The sub-themes: students' attitude towards mathematics, students' absenteeism, and mathematics content knowledge, emerged during interviews in response to the research question.

4.3.2.1 Students' attitudes towards mathematics

Lecturers explained that students' attitudes towards mathematics impact performance.

'To describe the attitude of students at the TVET College, I would say the students are willing to learn and are positive. But the fact is that they come with that negative attitude from high school level because generally, it is admitted that the majority of students who pass mathematics are with 30% average. So, the attitude that they come with to the college is that mathematics is difficult. Really, I will say generally, in previous years the result has not been good. They just started last year improving because of the promotion policy that says now, if you fail mathematics in Level 3, you cannot do the mathematics in level 4, then we started to see the results improve.' (Joel)

Joel holds the positive feelings about students, believing they have a positive attitude towards the subject and are willing to learn. However, Joel's observations indicate that students were affected by high school results which causes them to perceive that mathematics is a complex subject. Also, the lecturer pointed out that the Promotion policy introduced had a positive impact on last year's results. Justifying that if a student failed any subject in Level 3, they would not be allowed to register it at Level 4.

> *'I also believe that the attitude towards mathematics from students is growing very negatively. Unfortunately, this has come to this point because of the basic knowledge the student has towards mathematics. I have seen that most of the time students believe that mathematics is the subject for great thinkers, a subject for those who are smarter.'(Pat)*

Pat agrees with Joel's observation on students lack of basic knowledge, highlighting that students perceive mathematics as a difficult subject; however, pointing out that students' attitudes towards the subject develop negatively. Pat assumes that students measure mathematics according to ability and capability.

> *'The attitude is positive, although there are some factors that impacted negatively on their performance, if you look at the results of NCV in the year 2004 in the first level 4 mathematics paper, which was written in 2007, 2008, 2009. Look at the results of mathematics from there; the performance was very poor not only in this college, but it appears to be a national problem which I think is a crisis now.' (Sam)*

Sam shares a similar view with Joel on students' attitudes towards mathematics, admitting some factors affect students' performance negatively based on trends from the previous year's performance. Sam claims performance is a national concern in TVET colleges.

He further alluded that:

> *'Lack of interest in the subject is one of the reasons accompanied by the over-reliance on technology. For example, if a lecturer asks a question such as 3-10 =? to find the answer, the majority of students turn to use the calculator; for a Level 4 student to be saved by a calculator to find -7 is unbelievable. Students*

have a culture and the belief that mathematics is a difficult subject which leads to discouragement towards mathematics.' (Sam)

Sam observed that students depend on technology to perform basic math operations (arithmetic) and believe that mathematics is a complex subject resulting in a lack of interest in the subject.

I think most of the students have this negative attitude towards mathematics because most of them have the ideology that mathematics is a difficult subject from secondary school. They think that mathematics is for those who are capable or clever. (Zack)

Like Pat, Zack expressed that students had negative attitudes towards mathematics because of the psychological belief that mathematics is challenging, labelling it a subject for capable people.

Data shows that students' attitudes towards mathematics affect performance, including students' lack of interest in mathematics because of a lack of basic knowledge from secondary school level, the perception that mathematics is a challenging subject fit for clever people and reliance on technology for problem-solving.

4.3.2.2 Lack of content knowledge in mathematics

Lecturers pointed out that mathematics content knowledge is a contributing factor to poor performance in mathematics. Lecturers responded as follows:

'In Level 4, there are some certain topics that are added, like geometry, of which the student has last done the chapter five years back. Most of the time, students who enrol at TVET colleges start by staying at home for at least two to three years after matric before they register to TVET college; now, we add another two years for Level 2 and Level 3 that is five years. Then we started at Level 4 to introduce geometry to them; to them, it is something new, then it is done.' (Joel)

Joel expressed that introducing geometry topics in Level 4 to students lacking a solid basic foundation in mathematics concepts and the time that students last engaged with these are possible reasons for poor performance in mathematics. He further elaborated that TVET colleges enrol students who passed Grade 9. However, recalling foundational Grade 9 mathematics may be challenging for students who dropped out of high school after only completing three years of study; they may not have been exposed to some of the concepts at the secondary school level.

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He added:

> *Definitely, it confuses them they should have been starting with all the topics at Level 2 because Level 2 is equivalent to Grade 10, they should have started with geometry and carried on with it up to Level 4, but now they skip Level 2 and 3. in Level 4 it is where these chapters are introduced, which is why it becomes problematic. (Joel)*

Joel further expresses that students become confused when new topics are added at their exit level. Therefore, topics should be introduced at the entry level since Level 2 is a basic foundation phase in TVET college equivalent to Grade 10 in secondary school.

> *'The syllabus, more especially in mathematics as a subject in TVET college, lacks continuity, as my colleague mentioned. You find that Level 2 and Level 3 do not have Euclidean geometry at all. What they have instead of Euclidean geometry is Mensuration, covering areas of geometric figures. Then the third year of TVET college, that is, Level 4, students encounter Euclidean geometry for the first time. In Level 2 and 3, they should cover basics theorems like triangles, parallel lines and parallelograms, to mention a few.'(Sam)*

Sam and Joel agree that mathematics content lacks continuity. Sam points out the chapters not introduced at Level 2 and 3, which are equally important as the basic mathematical concepts in level 4 should be introduced. For example, basic theorems should be introduced as the foundation for geometry in Level 2.

He further added*:*

> *However, they are expected to apply basic theorems at Level 4, yet they are nowhere with the syllabus. Thus, the lecturer should start with the basics theorems to accommodate them in a short period of time. This leads to the frustration of incompletion of the syllabus, the students perform badly in geometry that affects the whole mathematics performance. (Sam)*

Sam expressed that lecturers did not complete the syllabus because they had to cover topics that were supposed to be completed in Level 2 and 3 in a short period, hence the incompletion of the syllabus. It appears that students are expected to apply basic concepts at Level 4 but have a poor background knowledge in these concepts, which impacts negatively on performance.

Data shows that lecturers revealed their frustrations with introducing more complex subject content at the exit level. They expressed that students struggled with mathematics in Grade 9, and are expected to learn new mathematical concepts at Level 4 without adequately understanding content from Level 2 and 3. As a result, it impacts student performance negatively. Therefore, lecturers must work harder to ensure students understand mathematics content since their performance reflects the lecturer's ability to deliver content knowledge. Also, lecturers need more time to teach mathematics content and students time to grasp and integrate the knowledge.

4.3.2.3 Student absenteeism

Lecturers expressed that student absenteeism often resulted in students failing to cope with their studies.

> *'Poor attendance of students at the college level is very high, especially in Level 4; their attendance is unlike when they were in Level 2 and Level 3. They were eager to learn by that time, but in Level 4, they think they are seniors. They just attend when they like to.'* (Joel)

Joel complained about the high rate of student absenteeism at college. He compared students class attendance rate in Level 2 and 3 to that in Level 4, where the rate of absenteeism is higher.

> *'Students high rate of absenteeism leads to misdirection and can be lost in progression of the curriculum and work program planned. Mathematics is a subject which builds on itself and missing one or two lectures in one unit dismantles everything a student needs to gain (understanding insight into the learning material).'* (Sam)

Sam affirmed that the high rate of student absenteeism impacts performance negatively. He further explained that mathematics is a subject that develops independently; therefore, when students miss one lesson, they could fail to integrate the content. Thus, students are unable to use and integrate learnt mathematical concepts into new learning experiences.

The data above shows that two lecturers (Joel and Sam) attribute the students' inappropriate behaviour to their poor performance in the subject. Lecturers find it challenging to complete the syllabus on time because daily lessons are interrupted due to student absenteeism, consequently impacting performance. In addition, lecturers alluded that if students miss one or two lessons in mathematics it creates a gap in their learning.

4.3.3 Theme 3: Challenges in improving Students' performance in mathematics

The lecturers' responses revealed they face some challenges in improving mathematics performance. The lecturers outlined these as: quality of students enrolled, lack of training workshops and supporting materials, time allocation, and students' progression.

4.3.3.1 Student enrolment criteria

Some lecturers expressed that the criteria used when students are enrolled in the NCV programme impacts mathematics performance.

> *'The entry requirement minimum is Grade 9; this does not mean that Grades 10,11, and 12 are not enrolled in the TVET college. This means that some students enrolled in the college have a poor background in mathematics; this leads to poor performance in the subject'. (Zack)*

Zack indicated that the TVET college entry requirement for NCV Level 2, which is minimum Grade 9, also applies to students who passed Grade 10, 11 and 12 to enrol in this programme; this creates a diverse classroom with some lacking basic mathematical concept knowledge.

> *'At TVET College, since the year 2017, the entry requirement during the NCV program starting phase was said to be at least Grade 9, and this has not been changed. The Level 2, 3 and 4 mathematics syllabus content is too heavy for a learner from Grade 9. A student with a mathematics Level 4 class who has not at all done some of the things covered in Grade 10 and 11 class is unimaginable. Finding a student fresh from Grade 9(ufestiya) encounters mathematical concepts*

such as complex numbers and differentiation in Level 4, which is equivalent to a Grade 12 learner. '(Sam)

Sam clarified that when TVET colleges implement the NCV program, the entry-level was Grade 9 to date. He expressed that the mathematics content of the Level 4 programme is not easy for a student who obtained grade 9 results, implying that the student would encounter new mathematical concepts in Level 4.
He further elaborated:

> *'NCV Level 4 qualification is equivalent to Grade 12, that is matric in terms of the National Qualification Framework NQF. Therefore, taking a learner from Grade 9 straight to the TVET college is equivalent to destroying the future of that learner because he or she is likely to get to mathematics Level 4 with a poor background.' (Sam)*

Sam further expressed that the student who obtained Grade 9 and enrolled at TVET college is likely to perform poorly in Level 4, equivalent to Grade 12, because the student lacks basic mathematical concept knowledge.

> *'I agree with Sam when saying that the intake in Level 2 is not of high quality. Some students sometimes had obtained 20% in mathematics at high school Level; already they are demoralised. The Level 4 mathematics content changed; it almost becomes Grade 12 mathematics. Therefore, a Grade 9 learner will not be able to cope since the geometry is introduced at their exit Level 4.' (Joel)*

Joel shared a similar view with Sam that some students enrolled in Level 2 did not pass mathematics at their basic school level. Thus, mathematics content knowledge becomes extensive and complex for students who did not study or pass Grade 12. Moreover, geometry topics are introduced at Level 4, making it difficult for these students to cope.

The data shows that three lecturers (Zack, Sam, and Joel) expressed the poor quality of students enrolled in the TVET college. Lecturers encounter students with varying academic backgrounds within the same class, which affects the mathematics performance. Moreover, the lecturers admitted that the minimum entry requirement is Grade 9 which is entry Level 2; that is equivalent to Grade 10 in a TVET college. However, Euclidian geometry is introduced in level 4, making it difficult for students to cope since they lack basic knowledge in mathematics. The data implies that without relevant previous knowledge, Level 2 and 3 mathematics lecturers would have to teach topics from the basics, which may be challenging for the lecturer due to time constrains in completing the syllabus.

4.3.3.2 Lack of training workshops

Some lecturers revealed that the shortage of training workshops affected mathematics performance. Their responses exhibit their perceptions of how training will assist them.

'Since three previous years not teaching mathematics in the college, I need to be trained and developed with the present curriculum in mathematics, but only to find that no training workshops to the lecturers are organised to provide newly and updated information to develop our students. That is why the performance in mathematics is not impressive.' (Zack)

> *'Since I was employed in year 2013, I have never seen a single lecturer being taken for mathematics symposium and attend training workshops. It was only early last year (2019), there was one session. Besides, in each and every subject, lecturers need to be exposed to new methodologies. During the subject meetings no information is discussed pertaining the sharing of the subject content in mathematics, solving problems, and different teaching methods. Instead we just share information and issues we encountered from the department.' (Joel)*

Two lecturers (Zack and Joel) unanimously confirmed that since they were employed at the TVET College there were no training workshops arranged apart from the session arranged in early February 2019. Thus, Lecturers emphasise the need to learn from one another on how to approach certain mathematical concepts in the syllabus. They believed that training workshops could help in addressing some of the gaps that exist in the department. However, Joel proclaimed that all lecturers must be developed in all subjects offered by the college, advocating that subject meetings provide an opportunity in sharing subject content knowledge; for example, different approaches used in mathematics problem solving. Therefore, it could be concluded that lecturers assume training is an essential factor which can improve mathematics performance.

The above excerpts indicate that lecturers are not adequately equipped with required skills to deliver mathematics content knowledge effectively. Therefore, they should be exposed to professional training workshops for their professional development to be up to date with the current trends in higher education.

4.3.3.3 Time allocation

Lecturers attributed poor performance to time allocation of mathematics on the timetable as an external but unstable factor.

> *'Timing of mathematics lesson periods- Mathematics periods should be early in the morning while students are still fresh. So you find that most mathematics lessons are taken after lunch when most students are tired, and others have already left the campus. If the students find that the subject is difficult, they don't want to attend to that subject, they would rather attend an easier subject such as Orientation or English.' (Joel)*

Joel was concerned about the time frame of mathematics lessons. He believed that mathematics performance would improve if the composite timetable displays mathematics lessons early in the morning. Hence, most of the students' attendance is higher. He further expressed that most mathematics lessons are allocated during midday when most students are exhausted and probably out of campus. Joel observed that some students did not attend mathematics because they perceived it as a difficult subject, and preferred to attend the easier subjects.

> *"contact time between lecturers and students, mathematics requires more time, to give enough information to the student; at least double periods each day is enough". (Pat)*

Pat shares a different view from Joel and stated that mathematics needs extra time for the lecturer to impart more knowledge to students, recommending that two hours each day for a mathematics lesson would be adequate for face-to-face contact with the students.

> *'Even though the time allocation for mathematics lessons is insufficient, and most of the lessons allocated after lunch, most of the students are not attending the*

mathematics lessons. They are already out of the campus; thus, extra lessons in mathematics would be of no benefit.' (Zack)

Zack, like Joel, believes the time allocated for mathematics lessons is inadequate, justifying that extra lessons at midday would not be of assistance because most of the students are usually out of the campus.

The above excerpts show that performance in mathematics is attributed to insufficient time allocated to mathematics. Thus, most students were unable to attend mathematics lessons because of time constraints. One of the lecturers suggested 2 hours per day would be adequate for students to gain knowledge and understanding of mathematics.

4.3.3.4 Lack of supporting materials

The lecturers also attributed poor performance to inadequate supporting materials to assist with academic teaching and learning in mathematics.

> *'The campus does not have enough supporting material in the mathematics laboratory and classrooms such as computer, printers, and HP (Hewlett-Packard tools that can help teaching and learning be implemented effectively. In Previous years, we used to have tutor software programme (learnscape) that supported teaching and learning in mathematics. At present, the campus failed to renew the learnscape contract.' (Joel)*

Joel pointed out that they had mathematics classrooms, although there were insufficient teaching and learning resources that can assist lecturers to implement the curriculum effectively. He elaborated that they use a mathematics programme (learnscape) to support their teaching and learning, although the college failed to renew the programme contract with the service provider.

> *"We need supporting materials and technology that are in line with the curriculum like prescribed books, study guides, and videos to clarify problems in mathematics." (Pat)*

Pat reinforced that lecturers need teaching and learning support materials that correspond with the curriculum and present technology to help them explain mathematical concepts clearly.

'As NCV lecturers of mathematics in a campus we experience problem of sharing one class with Report 191 programme, so even the little supporting material we have become lost and disappear since there is no control over it, it is exposed to everyone who enters and leave the class.' (Sam).

Sam agrees with Pat that there is a lack of supporting material, admitting that a lack of management, sharing the classroom with other programmes and lack of accountability lead to loss of the available supporting material available. This implies that the provision of a mathematics laboratory for students, may eliminate the loss of teaching and learning support materials.

'I agree with Pat on lack of resources in the campus; it is very important because we are living in the world of technology nowadays. Teaching and learning is not all about the contact time between students and the lecturers. The use of the tutor software programme can assist students as they can view the programme on their own time to see the depth and understanding of mathematics.' (Zack)

Zack, like Joel and Pat, agrees there is insufficient teaching and learning materials in the college campus, highlighting the importance of learner-teacher support material (LTSM) as technology changes. He recommended that the students should use the *learnscape* programme to develop their understanding.

The above excerpts show that mathematics performance is affected due to insufficient supporting materials for teaching and learning. Thus, lecturers agree that the availability of the learner-teacher support material (LTSM) that correspond with the curriculum could assist students in the acquisition of different chapters in mathematics. Furthermore, the availability of the *learnscape* programme would provide students with some independence in learning rather than relying on lecturers to teach them, which can improve their performance in mathematics. Also, providing a mathematics laboratory will allow the upgrading of the *learnscape* programme and elimination of loss of LTSM.

4.3.3.5 Students' progress

Lecturers felt that students' progression to the next levels negatively impacts performance in mathematics.

“As from 2009 to 2017 mathematics Level 4 performance was very bad rated between 20% and 40%. As from 2018 results started to improve because of the Promotion policy implemented in 2017.” (Sam)

Sam explained that mathematics performance was poor from 2009 to 2017. He further elaborated that a promotion policy was implemented in 2018 at Level 4, which improved the performance.

“We started to see the improvement of Level 4 mathematics result just last year because of the new College Promotion policy that was implemented that says, if a student failed mathematics in Level ,3 he or she cannot do the mathematics in Level 4.” (Joel)

Joel shared a similar notion with Sam that there is an improvement because of the new college promotional policy; adding that before the policy was implemented, students failed the subject in Level 2 or in both Levels 2 and 3, and even the next Level.

The excerpts highlight that students’ progression from one level to the next, especially for those who performed poorly, affected the overall performance in mathematics. Thus, the implementation of the promotion policy improved mathematics performance. In addition, Promotional policy on minimum requirements and progression requirements to the next level appears to set a high standard; students, enter the next level of mathematics prepared and with a sturdy base in mathematical concepts. This may have contributed towards students’ good performance.

4.3.4 Theme 4: Improving mathematics performance

This section outlines various aspects that lecturers conceptualised as attributions to success in improving performance in mathematics. Participants suggested student engagement, change in attitude towards mathematics, college management and curriculum revision as ways of improving mathematics performance.

4.3.4.1 Student Engagement

Lecturers expressed how students could improve their performance in mathematics.

“Students must practice mathematics daily; they should be engaged in group discussions.” (Joel)

> *"Student should adhere to at least 80% class attendance requirement provided by the admission requirements for national examinations policy stipulated by Public Further Education and Training, do homework, participate in class activities, and avoid over reliance on calculators." (Sam)*

Two lecturers (Joel and Sam) agreed that students should engage in class activities such as group discussions and practice mathematics daily, adhere to 80% class attendance requirements and only use of the calculator where unnecessary, encouraging independent thinking.

4.3.4.2 Change in Attitude towards Mathematics

Lecturers believed their change in attitude towards students can enhance students' performance in mathematics.

> *'We have to change attitude towards students to show that mathematics is practical and easy as long as you give it time to practice. Lecturers should demonstrate that mathematics that students are studying is relevant and to be used in industries in a practical way; Motivate students and instil the love of mathematics by solving problems related to their field of study. For example, in politics they use statistics as mathematics.' (Joel)*

Joel believed that students' motivation towards mathematics can be enhanced by giving them practical mathematical problems related to their field of study in the outside world and encouraging students to practice mathematics often.

> *'Motivating the students timeously can help students to improve their performance in mathematics. Lecturers also must upgrade their understanding of knowledge through the training workshops. Through networking with other campuses, lecturers from the different campuses help each other through team teaching within the campus where lecturers can share mathematics sections that can also assist in improving our performance in mathematics'. (Zack)*

Zack agrees with Joel that students' motivation towards mathematics is vital and can impact their performance positively. However, lecturers training workshops, networking with other campuses and team teaching could build a strong foundation of mathematics subject content and also improve students' performance.

> *"Mathematics lecturers lack resourcefulness due to insufficient training workshops. Mathematics professional bodies can assist if lecturers are given a chance to join their memberships." (Sam).*

Sam advocated that Mathematics Professional bodies should provide the necessary support to lecturers with all the resources required in mathematics at TVET college.

Data shows that lecturers can contribute positively to improve mathematics performances by motivating students often, providing students with mathematical problems related to their field of study to develop subject interest and encouraging daily practice in mathematics. Moreover, networking and team teaching, applying content knowledge obtained from training workshops and collaborating with the mathematics professional body for support in teaching resources and strategies may improve student performance in mathematics.

4.3.4.3 College management

Lecturers expressed how the college management team can contribute towards improving students' performance in mathematics.

> *'College management should provide the (learnscape) tutor software program and upgrade it, this can contribute to both students and lecturers in some chapters that are not clearly understood. They should provide enough time and access for students to view on their own; this can improve their interest and motivation towards mathematics.' (Sam)*

Sam pointed out that the college management team should upgrade the tutor software programme, and provide adequate time and access for students to log in to enhance their interest and motivation towards mathematics, and develop students' understanding in mathematical concepts. Tutor-software programme is an interactive computer software program created as learning tool that help students learn new skills by using step-by step process in mathematics problem solving.

'Overloaded as a lecturer- teaching mathematics and other three vocational engineering subjects which also need practise, needs to spend a lot of time on it. I think the college management should consider the lecturers' subject specialisations within the department.' (Joel)

' I believe that the head of Engineering department should provide support and input towards the subject, since the person is a departmental specialist. The head of the department must see to it that all lecturers' duties must be allocated according to the curriculum, irrespective of the specialisation in a subject. '(Zack)

Joel and Zack unanimously agreed that the head of department should provide support to students and lecturers to implementing the mathematics programme effectively. However, lecturers' duties should be allocated based on the subject specialisation considering that mathematics and vocational subjects need sufficient time for students to be practically exposed. Thus, allocation of the lecturer's duty- load should take in to consideration that lecturer is an expert of the subject in terms of the subject content knowledge.

Data shows that lecturers suggest the college management team contribute towards improving performance in mathematics through providing support in the implementation of the subject, allocation of lecturers' duties based on subject specialisation and also considering that mathematics and vocational subjects need adequate time for students' acquisition of knowledge. In addition, the college management team should upgrade and renew the contract of the tutor software programme yearly, and provide access to students for viewing mathematical concepts on their own time to enhance their interest and motivation towards mathematics.

4.3.4.4 College Curriculum Revision

Some lecturers believed that revising the curriculum may contribute towards improving students' performance in mathematics.

"As we are guided by the curriculum (subject guidelines), the curriculum should be revised in terms of the time stipulated for each subject." (Zack)

Zack suggested that since the curriculum is the prescribed document for teaching and learning, the curriculum specialist should revisit and review time allocation for each subject.

> *' I think the subject curriculum specialist must shape the curriculum to be aligned with the technology of today. The whole system around us is changing. The way of doing things is changing but curriculum is still the same. I believe that developing the curriculum will find better solutions for students to do better in mathematics.' (Pat)*

Pat expressed that the world today is dynamic and constantly changes, so the curriculum should be developed in alignment with the current technology to improve students' performance in mathematics.

> *'In TVET sector we are conducting 7 assessments tasks in mathematics, more time wasted on marking rather than exploring with students in problem solving. I think if the curriculum specialist should revise the number of assessment tasks.' (Joel)*

Joel expressed that adequate time should be spent on marking the assessment tasks than teaching students and that curriculum specialists should revise the number of assessment tasks in the mathematics curriculum.

The data shows that performance in mathematics can be improved when curriculum developers reduce the number of written assessment tasks, aligning the curriculum with the current technology, and reviewing the time allocation for mathematics to provide adequate time for teaching and learning.

4.4 Differences and similarities in students and lecturers' explanations for performance in mathematics?

This section presents the differences and similarities in the participants' narratives of performance in mathematics. The differences are based on explanations by either lecturers or students but not both groups; though, it does not necessarily mean that the two groups of participants disagree with them. Lastly, the similarities presented are the explanations shared by both groups.

Students agreed that their irresponsibility, lack of motivation, and the need for different teaching strategies for problem-solving impacted their mathematics performance significantly. Meanwhile, lecturers indicated that the quality of students enrolled (Minimum entry requirement of Grade 9) determines performance in mathematics- it leaves room for students who passed Grades 10, 11 and 12 to enrol for the NCV programme. As a result, lecturers have students with different mathematical backgrounds in one class, making it challenging to prepare for such a class.

In addition, lecturers mentioned mathematics content knowledge, students' progression, lack of training workshops for lecturers' professional development and students' lack of motivation towards mathematics as factors impacting performance.

On the other hand, all participants agreed that high levels of absenteeism from both students and lecturers, attitude towards mathematics, a lack of adequate time allocation and supporting teaching and learning materials impact performance in mathematics significantly. In addition, they agreed that cooperative and collaborative efforts from lecturers, students, college management team and college curriculum developers to consider and revise the curriculum provide possible avenues of improving performance in mathematics at the TVET college.

4.5 Summary

This chapter presented the data that emerged from the semi-structured interviews and focus group discussion of eight NCV Engineering lecturers and students' explanations for performance in mathematics. The lecturers and students' explanations were collected through semi-structured interviews and focus group discussions and the data analysed for themes. The data was presented under themes including poor performance, factors affecting performance in mathematics, the challenges faced in improving mathematics performance, and how performance can be improved.

The next chapter discusses the findings on the Engineering lecturers and students' explanations for performance in mathematics, recommendations and a conclusion to the study.

CHAPTER 5

FINDINGS, RECOMMENDATIONS, AND CONCLUSION

5.1 Introduction

The previous chapter presented an analysis of data gathered from semi-structured interviews with eight participants (four Engineering lecturers and four NCV level 4 students). In this chapter, a discussion of the findings, implications of the research, recommendations, future research and conclusion of the study is provided.

5.2 Discussion of findings

The findings of this study are presented in relation to Weiner's Attribution theory and literature reviewed in chapter 2. The findings are organised thematically to demonstrate the TVET College Engineering lecturers and students' explanations for performance in mathematics. There were four findings that emerged from the analysis of explanations given for performance in mathematics: Poor performance in mathematics, factors linked to poor performance, challenges in improving mathematics performance and improving students' performance in mathematics.

5.2.1 Theme 1: Poor performance in mathematics

The findings of this study reveal that students relate their poor performance to external factors such as insufficient time spent in teaching and learning and poor background in basic mathematics from their previous school. Ushie et al. (2012) highlight that the degrees of complexity of the students' background could influence, for example, their ability to deal with academic language and engage with the content. For instance, students from a less sophisticated background may encounter difficulty in effectively applying skills and the language of academia. Conley (2003) viewed that students who mistake tertiary requirements as equal to secondary school demands are often unsuccessful due to failure in necessary psychological and cognitive shifts.

Furthermore, the data indicates that insufficient time is spent teaching students with poor background schooling; therefore, they require more teaching at the tertiary level; this creates a burden on tertiary institutions to make up for the weaknesses in the basic education sector.

According to Kilpatrick et al. (2001), mathematical proficiency relies on teaching the subject using the proper methodology.

It includes conceptual understanding (logic-mathematical knowledge) and procedural fluency ('knowing how' that will coherently develop within the learner). In addition, introducing and discussing the basic concepts of the section before teaching could positively impact delivery in mathematics content and develop strong mathematics content knowledge and a rich conceptual understanding of mathematical pedagogy.

Students have a similar dependence, that a lecturer must teach everything instead of the learner initiating their learning. According to Kalenga and Samukelisiwe (2015), first-year students expect their lecturers to be as vigilant as their high school teachers and principals. Within Attribution Theory (Weiner, 1985), the students connect poor performance to an external object, like lack of teaching commitment and basic practical subject skills. It seems the school environment contributes to student's under-preparedness for higher education.

The research from this study has shown that the Level 2 and Level 3 mathematics curriculum at TVET Colleges is more aligned to the school curriculum for grades 10 and 11. According to Tshabalala and Ncube (2014), teachers struggled to cope with students who had weak foundations in "difficult" subjects like mathematics and science since teaching begins in primary schools. Thus, concepts in these subjects should be well-grounded from learners' formative cognitive stages and developed at higher learning institutions. Education at the primary school level should be the foundation for higher knowledge in secondary and tertiary institutions (Bourne, 2019). The National Policy on Education (2004) stipulated that secondary education is an instrument for national development that fosters the worth and development of the individual for further education and development. Hence, Level 3 students are expected to perform better since they are familiar with mathematical concepts from the school curriculum. Gewer (2013) stated that pre-grade 12 learners usually strive to cope with the curriculum requirements.

Based on the findings of this study, most students attending enrolled with a poor basic background in mathematics.

Woods et al. (1976) stated that mathematical concepts and their procedures demand that lecturers structure their teaching and learning processes in ways that will "scaffold" students' understanding and development of mathematical ideas from the point of dependence to that of independence, (p.90).

This statement confirms the Attribution theory, which asserts that when students receive poor performance results, they start to perceive the causes of the negative outcome and tend to attribute their failure to external factors such as task difficulty and luck (Schunk, 2008; Weiner, 2000, 1985). Mathematics is an abstract subject; therefore, to make it exciting and easy to comprehend, Noddings (2013) suggests that teachers should create an environment that suits the learners' needs and which does not kill their enjoyment of the subject.

Attribution theory is grounded on the assumption that lecturers and students want to explain the events or outcomes in their lives, including what happens within academic settings (Weiner, 1983). The findings of this study indicate some lecturers revealed that performance in mathematics has improved compared to past years. However, they argue although mathematics minimum pass rate is 30%, most students pass rate ranges along the minimum pass rate, which suggests that there are areas in the mathematics curriculum that need improvement at the TVET College.

5.2.2 Theme 2: Factors linked to poor performance

The study's findings revealed both students and lecturers shared some factors that could be linked to poor performance in mathematics. The Attribution theoretical framework by Weiner (1970) makes provisions for this point of analysis because it holds that a process of attribution is involved with how individuals interpret a particular situation and its relation to their experiences and behaviour, that is, lecturers and students realize factors that contributed to the performance in mathematics.

5.2.2.1. Self-blame

This study finds that student self-blame correlates with the internal attributions theoretical category of students' self-irresponsibility and self-awareness. Thus, even though students knew they need to practice mathematics to improve their performance, they do not because of their ignorance and negligence, resulting in poor performance. There is also a contradiction where the students blame the lecturers for their own negligence. Alex mentioned that he was not given much tasks to practice in mathematics, not even research in chapters that he did not fully understand to master the content.

Penny revealed that mathematics is not an easy subject but admitted she pays less attention to the subject. In addition, the participant pointed out that mathematics needs students to invest more time, dedication, and self-esteem to perform better. Similarly, Mijs (2016) discovered that students involved in vocational education are most likely to take the blame for their poor performance in mathematics. However, Thompson and Geren (2002) suggest that students who fail to take responsibility may show signs such as absenteeism from lectures and failure to meet deadlines for submissions.

All students who participated attributed their failure to the insufficient effort they exerted in the study of mathematics. As a result, they realised that attention should no longer be expected from the lecturer, but they should make an effort to do better. Booth-Butterfield (1996) perceived that internal attributions lead to feelings of confidence, meaning effort is related to unstable internal attributions, which advocates that if students can invest more effort in improving strategies, they can perform better. Moreover, since Mathematics is an abstract subject, solving simple to more complex problems needs to be practised daily. These findings concur with the findings of Ali and Jameel (2016), who highlight that lack of practice and provision of sufficient exercises are at the centre of the reasons affecting mathematics achievement.

Students cannot perform exceptionally in mathematics if they lack interest in the subject. Lack of practice can indeed lead to poor achievement. When students attempt practical assessment tasks, they realise that mathematics is an interesting subject and present in almost every activity (Madimabe et al., 2020). According to Hashim (2012) and Wilder (2014), the interest which arises in a student will affect the learning process. Thus, engagements in teaching and learning are necessary to ensure that a student is interested. The above statement is consistent with studies by Cheng (2014) and Stupple (2017), who highlight that students' interest in learning will encourage them to think critically.

It appears that in the TVET College research site, students are stereotyped because they are used to being taught by one mathematics lecturer with the same teaching style and method of assessment. While students probably base this on their former school, which allows the same teacher to teach mathematics in grades 11 and 12 for purposes of continuation and consistency, at the TVET College, mathematics lecturers change at different levels. Thus, students fail to adapt to new lecturers, their teaching styles, and their assessment methods, which leads to poor performance. Students usually compare lecturers and may also develop a negative attitude towards some. They expect new lecturers to present a lesson precisely the same way as the previous lecturer.

Furthermore, there is a discrepancy in expectations between secondary school and TVET College regarding responsibility, teaching style, academics, discipline, conduct, and maturity, all of which come as a culture shock to students in higher institutions. The previous statement aligns with Quinn et al.'s (2002) suggestion that students experience an academic culture shock as they transition from school to higher education. Some students enter higher education lacking basic skills, fail to adjust to the unfamiliar approaches to teaching and learning, struggle with aspects of the academic discipline, fail assessments, and feel unable to ask staff or peers for help (Yorke & Longden, 2008). This resonates with how students cannot adapt to new lecturers, different teaching styles, and new pedagogies.

According to Martinez and Klopott (2003), the intensity of the school curriculum, the quality of academic experience, and teaching and learning style all directly impact a student's readiness for higher education, which affects almost every aspect of success in post-secondary education. Similar findings by Vakalisa (2008) showed that students who receive poor quality schooling tend to lack academic skills such as study skills and time management demanded by higher education.

5.2.2.2 Attitudes towards mathematics

The current study's findings show that most student participants attribute excellent performance to lecturers' positive attitudes towards mathematics, which create motivation and interest towards the subject.

Lecturers enhanced students' motivation, self-confidence, and interest by emphasising self-dedication in practising mathematics daily; assisting students in solving mathematical problems related to real-life situations; using various teaching methods, including tutorials and audio-visual lessons. Thus, the attitude of lecturers towards students and the teaching and learning process is paramount to students' academic performance (Puyate, 2012). Gallagher (2013) affirmed this assertion by positing that positive lecturer-student relationships enable students to feel safe and secure in their learning environments and provide scaffolding for critical academic skills.

Findings also reveal that one participant (Shaun) had negative attitudes towards mathematics, attributing poor performance to assessment tasks given by the lecturer with unfamiliar content. Thus, Shaun felt incapable of understanding mathematics, which developed a negative belief that ultimately resulted in low self-confidence that may cause

Shaun to give up on mathematics at the TVET College. These findings align with Kelley and Michela's (1980, p.469), highlighting "unexpected task outcomes are attributed less to ability". The above finding is also consistent with Weiner's (1986) Attribution theory that states students who believe failure is due to uncontrollable causes such as lack of ability are more likely to experience shame. Higgins and LaPointe (2012) believe that desire to quit indicates a loss of self-confidence in handling pressure and a lack of persistent behaviour. Some respondents indicated a lack of time in completing exercises to solve some mathematics problems. The current study shows that understanding can be conceptual, functional, procedural, and disciplinary in Engineering mathematics learning.

Furthermore, the current study's findings reveal that lecturers who teach mathematics change annually, which brings misunderstanding and confusion as students fail to adapt to the teaching style of the new lecturer. As a result, they believe the previous mathematics lecturer is comparatively better than the new one. The findings further reveal that participant lecturers agree that students' positive attitude towards mathematics changes and is affected by culture.

The findings reveal that students usually view Mathematics as a complex subject and believe they are incapable of passing even if an effort is exerted. Reyes et al. (2005) believe that some students attribute their failure in Mathematics to opinions about the difficulty of the subject, especially if it is common among other students. However, Dube (2016) challenges the assumption that mathematics is difficult, highlighting that students' potential is often taken for granted.

Similarly, in their study, Tshabalala and Ncube (2016) observed that most students believe that Mathematics is naturally a difficult subject, which means that they fear the subject. They further discovered that students' attributions become beliefs and affect actions. Their belief that more effort was consumed does not indicate the best possible approach was utilised. Thus, in the current study, participants who believed they were incapable (Shaun, Judy, and Alex) found more appropriate and alternative means of continuing and improving their performance.

Another finding revealed that students lack interest in Mathematics because they depend on current technology; they fail to solve problems without a calculator. According to Sarwadi and Shahrill (2014), "lecturers assume that students know fundamental and straightforward concepts such as addition and subtraction because such were taught at primary level" (p.8). Thus, students are reluctant to use their cognitive thinking when calculating mathematics and are likely to give up without a calculator.

5.2.2.3. Absenteeism

The current study's findings show that the college environment operates differently in supervising and instilling discipline in students. Colleges are not as strict as schools, where students are under the watchful eye of a teacher. In TVET colleges, students are not reprimanded for late coming, absenteeism, and not doing homework.

The finding is in line with Garisch's (2007), which indicates that a larger percentage of the type of students the modern TVET College unintendedly attracts is immature, irresponsible, unmotivated, difficult, demanding, disruptive in the classroom, and mostly lacking in concentration.

Moreover, absenteeism is one of the significant challenges encountered in the NCV programme, according to student and lecturer participants from the current study. The finding parallels Garisch's (2007), which showed that present-day TVET college students are very young and lack discipline, resulting in very high absenteeism and late arrival for classes, putting an emotional burden on lecturers. Reche et al. (2012, p.131-132) also mention that students in Kenya perform poorly due to absenteeism. Absenteeism creates a demotivating classroom environment that causes students who attend class to become demotivated (Segal, 2008). According to a study conducted by Geda (2016, p.46) at TVET Colleges in Oromia, Ethiopia, the students were continuously absent from classes, and some attended classes very late.

In the current study, lecturers and students were not classroom-based. Students used different venues to attend their lectures. Due to the large number of students enrolled, there were inadequate classrooms allocated to the mathematics department. Thus, lecturers and students did not have fixed mathematics classrooms. Both participant lecturers and students in this study confirmed that poor attendance and insufficient classrooms on the campus significantly impact students' mathematics performance. Furthermore, they believed that missing one lecture would affect the understanding and continuity of the mathematics content program.

In line with the research findings, a study conducted by Moore (2006) revealed that students who did not attend lectures were likely to answer questions incorrectly to concepts taught during their absence. Otto's (2016) research indicated that lecturers experienced hardships in continuing with a new topic because they had to bridge the gap between current and previous content knowledge due to students' absenteeism. Also, Ali et al. (2009) explained that students who avail themselves in lecture theatres regularly obtained greater symbols than those who did not attend lectures. In addition, Tshabalala and Ncube (2016) discovered that regular class attendance is vital for students to acquire mathematics skills. Thus, their findings suggest that the lecturer and students in TVET colleges should be encouraged to attend all lectures since attendance is linked to academic success.

The study's findings are also in line with the Attribution theory, which states that behaviour remains meaningless until it is attributed to a cause that influences future performance (Heider, 1958). Thus, when students and lecturers fail to present themselves in teaching and learning or show irresponsible behaviour, they do not realise the impact of that behaviour until they fail.

5.2.2.4. Lack of various teaching strategies

The study revealed that some students attributed their failure to a lack of various teaching strategies to meet their individual needs. This finding aligns with Miheso's (2002) findings, which indicate that poor performance in mathematics can undoubtedly result from teaching methods used in the classroom. Furthermore, according to Nevill and Rhodes (2004), teaching methods, teaching style, and teaching material significantly affect a student's performance.

All students pointed out that lecturers were not using different teaching strategies when teaching mathematics. Noddings (2009) suggests that teachers should create new activities and improve their teaching style to suit the learners, restoring their desire to learn and improving their performance. In agreement, Ndlovu (2011) asserts that teaching strategies should vary to sustain teacher motivation and interest. Similarly, Khoza (2014) points out that lecturers should act professionally and always be aware of alignment between teaching practice and their curriculum by reflecting on their teaching strategies.

Weiner's Attribution theory as a theoretical lens highlighted factors that impact student academic progress within higher education, which indicated how students relate their failure to internal and external factors. The internal factors include self-blame, negative attitudes towards mathematics, lack of teaching strategies, and absenteeism. External factors include lack of motivation, supporting materials, time allocation, and content knowledge; some of these factors are also challenges in improving poor mathematics performance.

5.2.3 Theme 3: Challenges in improving mathematics performance

This subsection discusses the findings on challenges faced by participants in improving performance in mathematics at the TVET college understudy in alignment with the relevant literature and Weiner’s Attribution Theory. The challenges include lack of using different teaching strategies, mathematics content knowledge, insufficient time allocation, lack of motivation, student enrolment criteria, student progress, lack of supporting materials and training workshops.

5.2.3.1 Mathematics content knowledge

The findings reveal that lecturers indicated as the level progresses, the Euclidean geometry section is added to mathematics content; thus, Grade 9 students find it challenging to adapt to new mathematics concepts. In general, Euclidean geometry is referred to as paper 2 in mathematics examinations. Martinez and Klopott (2003) argue that the intensity of school curriculum, quality of academic experience, and teaching and learning style directly impact students’ readiness for higher education and affect almost every path to success in post-secondary education. At a TVET College, the minimum entry requirement is grade 9 qualifications. At Level 4, Euclidean geometry is introduced. Therefore, students who enrol at college without grade 12 qualifications have a poor background in geometry and are less likely to pass mathematics at level 4.

Similarly, Yorke and Longden (2008) claim that students who lack basic skills fail to adjust to the unfamiliar approaches to learning, which may result in recurring poor academic performance. Some participant lecturers suggested that Euclidean geometry should be added to the Level 2 mathematics curriculum as the level progresses, reducing poor mathematics performance in Level 4. Spaull and Kotze (2015) agree that the earlier this intervention is implemented, the sooner the learner’s competencies can be improved, ultimately improving performance.

Furthermore, participants emphasised that insufficient time and more work led to the incompletion of the syllabus.

5.2.3.2 Student enrolment criteria

This study's findings indicate that lecturers attribute students' failure to a lack of standardised admission criteria for students to study a subject, reflecting at the end of the year in the throughput rate and certification. The NCV students are enrolled from grade nine (DoE, 2007). It also appears that students did not feel prepared for the TVET sector regarding personal adjustment and the institutional transition from school to higher education (GET to TVET sector). The NCV programmes are not sufficiently equipped to assist students' transition from school to college successfully. According to Oketch (2006), colleges are there for "students who are not able to advance through the school system" (p.4). In the TVET college understudy, students are mostly not academically able because they have poor basic mathematical knowledge from the school level. Thus, students find level 4 of the NCV Programme complex, which results in poor performance (Badenhorst & Radile, 2018, p. 11-12).

Papier (2014, p.38) highlighted student-related issues as a poor foundation in mathematics, poor reading, writing, and research skills required for study in the TVET sector. At TVET Colleges, the entry requirement for the NCV Level 2 programme is a minimum of Grade 9, which also accommodates students who passed Grade 10, 11, and 12. In addition, the South African Qualifications Authority (SAQA) classifies and equates the NCV to the National Senior Certificate (NSC) at the NQF Level 4 (Taylor, 2011); meaning the mathematics TVET curriculum is too close to the school curriculum, negatively impacting students' expectations to perform better. Therefore, according to Kruzicevic et al. (2012, p.42), institutions of higher learning need to focus on reducing high student failure rates by enhancing the placement procedure and adopting robust strategies to identify and support students experiencing academic difficulties.

The study reveals that admission requirements at TVET colleges are ambiguous and unreasonable; students with and without grade 12 and post-matric are allocated the same class to study the same subject content. Therefore, this presents a challenge in teaching, learning, and pass rates as most students who enrol in the NCV programme lack basic knowledge in mathematical concepts and procedures.

Moreover, the above negatively impacts the impartation of knowledge because lecturers may be unable to complete their syllabi on time, ensuring that all students are at the same level of understanding.

Concurrently, Mashongoane (2015) findings show that entry requirements of Grade 9 mean that many students are admitted to NCV Level 2 with Grade 9 to 12, which creates learning diversity in the classroom during the teaching and learning process. Then it becomes difficult for lecturers to pace delivery and pitch teaching at a level that is inclusionary.

Similarly, the NCV classes consist of students of different academic backgrounds (DHET, 2013), which confirms poor delivery of the mathematical concepts resulting in a high failure rate, drop-out, and inconsistency in assessment (Papier, 2011). In addition, the student recruitment strategy is based on the diverse academic qualifications of Grade 9 to 12. Thus, students from disadvantaged backgrounds, especially Grade 9 and 10, performed poorly because the subject content is too complex compared to Grade 11 and 12 students coping with the syllabus.

5.2.3.3 Lack of training workshops

This study revealed that there is a need for the professional development of lecturers. This finding aligns with Helminiry et al.'s (2016, p.198), who identified the main causes like lack of proper training facilities and poor classroom conditions, which are uncomfortable. Similarly, Buthelezi (2018) argues that most lecturers in TVET colleges have TVET related qualifications but do not possess the required teaching qualifications.

Participant lecturers emphasised the need to learn from one another by practising certain mathematics sections in the syllabus. A study by Umalusi (2014) concluded that lecturers are not equipped to cope with the social demands of vocational teaching. In the current study, lecturers confirmed that since they were employed at the TVET College, there were no training workshops conducted, except the five-day training held in February 2019. Joyce and Showers (2012) argue that providing lecturers with training enables them to acquire new skills and knowledge to transfer into their practices. The findings of this study also align with those of Kanongo (2007), which highlight the importance of lecturers' content knowledge in impacting students' mathematics achievement.

However, Kazima and Adler (2006) clarify that teachers are responsible for acquiring more knowledge in mathematics. Msibi and Mchunu (2013) further maintain that professional teachers should be qualified and continue to improve themselves in teaching, learning, and technology. Therefore, it is necessary to equip lecturers with the latest information to improve their practice. Moreover, staff development is vital because lecturers implement the curriculum, develop lessons, organise teaching, and possess evidence of any successful teaching and learning process. Thus, lecturers must develop their interests to achieve the best indicator of their abilities.

College subject meetings and training workshops should not only focus on the quality of curriculum documents in terms of what is contained in academic programs. Still, they must include the levels of content knowledge that students should obtain. In addition, lecturers with a low self-concept are likely to fail in performing their roles. However, once they know their job and find themselves successful, together with their inherent attributes, they can contribute significantly to developing a positive self-concept. Umalusi (2008) points out that lecturers' attributes include their knowledge and effectiveness in communicating their skills, knowledge, values, and attitudes. Darling-Hammond (2011) and Machaba (2013) agree that mathematics teachers should be well versed in the content knowledge and acquainted with the methods to teach.

Lecturers in subject meetings and training workshops must be conversant with the NCV mathematics curriculum to share new skills, teaching styles, and knowledge in the subject. Similarly, Zwiep and Benken (2013) observed that specialised and shared knowledge in teaching mathematics seemed to grow during teachers' training, but the content knowledge seemed to deteriorate. Therefore, such situations need to be addressed by the curriculum specialist during training workshops. What should be taught in the classroom by lecturers and how it should be delivered must form the background content for lecturer education and training.

5.2.3.4 Student progression

The current study's findings indicate that lecturers mentioned the minimum pass rate and progression as reasons for students' poor performance in mathematics. Consequently, much attention is on the NCV programme progression, throughput, and certification. This study finds that the policy on progression is inconsistent. The DHET has enacted various policies on progression. For example, students need a minimum of 30% to pass NCV mathematics; meanwhile, before 2015, students who failed mathematics progressed to the next level but had to repeat the subject.

In this study, lecturers were vocal about students repeating mathematics on a lower level while continuing with the next level. Each student is expected to do seven compulsory subjects as well as those to be repeated. Lecturers indicated that this creates pressure of workload on students and causes many clashes in the subject timetable. In addition, it is evident that the policy on minimum and progression requirements to the next level appears to set too low a standard; hence, students enter the next level of mathematics underprepared and without a strong base in mathematical concepts.

However, this study revealed lecturers felt that attributions to success include implementing the promotion policy that brought the change in mathematics results at the TVET college campus. They pointed out that students cannot be promoted to the next level while they have failed in the previous level in mathematics. Internal assessments provide lecturers with a systematic way of evaluating how well students progress to a level and in a particular subject (DHET, 2016). Every student is obliged to write all the assessment tasks for a progressive year mark, which suggests that all NCV students should be fully informed about the assessments, attendance policies, and their impact on the whole course.

5.2.3.5 Time allocation

This study's findings revealed that the mathematics curriculum demands more facilities, knowledge, and time. According to Papier (2014, p.38), the mathematics curriculum is too loaded and long to be completed in one year, and TVET colleges have poor timetabling plans. Participants believed that mathematics performance would improve if the composite timetable displays mathematics lessons early in the morning. Hence, students' attendance is high when most students present themselves at the college campus.

However, one participant lecturer noticed that students gained more knowledge, and their performance in mathematics improved when more contact time with lecturers is provided. The participant highlighted that mathematics lessons scheduled at late hours of the day promote student absenteeism; even if some extra lessons/classes are offered, they would be of no benefit. Gitaari et al. (2013) assert that lecturers must complete coverage of the syllabus, involve students in practical activities, ensure acquisition and use of appropriate textbooks, and thorough mastery of subject content to maintain good performance.

Moreover, the research findings indicate that each mathematics class group was allocated five periods of 55 minutes each per week, which is insufficient based on the prescribed curriculum documents. A participant lecturer (Zack) suggested that since the curriculum is the prescribed document for teaching and learning, curriculum developers should revisit and review time allocation for mathematics to cover the subject content and achieve learning outcomes. Berkvens and Van den Akker (2014) revealed that "such strict guidance to times stipulated for teaching and learning, tends to raise learning outcomes in the short term, but demotivates teachers and does not allow for individualised learning" (p.18). The authors (2014) further state that "formal time for learning is often still spent at school. Timetables are rather conservative, while many opportunities are ignored" (p. 18).

Due to time constraints, it appears lecturers taught to complete the syllabus and assessments at the expense of imparting mathematics concepts and their application. Therefore, assessments should be planned considering the embedded objectives and a clear understanding of the assessment purpose

Another finding of the current study suggests students should write seven formal assessments during the year as per assessment guidelines so lecturers can concentrate mostly on marking these tasks rather than teaching and learning to meet the submission dates. In support, Banta (2002) posits that assessments should be accompanied by required resources such as sufficient time, guidance, support, and feedback involving all stakeholders in the learning process.

5.2.3.6 Motivation

The data revealed that students attributed their poor performance to the lack of motivation from their lecturers, which caused a lack of interest in the subject. In agreement, Domino (2009) points out that the teacher's character, competency and teaching style influence students' attitude, performance, and perception towards mathematics. However, Tella (2007) suggested that teachers develop and use methods that stimulate students' interest in learning mathematics.

Another finding from the current study from a participant (Penny) showed that the issuing of the memoranda first-hand discouraged and demotivated students. They did not attempt to practice and put more effort into finding answers on their own; instead, they copied the answers from the memorandum. This frustrated other student who believed they were doing the tasks correctly but were not rewarded in marks according to their efforts. Such may lead to a low expectation of future success in the domain, lower hope, and lower persistence (Weiner,1981). Thus, it creates low self-esteem, lack of interest, less effort, and the student may become demotivated in mathematical problem-solving.

Student participant Judy attributed her failure to the lack of parental and family support because of their illiteracy. This finding is consistent with assertions by Schwanz et al. (2014), who maintain that parental support is considerably and positively associated with various academic consequences such as academic adjustment, persistence, and achievement.

In other words, family support usually preserves student's motivation, causing them to strive for excellence and become resilient despite all odds. Furthermore, according to Delpit (2006), parents can assist their children in school when they have higher educational attainment by sharing their knowledge of their children's lessons. Nevertheless, Alrwais (2000) found that peer affiliations are becoming increasingly influential in shaping attitudes than parents and teachers, advocating that students' attitudes are influenced more by cohort relationships. Moreover, Shaun and Judy expressed the loss of self-confidence due to their lecturer's lack of motivation and support. Even if they failed the assessment task, the lecturer seemed to only focus on those who passed. According to Pajares and Schunk (2001), students with low self-efficacy tend to be less confident and therefore more anxious and stressed when attempting a task.

This finding revealed that students attributed their failure to support they did not receive after they had already failed exams. They wished they had their lecturer's support at their first assessment task because it might have prevented failure. Porter and Swing (2006) agree that facilitating the beginning of students' engagement with, performance on, and response to feedback from their early assessment is a justified priority on both theoretical and practical grounds. A similar notion by Sardiman (2011) underlines that giving feedback, knowing the results, and giving the score can accumulate student learning motivation. To enhance the student's self-confidence and positive attitudes towards mathematics, the role of the lecturer is vital.

In particular, a lack of motivation was a key concern among all participants. The lecturers agreed that deficient levels of motivation were the primary source of their frustration. A lack of motivation indisputably leads to students' poor performance and a lack of interest in mathematics. The study conducted by Sumantri and Whardani (2017) revealed a significant relationship between motivation and learning achievement. Lecturers believed that enhancing students' motivation towards mathematics was to give them mathematical problems related to their field of study. This finding supports the thought that teaching and learning mathematics must be contextualised inside social practices (Moloi, 2013). In addition, Heuristic methods are used to combine knowledge gained in Mathematics to allow learners to solve real-life problems (Hoon et al., 2013). Finally, by incorporating mathematics into daily language and experiences, it is made accessible to students.

Thus, the concept of field is essential in understanding student academic outcomes in the TVET College. In alignment with the current study's findings, Mamali (2015) found that hands-on activities will provide students with the opportunity to investigate, build and take apart, create and make drawings, and observe shapes in the world around them. Lecturers must ensure that students are aware of important subjects that will enrich them in society. Also, Tsanwani (2014) found that applying sound teaching and learning principles promotes an atmosphere where students are inspired to achieve their full potential.

5.2.3.7 Supporting instructional materials

The current study's findings show that participants (students and lecturers) indicated that inadequate instructional material, too much work for un-supported and untrained lecturers, affects the NCV students' mathematics performance. According to Buthelezi (2018, p.12), looking at the college challenges in the post-apartheid era in South Africa, the TVET Colleges still have a challenge of resources, which makes it difficult for the students to perform well in their studies. As a result, students become mere spectators, which is against the curriculum requirement that states students must have access to all the necessary resources (DoE, 2007).

Some student participants recommended the college should provide them with more supporting materials and access to the mathematics laboratory to do more practice, suggesting that students are willing to improve their mathematics performance.

Moreover, the participant lecturers indicated that in many NCV programs, 80 per cent of the lecturers shared classes. There was also a lack of learner-teacher support material (LTSM) that aligns with the curriculum, which can assist in the clear understanding of different chapters in mathematics. This finding indicates that TVET colleges need infrastructural and learning program upgrades to support the effective teaching and learning of NCV mathematics. Maimane (2016) also affirms that students should access the learning resources with ease. Ngubane-Mokiwa and Khoza (2016) agree that student support systems should have academic programmes accessible to students.

Ngubane-Mokiwa and Khoza (2016) claim that all students should be provided with academic support for their development to improve their performance. Meanwhile, increasing student access to college resources is yet to transform corresponding numbers in students' success. Letseka and Maile (2008) contend that access has not been equated with students' success. According to the Subject Assessments Guidelines (SAGs), the College's responsibility is to provide the student with the necessary tools to meet the National Certificate Vocational (NCV) demands (DoE, 2007). Ornstein and Hunkins (2012) note that curricula can fail because of inadequate support in the form of materials and adequate equipment available. The TVET College education is exam-oriented, lacking educational resources and skills (Bhagat & Chang, 2015).

The above findings are supported by the Attribution theory, which assumes that lecturers and students relate their failure to factors they could not control themselves. These factors include the unavailability of the learner-teacher support material (LTSM) that aligns with the curriculum, which could assist in the clear understanding of different chapters in mathematics, and sharing of classes by lecturers of NCV and Report 191 programs. This notion is supported by Rusznyak and Walton (2011), who highlight that teachers must be equipped to develop good lesson plans that will meet the needs of learners and the demands of the subject content. Baloyi-Mothibeli (2018) also agrees that additional resources are needed for content presentation and lesson preparation.

5.2.4 Theme 4: Improving student performance in mathematics

All participants believed that students, lecturers, college management, and the curriculum have a collective role in improving mathematics performance.

5.2.4.1 Suggestions for students and lecturers

Students and lecturers believed that changing their methods of teaching and learning mathematics can improve performance. Students possess the self-confidence to do well in mathematics; this is parallel to the findings of Van der Bergh (2013) that revealed self-confidence significantly influences students' ability to learn and perform successfully in mathematics.

Participants agreed that mathematics needs more time and is to be practised daily, understanding mathematical concepts, formulas, and methods in solving problems ranging from simple to complex. Students must also constantly engage with their studies, watch videos, have extra classes, make study groups, solve problems related to real-life scenarios to improve performance. One participant lecturer (Sam) suggested that students attend lectures regularly. Tshabalala and Ncube (2016) support that regular class attendance is vital if students acquire the necessary skills in mathematics.

Furthermore, student participants recommended lecturers should use various teaching methods when teaching mathematics. In support, Etkind and Shafrir (2013) find that teaching strategies are various teaching techniques or methods used by lecturers to improve students' learning. One student participant (Penny) pointed out that visual learning should be used in mathematics during teaching and learning. The participant added that lecturer training workshops should be provided. Teachers should create new activities and improve their teaching style to suit the learners to restore learners' desire to learn and be successful in their studies (Noddings, 2009). Lecturers should use different strategies and approaches when teaching to accommodate different students with different backgrounds in mathematics. In support, Nel et al. (2016) posit that students grasp concepts better when they see, hear, and touch, a mixture of visuals and tangible interactions.

Another finding from the study showed that lecturers' motivation towards students and mathematical problems related to their field of study impact student performance. Hence the participants suggested developing interest in the subject and encouraging mathematics practice daily. A study by Domino (2009) revealed that students' attitude, performance, and perception towards mathematics are highly influenced by the teacher's character, competency, and style of teaching. However, Basch (2011) argues that it does not matter how well the teachers are prepared, what measures (availability of the LTSM, infrastructure, to mention a few), and management structures are in place; learning will occur only if the students are motivated and capable.

Findings also revealed that networking, team teaching, and training workshops could improve lecturers' subject content knowledge. In alignment with the findings, Steyn and Van Niekerk (2012) explain that there are direct benefits for students and lecturers working in teams; teamwork is essential in building a professional culture in schools.

This view is supported by Pillay (2012), who states that nobody should claim to have all the answers, but lecturers should depend on the knowledge and insight of their colleagues to best support students.

One participant lecturer (Sam) also suggested that lecturers collaborate with a mathematics professional body for support in teaching resources and strategies. According to a report on lecturer training conducted by the DoE (2007), the importance of recognising high-level knowledge and skills in this new qualification is significant in lecturer training. In addition, Hargreaves and Fullan (2013) perceive that teacher development must be thoroughly considered because it is imperative in transforming educational institutions.

5.2.4.2 Suggestions for college management

Students and lecturers agreed that college management could contribute significantly to improving student performance in mathematics. They suggested that mathematics lessons be scheduled in the mornings to reduce student absenteeism, increase mathematics Level-4 lecturers within the campus, and provide lecturer training workshops. One student participant suggested that management provide the necessary teacher-learner support material; more experienced lecturers should be employed; the college should reinforce the relationships with companies regarding work-based integration. Furthermore, participants pointed out that mathematics teaching and learning should commence at the beginning of the academic year for syllabus completion. In support, Spaull and Kotze (2015) approve that the earlier this intervention takes place, the sooner the learner’s competencies could be developed, ultimately improving performance. In addition, participant lecturers pointed out that the Head of Department should support the subject's implementation; duties of the lecturer should be allocated based on the subject specialisation, considering that mathematics and vocational subjects need more time for students to be practically exposed. Unfortunately, the TVET college lecturers in South Africa have not been appointed based on specialisation as reflected by their qualifications (Gitaari et al., 2013). Most TVET college staff are recruited from other industries due to their skills; hence, it is difficult to impart that knowledge to students because they lack lecturing skills.

According to Franklin and Molina (2012), college management may initiate professional developmental programmes where lecturers meet and share experiences, discuss difficulties, and attend meetings that expert speakers discuss topics ranging from classroom management to lecturers' performance. In addition, training and workshops can be organised to upgrade the qualifications of the staff (Le Hong & Funfhaus, 2014).

Moreover, the college management team should upgrade and renew the tutor software programme (learnscape) yearly and give access to students for viewing mathematical concepts in their own time to enhance interest and motivation towards mathematics. Managerial support helps ensure an improvement in the quality of college systems (Albashiry et al., 2015). Ngubane-Mokiwa and Khoza (2016) confirm by stating that student support systems should have academic programmes that are accessible to students.

5.2.4.3 College curriculum development

Some participants (students and lecturers) believed that developments in the college curriculum should contribute to students' performance in mathematics.
Two student participants agreed that the curriculum should include basic content knowledge of Euclidean geometry from level 2 as they progress at various levels. However, they added that the time allocated to mathematics periods was not enough to complete the syllabus on time.

According to Papier (2014, p.38), the mathematics curriculum is too loaded and too long to be completed in one year; meanwhile, TVET colleges have poor timetabling plans. Therefore, the mathematics curriculum should be revised to include basic knowledge of all mathematical concepts, such as Euclidean geometry. Participant lecturers suggested that curriculum developers reduce the number of written assessment tasks to allow more time in teaching and learning. The Curriculum Assessment Policy Statement (2011) is also available to guide what must be taught at that particular time, how it should be managed and the assessment activities. The mathematics curriculum should be developed and aligned with the current technology and adequate time allocation. Likewise, Ngussa and Mbuti (2017) point out that the mathematics curriculum is intended to provide students with knowledge and skills essential in the changing technological world.

5.3 Recommendations

The findings of this study and relevant reviewed literature inspire the following recommendations. Addressing the issues raised in the study can improve teaching and learning and student performance in mathematics.

5.3.1 Review of admission requirements for student enrollment

The study revealed that admission requirements at TVET colleges were too ambiguous and unreasonable. Students with and without grade 12 and post-matric qualifications are enrolled at the same level to study mathematics. Therefore, this presents as a challenge for teaching, learning, and pass rates. The majority of students who enrol in the NCV programme lack basic knowledge of mathematical concepts and procedures. Hence, this study recommends proper screening at the admission level.
Moreover, the TVET College, in collaboration with DHET, must review the recruitment policy to improve the throughput rate. In support, Papier (2009) asserts at the initial stage, appropriate recruitment and selection are vital aspects that contribute to students' success at TVET colleges, implying that students' poor performance is at least partly the result of a discrepancy in student enrolment.

5.3.2 Sufficient time for teaching mathematics

Time allocated to mathematics periods was not enough to complete the syllabus on time since new chapters (Euclidean geometry) are added without knowing the entry-level. Moreover, according to Papier (2014, p.38), the mathematics curriculum is loaded and too long to be completed in one year; meanwhile, TVET colleges have poor timetabling plans. Hence it is recommended that allocating sufficient time for mathematics allows for homework review, assessment feedback discussions, remediation, and completion of the syllabus. In addition, the mathematics curriculum should be revised to include basic knowledge of all chapters in Level 2.

5.3.3 Reduce absenteeism

The findings of the study showed that lecturers and students are not classroom-based. Due to the large number of students enrolled, there are inadequate classrooms allocated to the mathematics department. Thus, lecturers and students confirmed that poor attendance and insufficient classrooms have a negative impact on students' mathematics performance. Furthermore, participants believed that missing one lecture would affect the understanding and continuity of the mathematics content program. Therefore, it is recommended that TVET colleges enforce the punctuality and attendance policy provided by DHET together with the code of conduct during the registration and induction process. Amoo and Swart (2018) suggest that the policy needs to be revised and re-enforced to adhere to awareness and accountability. The TVET Colleges should also put measures to ensure that the attendance policy is available and adhered to.

Lecturers should set the example of being punctual and well prepared, and students must attend classes regularly, complete their homework, and study regularly. Moreover, during the induction of NCV students, emphasis should be on the NCV assessment and absenteeism policies and their impact on the course.

The Punctuality and Attendance Policy (DHET, 2013) indicates that a student shall be allowed to sit for the examination for every subject that they have attained 80 per cent attendance. Amoo and Swart (2018) echo that in the TVET Colleges in South Africa, 80 per cent of classroom attendance is required for students to qualify to write the final summative examination. Therefore, reviewing the number of internal and external assessment tasks for the NCV mathematics programme is recommended.

5.3.4 Professional staff training workshops

This study revealed that there is a need for the professional development of lecturers. In all countries, teacher training and professional development are the cornerstone of teaching and learning (Jones et al., 2013). Lecturers emphasised the need to learn how to approach specific chapters in the mathematics syllabus from colleagues.

Participant lecturers confirmed since they were employed at the TVET College, there was no training workshop apart from the five-day training in February 2019. However, Joyce and Showers (2012) argue that providing lecturers with training enables them to acquire new skills and knowledge to transfer into their practices. In view of this finding**,** TVET colleges should organise periodical specialised training workshops to help capacitate lecturers with mathematics content knowledge.

A White Paper for Post School Education and Training (2013) highlights that universities play a vital role in building and developing TVET lecturers already in the sector. Spaull (2015) further asserts that alternative teacher training techniques should be identified, especially in major deficiencies and teacher training opportunities. Finally, UNESCO-UNEVOC (2018) affirms there is a need for TVET lecturers' professional development.

5.3.5 College subject meetings

Subject meetings should be held regularly across the TVET Colleges to address the knowledge gaps that lecturers may have and allow lecturers to share teaching strategies. Similarly, Barnett and Hodson (2001) believe that experienced lecturers have more accessible, useful, and organised knowledge than novice teachers. Pillay (2012) is in support by stating that nobody should claim to have all the answers, but lecturers should depend on the knowledge and insight of their colleagues to best support students. Similarly, Balkrishen and Mestry (2016) suggest that one of the roles of an effective campus manager is to develop lecturers.

5.3.6 Enhancing lecturers and students' motivation

The study's data revealed that students felt that they lack motivation from their lecturers, which impacts their performance and causes a lack of interest in the subject. Botty et al. (2015) posit that lecturers should help build students' positive attitudes (in and outside the classroom). The study recommends lecturers appropriately adopt instructional procedures that include diverse students, enhance active interest, and allow students to enjoy what is being taught and learned.

According to Blazar and Kraft (2017), emotional support is associated with increased students' self-efficacy in mathematics and their happiness in class. Likewise, Ngussa and Mbuti (2017) assert that using humour as a teaching strategy makes a lesson interesting and enjoyable because students perform better.

5.3.7 Provision of supporting materials and various teaching strategies

From the findings, educational resources such as textbooks, computer laboratories, and other instructional materials for effective mathematics learning significantly influence performance in mathematics. According to Legotlo et al. (2002), if a school has inadequate resources like textbooks, it results in low morale and lack of learners' commitment, which are the factors contributing to their failure.

The majority of participants suggested that access to resources, including the mathematics laboratory, should be supplemented by installing an updated learnscape program. Amory (2010) confirms that learning environments must also provide collaborative opportunities that support teaching and learning.

Based on the teaching strategies, all student participants expressed that most mathematics lecturers were not using different teaching strategies to accommodate all students. It is recommended that lecturers should use different teaching strategies to provide any level of understanding of mathematical concepts to enhance students' abilities.

Makonye (2017) agrees that using different representations helps students realise that mathematics makes sense. Lastly, lecturers should act professionally and be aware of the alignment between teaching practice and the curriculum by reflecting on their teaching strategies (Khoza, 2014).

5.4 Implications of the study

There is one thing that the researcher has learnt from this study, is that, there are some similarities for this attribution for poor performance which students and lecturers agreed upon. Some of them are, the attitudes towards mathematics, high level of absenteeism, insufficient time allocation, inadequate supporting teaching and learning materials, lecturers' inability to deliver the mathematics content knowledge, lecturers have to undergo professional development, cooperative and collaborative efforts from lecturers, students, college management team and college curriculum developers to consider and revise the curriculum. This implies that the researcher has recognize that there is a core group of issues that are leading to this poor performance, and the TVET College has to attend to these issues for both lecturers and students. Conversely if it means they have different explanations for poor performance in mathematics, it will become a greatest challenge to deal with it, so it means that this will need more communication and collaboration between lecturers and students. This indicates how two different worldviews are coming together.

5.5 Limitations

The current study was conducted at one TVET college campus in KwaZulu-Natal and focused on eight participants; hence the findings cannot be generalised to other campuses. In addition, the research was limited to one campus, although extending to other campuses across the college would have provided more insight into students' mathematics performance. Moreover, there were delays in collecting data because it was difficult to contact all participants on individual telephone interviews simultaneously due to their busy schedules and network problems.

5.6 Recommendations for further research

The researcher acknowledges that this was a case study of one institution, and as a result, the findings are specific to that institution and cannot be generalised. Therefore, the researcher recommends that a similar study be conducted and be extended to other TVET colleges, but using different data collection methods, so that the study would have the potential to be generalised to the wider population.

5.7 Conclusion

The purpose of the study was to explore lecturers and students' explanations for poor performance in mathematics. There are very few current research studies on poor performance in mathematics within the TVET sector, which led to the adoption of Weiner's Attribution theory to fit the context of the current study. This study contributes to the body of knowledge on student performance in mathematics in higher education. The study can assist lecturers, students, college managers, and curriculum developers overcome the challenges that negatively affect student performance in mathematics at the TVET college. In addition, the successful implementation of the proposed solutions will lead to an increment in student enrolment for mathematics, better student academic performance and certification rate at exit NQF Level 4, improved teaching skills and mathematical proficiency.

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APPENDICES

APPENDIX A

INFORMED CONSENT FORM

10 MARCH 2020

Dear Participant

Re: Participation in research on comparing Engineering lecturers and students' explanations for performance in mathematics

I, Fikile Cynthia Linda, am a student in the School of Education at the University of KwaZulu-Natal (Edgewood Campus). As part of my MEd dissertation, I am conducting research on **COMPARING ENGINEERING LECTURERS AND STUDENTS' EXPLANATIONS FOR PERFORMANCE IN MATHEMATICS**. I hereby request you to participate in my research project.

This study aims to explore and understand the TVET College NCV engineering lecturers and students' explanations for performance in mathematics. Their explanations will be revealed through a semi-structured interview and the focus group. The outcomes of the study may provide solutions to current performance of students in mathematics.

There are no direct benefits to participants for this study and the participants will be allowed to withdraw at any time they wish. Your identity will not be divulged under any circumstance/s, during and after the reporting process. All your responses will be treated with strict confidentiality. After I have transcribed I will send it back to you so that you can change anything that you want.

For further information on this research project, do not hesitate to use the following contact details:

SUPERVISOR	RESEARCH OFFICE	RESEARCHER
Professor N Amin Tel: 031 260 7255 Email: amin@ukzn.ac.za	Research Office, Westville Campus Govan Mbeki Building Private Bag x54001 Durban 4000 KwaZulu-Natal, South Africa Tel: 27 31 2604557-Fax 27 31 2604609 Email: HSSREC@ukzn.ac.za	Fikile Linda Tel: 035 7965 568 Cell:082 226 8933 Email: 951048666@stu.ukzn.ac.za

Your positive response in this regard will be highly appreciated.

Thanking you in advance

Yours sincerely

Linda FC

Informed Consent

Declaration

I ____ (full names of participant) hereby confirm that I understand the contents of this document and the nature of this research project. I also understand that individual interviews will be conducted telephonically. The focus group discussion will be conducted through online interviewing (Zoom meeting and Skype) to adhere to social distancing due to Covid-19 regulations.

CHOOSE ONE OF THE FOLLOWING WITH A TICK.

☐ I consent to participate in the semi-structured interviews and focus group discussion and also agree that interviews may be recorded.

OR

☐ I do not consent to participate in the semi-structured interviews and focus group discussion and also disagree that interviews may be recorded.

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

______________________________ ____________________

SIGNATURE OF PARTICIPANT DATE

APPENDIX B

LETTER TO THE COLLEGE PRINCIPAL

P. O BOX 1416
ESIKHAWINI
3887
10 MARCH 2020

The College Principal

REQUEST FOR GATE-KEEPER PERMISSION TO CONDUCT RESEARCH

I, Mrs Fikile Cynthia Linda, am a student in the School of Education at the University of KwaZulu- Natal. I am conducting a research on TVET College Engineering lecturers and students comparing their explanations for performance in Mathematics as part of my Master of Education dissertation. I therefore, kindly seek permission to conduct research at your college. The title of my research project is:

COMPARING ENGINEERING LECTURERS AND STUDENTS' EXPLANATIONS FOR PERFORMANCE IN MATHEMATICS

This study aims to explore and understand the TVET College NCV engineering lecturers and students' explanations for performance in mathematics. Their explanations will be revealed through a semi-structured interview and the focus group. The outcomes of the study may provide solutions to current performance of students in mathematics.

Responses will be treated with confidentiality and pseudonyms will be used instead of the actual names. Participants will be contacted well in advance of the data gathering exercises as they have been purposively selected to participate in this study. Participation will always remain voluntary which means that participants may withdraw from the study for any reason, anytime if they so wish without incurring any penalties.

For further information on this research project, do not hesitate to use the following contact details:

SUPERVISOR	RESEARCH OFFICE	RESEARCHER
Professor N Amin Tel: 031 260 7255 Email: amin@ukzn.ac.za	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, South Africa	Fikile Linda Tel: 035 7965 568 Cell:082 226 8933 Email: 951048666@stu.ukzn.ac.za

	Tel: 27 31 2604557-Fax 27 31 2604609 Email: HSSREC@ukzn.ac.za	

Your positive response in this regard will be highly appreciated.

Thanking you in advance

Fikile Cynthia Linda

APPENDIX C
CONSENT DOCUMENT

Dear Mrs Linda,

I, ____, hereby consent to participate in the study entitled:

COMPARING ENGINEERING LECTURERS' AND STUDENTS' EXPLANATIONS FOR PERFORMANCE IN MATHEMATICS. I understand that confidentiality will be maintained and understand that individual interviews will be conducted telephonically. The focus group discussion will be conducted through online interviewing (Zoom meeting and Skype) to adhere to social distancing due to Covid-19 regulations.

CHOOSE ONE OF THE FOLLOWING WITH A TICK.

☐ I consent to participate in the semi-structured interviews and focus group discussion and also agree that interviews may be recorded.

OR

☐ I do not consent to participate in the semi-structured interviews and focus group discussion and also disagree that interviews may be recorded.

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

Signature:-- Date: --------------------------------

APPENDIX D

LETTER TO THE PARENT

Dear Parent

I, Fikile Cynthia Linda, am a Med student at the University of KwaZulu-Natal and currently conducting a research study which is entitled**: COMPARING ENGINEERING LECTURERS AND STUDENTS' EXPLANATIONS FOR PERFORMANCE IN MATHEMATICS.** I hereby request you to grant your child, ……………………………………… who is in NC(V) Level 4, a permission to participate in my research project. The outcomes of the study may provide solutions to current performance of students in mathematics.

The study requires the lecturers and students to participate in a semi-structured interview which will be followed by a focus group discussion. During the semi-structured interview participants will be individually interviewed to gather their experiences of teaching and learning mathematics. The duration of the semi-structured interview will be approximately 45 minutes per participant. The interview will be audio-taped with your permission.

Every effort will be made to ensure that no one, besides the participants, will know that you took part in this study. If I use any information that you share with me, I will be careful to use it in a way that will prevent people from being able to identify you. To protect your identity, I will ask you to provide a different name during the interview, for use in reports.

The semi-structured interview will be followed by a focus group which will also take approximately 45 minutes. You are free to withdraw from the research at any stage without negative or undesirable consequences. All information is only intended for research purposes. All data recordings and transcripts will be stored in a locked cabinet in my supervisor's office. When the study is completed you are entitled to a copy in a print format or soft copy format.

Permission to conduct this research study has been obtained from University of KwaZulu-Natal. For further information on this research project, do not hesitate to use the following contact details:

SUPERVISOR	RESEARCH OFFICE	RESEACHER
Professor N Amin Tel: 031 260 7255 Email: amin@ukzn.ac.za	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, South Africa Tel: 27 31 2604557-Fax 27 31 2604609	Fikile Linda Tel: 035 7965 568 Cell:082 226 8933 Email:951048666@stu.ukzn.ac.za

	Email: HSSREC@ukzn.ac.za	

Thank you for your co-operation.

Fikile Cynthia Linda

Informed Consent

Declaration

I ____ (full names of parent) hereby confirm that I understand the contents of this document and the nature of this research project. I also understand that individual interviews will be conducted telephonically. The focus group discussion will be conducted through online interviewing (Zoom meeting and Skype) to adhere to social distancing due to Covid-19 regulations.

CHOOSE ONE OF THE FOLLOWING WITH A TICK.

☐ I consent to participate in the semi-structured interviews and focus group discussion and also agree that interviews may be recorded.

OR

☐ I do not consent to participate in the semi-structured interviews and focus group discussion and also disagree that interviews may be recorded.

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

______________________________ ____________________

SIGNATURE OF PARTICIPANT DATE

APPENDIX E
SUPPLEMENTARY LETTER

Dear

The purpose of this letter is to motivate and declare that I Fikile Cynthia Linda (951048666) will provide my participants with 1Gigabyte data bundles for the following reasons:

- To adhere on the rules and regulations for Covid-19 social distancing
- To avoid the interruption of my study during the process of interviews due to the shortage of data bundles.

SUPERVISOR	RESEARCH OFFICE	RESEARCHER
Professor N Amin Tel: 031 260 7255 Email: amin@ukzn.ac.za	Research Office, Westville Campus Govan Mbeki Building Private Bag x54001 Durban 4000 KwaZulu-Natal, South Africa Tel: 27 31 2604557-Fax 27 31 2604609 Email: HSSREC@ukzn.ac.za	Fikile Linda Tel: 035 7965 568 Cell:082 226 8933 Email: 951048666@stu.ukzn.ac.za

Yours sincerely
Fikile Cynthia Linda

APPENDIX F

DECLARATION LETTER

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

Let the future be born

DECLARATION LETTER

To whom it may concern

I Elsie Ph du Toit..........(College Principal) hereby confirm that I understand the consent and the nature of the research study, and I will not be participating in the study as a participant. It is noted that you will be constituting your sample by conducting interviews with Engineering lecturers and students. I also understand that you will be using telephone and online interviewing. Therefore, I grant permission to Linda Fikile.C to conduct the research project in this college.

[redacted]

EPL du Toit

ACTING PRINCIPAL

UMFOLOZI TVET COLLEGE
CENTRAL OFFICE
25 JUN 2020
PRIVATE BAG X5023
RICHARDS BAY

Private Bag X5023, Richards Bay 3900, Tel: +27 (35) 902 9501, Fax: +27 (35) 789 2585, www.umfolozicollege.co.za
SERVING COMMUNITIES IN ILEMBE, UTHUNGULU & UMKHANYAKUDE DISTRICTS

APPENDIX G

LETTER OF PERMISSION TO CONDUCT RESEARCH

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

Let the future be known

2020

TO WHOM IT MAY CONCERN:

The purpose of this letter is to grant permission to Linda FC

As per the request to conduct the research project :

Research Project Title: : Comparing Engineeing lecturers and students' explanations of performance in mathematics

Aim of the Research:.To explore and understand the Engineering lecturers and students explanations of perforamnce in mathematics

Tertiary Insitution : University of KwaZulu - Natal

Faculty : Education

Qualification: MED

Name of Supervisor : Professor Nyna Amin

Study Site Location: Esikhawini

Consent of participants : All participants must be given consent forms to sign before the commencement of study.

Confidentiality : All participants must be guaranteed confidentiality

Permission granted by:

[redacted]

EPL du Toit

ACTING PRINCIPAL

16/03/2020

Private Bag X5023, Richards Bay 3900, Tel: +27 (35) 902 9501, Fax: +27 (35) 789 2585, www.umfolozicollege.co.za
...COMMUNITIES IN ILEMBE, UTHUNGULU & UMKHANYAKUDE DISTRICTS

APPENDIX H

SEMI-STRUCTURED INTERVIEWS

SEMI STRUCTURED INTERVIEWS QUESTIONS

(LECTURERS INTERVIEW QUESTIONS)

1. What are your perceptions about the NCV Engineering level 4 mathematics performance?
2. What do you think are the reasons of this performance in mathematics?
3. What are some of the challenges that you are facing as an NCV Engineering mathematics lecturer?
4. As mathematics lecturer how would you motivate students towards mathematics as a subject.

LECTURERS FOCUS GROUP QUESTIONS

1. How would you describe the attitude of students towards mathematics? Probing: would you relate to their performance in Mathematics?
2. What factors would you identify as contributing to mathematics performance of your students? Explain why?
3. What are possible ways in which NCV Engineering level 4 can improve mathematics performance?

STUDENTS INTERVIEW QUESTIONS

1. What are your perceptions about your mathematics performance?
2. What do you perceive to be the factors associated with your performance in mathematics?
3. What challenges can you identify as a contributing factor towards your performance in mathematics?
4. What is your attitude towards mathematics as a student?

STUDENTS FOCUS GROUP QUESTIONS

1. To what extent do you understand your performance in mathematics and why?
2. How would you describe the attitudes of your mathematics lecturers in teaching and learning? Probing: does it have an effect on your learning?
3. What would you think the possible ways to improve your performance in mathematics?

APPENDIX I

ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

02 July 2020

Mrs Fikile Cynthia Linda (951048666)
School Of Education
Edgewood Campus

Dear Mrs Linda,

Protocol reference number: HSSREC/00001515/2020
Project title: Comparing Engineering lecturers and students explanations for performance in mathematics
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 17 June 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has 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.

This approval is valid until 02 July 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities & Social Sciences Research Ethics Committee
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Tel: +27 31 260 8350 / 4557 / 3587
Website: http://research.ukzn.ac.za/Research-Ethics/