STUDENTS' ACADEMIC PERFORMANCE OF THE BRIDGING MATHEMATICS MODULES AT A RURAL UNIVERSITY

by

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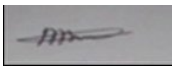
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DECLARATION

I, **Avhatakali Manthada**, declare that the thesis titled:

Students' Academic performance of the bridging mathematics modules at a rural University

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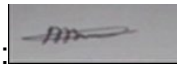
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DECLARATION OF PLAGIARISM

I, **Manthada Avhatakali**, student number 9409617, hereby declare that the thesis titled, **Students' Academic Performance of Bridging Mathematics Modules at a Rural University,** is my work and that all sources used have been duly acknowledged in the text and on the list of references.

Signature:  Date: 28/04/2025

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DEDICATION

I dedicate this thesis to my children, Gift Lutendo Manthada, Khodani Manthada, Unarine Manthada, Rialivhuwa Manthada, Ndingatshilidzi Manthada, and my lovely wife, Ndivhaleni Manthada.

Additionally, I dedicate this thesis to Thomas Mbengeni Manthada, my late father. After I finished Grade 12, he supported and urged me to go to university. I honour you with all my heart.

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ABSTRACT

Many degrees at the university require a pass in Grade 12 Mathematics as part of their entry requirements. Due to low achievement in Grade 12 Mathematics, students are compelled to start by bridging Mathematics at the university level, which provides a pathway to qualify for specific study programmes and work toward their ideal careers. The study aimed to explore factors that influence students' academic performance in Mathematics bridging modules. This research utilized a qualitative design and was guided by interpretivist ideology. The study's population consisted of all students, lecturers, and heads of departments involved in the two bridging Mathematics modules. A purposive sampling technique was employed to select participants for the study. A purposive sample of six students (three from each bridging module), two lecturers (one from each bridging module), two heads of departments (one from each bridging module), and two focus groups (one from each group) was used in this study. Data were collected through individual face-to-face and focus group interviews, as well as classroom observations, and were analysed thematically. Time management, attitudes, overcrowding, group work, workload, timetable clashes, and unstable venues were found to influence students' academic performance. The study recommended strategies that can be used to improve bridging mathematics modules academic performance, such as bridging the modules that students have failed only, dividing large groups into two or three groups, and a change of module contents.

Key Concepts: Academic Performance, Attitude, Bridging Modules, Pure Mathematics, Mathematics Literacy, School, Undergraduate Mathematics

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LIST OF ACRONYMS

ANU	:	Australia National University
APS	:	Admission Point Score
CAPS	:	Curriculum and Assessment Policy Statement
CQU	:	Central Queensland University
DoE	:	Department of Education
F_{iA}	:	Focus Group for Group A Module (i=1, 2, 3…9)
F_{iB}	:	Focus Group for Group B Module (i=1, 2, 3… 6)
FP	:	Foundation Programme
GPA	:	Grade Point Average
GUT	:	Graz University of Technology
HoD_A	:	Head of Department for Group A Module
HoD_B	:	Head of Department for Group B Module
HoDs	:	Heads of Department
ICMI	:	International Commission on Mathematical Instruction
KIU	:	Kampala International University
L_A	:	Lecturer for Group A Module
L_B	:	Lecturer for Group B Module
MLC	:	Mathematics Learning Centre
NDP	:	National Development Plan
PBL	:	Problem-based Approach
PCR	:	Pre-College Stems
PUM	:	Philipps-Universität Marburg
SDG	:	Sustainable Development Goal
S_{iA},	:	Students for group A module (i=1, 2, 3)
S_{iB}	:	Students for group B module (i=1, 2, 3)
SSS	:	Senior Secondary School
STEM	:	Science, Technology, Engineering, and Mathematics
UNE	:	University of New England
UNIVEN	:	University of Venda

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CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

This section provides the background of this study based on its aim, which is to explore the academic performance of students bridging Mathematics modules at rural universities. Mathematics plays a vital role in all aspects of life, whether in everyday matters such as time management, driving, cooking, or in professions such as accounting, finance, banking, engineering, and software development. These roles require a strong mathematical and scientific foundation. According to Darlington and Bowyer (2016), the proportion of full-time undergraduates studying Mathematics has significantly increased, as has the number of undergraduates studying the subject overall.

Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigour. The International Commission on Mathematical Instruction (ICMI) reaffirmed that mathematical knowledge is essential to comprehending the material covered in other educational courses, including science, social studies, and even music and art (Shimizu & Vithal, 2023). The number of Mathematics graduates is important for economic development. As a result, there is a growing demand for graduates who are proficient in Mathematics since these skills will help students land employment and succeed in the labour market (Jitka & Nocar, 2016).

When Grade 12 results let students down, most students who had great hopes of earning those major degrees were obliged to enrol in bridging courses or programmes. Lisciandro, Jones and Geerlings (2018) discovered that students' expectations about their future coursework did not align with the realities of their chosen degrees and professional goals. Hochmuth (2020:77) mentioned that bridging university courses are courses provided for students who do not study Mathematics as their major but Engineering, Natural Sciences, Informatics, Economics, Social Sciences, Psychology,

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Medicine or Life Sciences. Higher levels of Mathematics studied in senior secondary school are strong predictors of success in first-year science and Mathematics (Nicholas, Poladian, Mack & Wilson, 2015). However, students who place in the top bands of each senior secondary school Mathematics level can and frequently do outperform their peers who study a higher level of Mathematics at school but receive a lower band result.

According to Poladian and Nicholas (2013), in bridging courses, students were able to pass their first semester university calculus-based subject overall, but they did not achieve at the level of their mathematically well-prepared peers. Most students who do bridging Mathematics modules perform better than students who do not do bridging courses. The same result was also found in Germany, Philipps-Universität Marburg (PUM). Those students who consistently enrol in a Mathematics bridging course will improve their mathematical abilities and have a 35% higher chance of passing the final Mathematics test (Büchele, 2018).

The conceptions of Mathematics bridging courses were also investigated at a major Australian university, where Sue and Nicholas (2012) showed that students know the value of the bridging courses not only to deal with prior difficulties with Mathematics and improve their approaches to learning Mathematics but also, less openly, as a crucial chance to help them meet other students, fulfil their potential, and ease their move into college. As a result, students' results on the Mathematics placement examination improved dramatically after completing the four-week programme. In addition, these students passed their first college Mathematics course at a higher rate than the general student body enrolled in the same course (Jodi & Dreher, 2017).

According to the Australian National University (ANU) (2023:1) calendar, the bridging course modules have been specifically designed to cover the prerequisite knowledge required to undertake the following first-year maths courses. Students who are required to take one of the first-year Mathematics courses above as part of their degree programme but do not have the prerequisite knowledge must complete one or more of the bridging modules. Students who have the prerequisites but would like to refresh their knowledge are welcome to enrol in the bridging modules.

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In England, the Mathematics bridging course is a free course open to anyone enrolled at the University of New England (UNE) that aims to help build up knowledge and fill gaps in mathematical skills to prepare students for studying first-year Mathematics, but is also helpful to any students in schools or disciplines that require quantitative skills. The mathematics bridging course at UNE is structured to allow students to start at any time, work at their own pace and cover any topics in any order that is most helpful to them. It includes no formal assessment and does not have any credit points associated with completion.

Transitioning from high school to university is a great challenge for many students and also brings difficulties for many undergraduate students. Many people in South African secondary schools are studying Mathematics, be it pure Mathematics or Mathematics literacy. In Germany, where the transition from school to university is a big challenge for many students, especially in Mathematics, the high failure rate in Mathematics in Germany forced the university to introduce several supportive measures such as bridging courses or mathematical support centres to be implemented at German universities to ease students' difficulties in the transition phase (Hoppenbrock, Biehler, Hochmuth & Rück, 2016:49).

In 2018, a free, accessible online bridging course for Mathematics was designed by the German University of Technology, called Graz University of Technology (GUT), and the course was provided on the iMooX platform 1 and represented a form of technology-enhanced learning (Reich, Ebner & Ebner, 2019). They offer students an opportunity to get back on track and help them identify what they want to do after matric to move forward with their future careers. Bridging courses provide a way for students to qualify for specific study programmes and work towards their ideal careers. Bridging courses are primarily offered to students who need to improve their understanding of subjects that relate to studying the programmes.

In Uganda, Ssempebwa, Eduan and Mulumba (2012:140) reiterated that "the academic performance differentials between students enrolled through the programmes and those admitted through conventional routes, taking the case of Kampala International University (KIU)". The findings were that, overall, there is no

significant difference between the two, meaning that the programmes are effective in preparing their attendees for university education.

According to Tachie and Chireshe (2013:67), “there is a high failure rate in Mathematics examinations in rural senior secondary schools in Mthatha District, Eastern Cape.” After passing Grade 12, some students choose to go to university with low achievement in Mathematics, and that is where they encounter the so-called bridging Mathematics course. Bridging courses are designed for those who may not have achieved their matric marks well and don't have the necessary qualifications.

In South Africa, according to the University of Venda (UNIVEN) undergraduate student information brochure (2023:19), “the University of Venda (UNIVEN) provides a bridging programme called the Science Foundation under the School of Mathematical and Computational Sciences. It is offered to any student who does not qualify for the degree programme of his/her choice and has met requirements for a bachelor’s degree or Grade 12 with university exemption, plus an APS of 28 to 32, excluding life orientation, an opportunity to be considered for admission into the extended bridging programme. This extended bridging programme is done for one year only, and then for students to proceed to the first year he/she should have obtained at least 120 credits.

All students with low achievement in Grade 12 Mathematics and who want to do a Bachelor of Commerce degree must start from a bridging Mathematics module, MAT 0143/0543. These modules are done in the first semester. If they fail, they have another chance during the second semester to repeat those modules but with different codes, MAT 0243/0643.

The University of Johannesburg (UJ) offers bridging courses to provide additional support and preparation for students who may not meet the entry requirements for their chosen degree programme. (University of Johannesburg undergraduate prospectus, 2024). Here are some of the UJ bridging courses available:

- **Foundation Programmes:** These are one-year bridging courses offered in various fields, including Engineering, Health Sciences, Humanities, and Natural

Sciences. The programmes aim to provide students with the necessary knowledge and skills to succeed in their chosen degree programme.

- Extended programmes: These are four-year degree programmes that include an additional year of foundational courses to help students who may not meet the entry requirements for their desired programme. The extended programmes are offered in various fields, including Law, Education, and Health Sciences.

- **Access Programmes**: "These are short courses that aim to provide students with the necessary academic and personal skills to succeed in their studies. The courses are designed to support students who may not have had access to quality education or who may need additional support to succeed at university.

- **English Language Proficiency Courses**: UJ offers English language courses to help international students or students who do not speak English as their first language to improve their language skills and meet the language requirements for their degree programme.

1.2 STATEMENT OF THE PROBLEM

Mathematics plays a big role as a prerequisite for many modules in different bachelor's degrees at universities. Due to low achievements in Grade 12 Mathematics, students are compelled to start with bridging Mathematics at the university level. However, some students choose to repeat Grade 12 to upgrade their Mathematics results. This study explored factors that influence students' academic performance in bridging Mathematics modules at a rural university in Limpopo Province, South Africa.

According to the Sustainable Development Goal (SDG), Goal number four is access to quality education. Students must have access to quality education; hence, the introduction of bridging courses or programs by different universities globally, regionally, and locally. Especially in rural areas, if learners don't go to school, they may begin to join gangs, smoke, and drink. Attending school keeps learners busy and

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prevents them from engaging in these unnecessary activities. The introduction of the bridging programme at rural universities ensures that everyone has an equal opportunity for education, regardless of gender, race, or location. Bridging courses or programs were introduced to help students gain access to quality education; otherwise, they would be denied entry into higher education. This study examined the academic performance of bridging Mathematics students at the university. If these students are unable to gain admission to the university, poverty would increase, leading to a rise in uneducated individuals in South Africa. The country requires skilled individuals who possess knowledge in various fields.

In Germany, Büchele (2020) mentioned that all institutions complain that students' arithmetic skills when they first enrol in the system are inadequate, which is a serious problem, particularly for math-related study areas like Physics, Engineering, or Economics. Almost all colleges offer remedial Maths classes to help close the gap.

To bring students' skills up to level with those of their peers who have passed, bridging courses appear to be a suitable remedial strategy. However, students are frequently insufficiently equipped for higher education, particularly in mathematics, even if remedial courses have benefits and can lessen heterogeneity (Büchele, 2020).

Central Queensland University (CQU) helps students make the transition from secondary to university by offering a bridging programme (CQUniACCESS) that prepares students for university admission regardless of their prior abilities and academic accomplishments (Dekkers, Adams & Elliott, 2011). Additionally, CQU offers specialised academic support centres to help undergraduate students with their Mathematics needs, and in 2011, the university looked at a new readiness programme to identify and help students who are at risk before the start of their undergraduate studies.

The study will make sure that there is a bridging programme campaign so that students become aware of this programme before they come to university. Students are seated at home there waiting to rewrite their matric, whereas there is a bridging programme in most, if not all, South African universities. More strategies are needed to share the information about bridging programs at universities because some students don’t

know about this bridging programme. In rural areas, there is a network problem and many people do not have access to the internet where they can Google and find this information.

Students' readiness for university education has become a national problem and of increased concern in South Africa. Frustrated by the trend, Wolmarans, Smit, Collier-Reed and Leather (2010) emphasised that if Higher Education Institutions (HEIs) are to remain relevant and increase access to higher education, ways to respond adequately to the problem of assisting underprepared first-year students, bridge the gap and succeed in their studies must be found. Most students do not finish their studies in record time, and this shows that there is a big gap between secondary school education and tertiary education.

A bridging programme is required to reduce the gap. STEM education, which stands for Science, Technology, Engineering, and Mathematics, is highly valued in educational systems across the globe. The availability of highly skilled workers is essential to the economies of most nations, including Australia. The drop in the number of students studying Mathematics and other Science or Technology topics in school, seen in many countries, is a major worry for Australia (Chubb, Finkel, King, Ryan, Speed, Borghesi & Carroll, 2015).

Although modelling abstract and concrete situations gives students the knowledge and abilities they need to comprehend the world around them, Mathematics is criticised for having curricular discontinuities at different educational levels that leave gaps in students' learning. Because of this, many students lack interest in Mathematics, and few students pursue higher education in Mathematics or pursue professions in STEM fields (West, Sweeting & Young, 2010).

The bridging programme has been established with the primary goal of helping students to bridge the gap between grade 12 and universities, improving grade 12 skills so that students can get the prerequisites and admission to the main degrees. The study examined factors that influence the academic performance of students with low achievement in Grade 12 Mathematics when they were admitted to a bridging course or programme.

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I served as a part-time lecturer at a rural university and have 15 years of experience teaching bridging mathematics modules. During that period, some students were performing better, and some were struggling, getting zero in the tests, and even in the final examinations. This prompted an investigation into the factors that contribute to this type of academic performance. Hence, this study, students' academic performance in bridging mathematics modules at a rural university.

To do this, the study must answer the following research questions.

1.3 RESEARCH QUESTIONS

The main research question of this study is: What influences students' academic performance in bridging Mathematics modules at a rural university?

To address the main research question, the study formulated the following sub-questions:

1.3.1 What role do bridging Mathematics modules play in the student's academic performance in a rural university?
1.3.2 What attitudes do students have towards the bridging of Mathematics modules?
1.3.3 What are the factors that influence students' academic performance in bridging Mathematics modules?
1.3.4 What challenges did students and lecturers encounter in this bridging Mathematics module?
1.3.5 Which strategies can be used to improve students' academic performance in the bridging Mathematics module?

1.4 RESEARCH AIM AND OBJECTIVES

The main aim of the study is to explore factors that influence students' academic performance in bridging Mathematics modules at a rural university.

To achieve the aim of this study, the following objectives have been set:

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1.4.1 to explore the role of bridging Mathematics modules in the academic performance of students.

1.4.2 to investigate students' attitudes towards the bridging Mathematics modules.

1.4.3 to determine factors influencing students' academic performance in bridging Mathematics modules.

1.4.4 to investigate the challenges students and lecturers encountered in the bridging Mathematics modules.

1.4.5 To establish strategies that could be used to improve students' academic performance in bridging mathematics modules.

1.5 THEORETICAL FRAMEWORK

A theoretical framework is a roadmap or foundation of research. Grant and Osanloo (2014:12) defined a theoretical framework as "the theory that a research project aligns itself with". Adom, Hussein and Joe (2018:438) defined a theoretical framework as a "blueprint that is often borrowed by the researcher to build his/her research enquiry".

Vygotsky believed that the lifelong process of development is dependent on social interaction and that social learning leads to cognitive development. In other words, all learning tasks (irrespective of the level of difficulty) can be performed by learners under adult guidance or with peer collaboration.

- **Constructivism**

According to Vygotsky (1978:5), "constructivism is an important learning theory that educators use to help their students learn". It is based on the idea that people actively construct or make their knowledge and that reality is determined by one's experiences as a learner. Learners use their previous knowledge as a foundation and build on it with new things they learn.

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Kalpana (2014:27) argued that “constructivism is a view that emphasises the active role of students in building understanding and making sense of the information and viewed constructivist teaching as learner-centred where students are actively involved in knowledge construction rather than mere passive listeners”. Constructivists’ views can be organised in two forms: psychological and social.

Because social constructivism is more prevalent in Vygotsky's 1978 work, this study considered it. Social constructivism is also called collaborative learning because it is based on interaction, discussion and sharing among students. This teaching strategy allows for a range of groupings and interactive methods. These may include total class discussions, small group discussions or students working in pairs on given projects or assignments. The underlying factor of the theory is that learners work in groups sharing ideas, brainstorming, trying to discover cause and effect, finding answers to problems or just creating something new to add to existing knowledge (Akpan, Igwe, Mpamah & Okoro, 2020).

Social constructivism focuses on the collaborative nature of learning. Knowledge develops from how people interact with each other, their culture, and society at large (Vygotsky, 1978). Vygotsky believes that learners learn best by doing and experiencing things for themselves. Additionally, constructivists believe that learning should be scaffolded or supported for students to be successful.

In Vygotsky’s constructivist theory of learning, learners actively construct their understanding of the world through their interactions with others. This social interaction is essential to cognitive development, as it allows learners to internalise new ideas and concepts. Scaffolding from more experienced or knowledgeable others is also important in this process, as it provides support for learners as they attempt to master new skills or concepts.

The constructivist approach has been applied to education, where it emphasises the importance of students constructing their knowledge rather than simply receiving information from teachers. It also recognises the role that experience plays in learning,

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and students need opportunities to explore and interact with their environment to learn effectively.

1.5.1 Implications of Vygotsky's social constructivism on students' learning

According to Akpan, Igwe, Mpamah, and Okoro (2020:54), there are some implications of social constructivism on students' learning, which are as follows:

- Students no longer sit down to be informed or taught by the teacher but discover lesson contents by themselves as they respond to the teacher's promptings in the form of questions, assignments, and project works.

- Students now learn to work in groups as organised by the teacher for effective collaboration or cooperative learning.

- Students become co-custodians of knowledge as they share and build on their previous experiences to create new knowledge.
- They take responsibility for learning by actively participating and collaborating in the process.

- Students should learn to consider the opinions of others by appreciating and investigating new ideas and lessons learned from their colleagues.

- They should value every experience, learn from them and be ready to share with their groups to improve their cognitive ability continuously.

The social constructivism approach is based on the fact that students build new knowledge from the foundation of knowledge acquired previously, in this case, knowledge acquired from Grade 12 Mathematics. The teacher's role in the social constructivist classroom social constructivism lends credence to social pedagogy by defining the teacher's role in the teaching/learning process.

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1.5.2 According to Vygotsky 1978's constructivist theory, teachers should adopt teaching Methods that are:

- Learner-centred: here, the focus is on the students rather than the teacher. This means the students are urged to be actively involved in their process of learning. They are allowed to come up with their ideas, questions, definitions, and make-ups (Akpan, Igwe, Mpamah & Okoro, 2020:53).

- Collaborative: here, emphasis is placed on learning through social interaction. This is done by making students work in groups to solve problems, investigate and explore topics/situations to arrive at conclusions. By so doing, they discover or construct knowledge by themselves (Akpan, Igwe, Mpamah & Okoro, 2020:53)

- Teacher-guided: In social constructivist classrooms, collaborative learning is a process of peer interaction that is mediated and structured by the teacher. The presentation of specific concepts, problems, or scenarios can prompt discussion. (Akpan, Igwe, Mpamah & Okoro, 2020)

Vygotsky developed the theory of social constructivism. He emphasised the role of social interactions and cultural tools in the learning process. Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which highlights the difference between what a learner can achieve independently and what they can achieve with the guidance and support of a more knowledgeable person. Vygotsky's work underscored the significance of social and collaborative learning in education.

A social constructivist approach influenced by Vygotsky's work emphasises "the social contexts of learning and that knowledge is mutually built and constructed. By interacting with other students, they get the opportunity to share their views and thus generate a shared understanding related to the concept (Bodrova & Leong, 2012:241).

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Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), as seen in Figure 1.1, which highlights the difference between what a learner can achieve independently and what they can achieve with the guidance and support of a more knowledgeable person (Vygotsky, 1978:12).

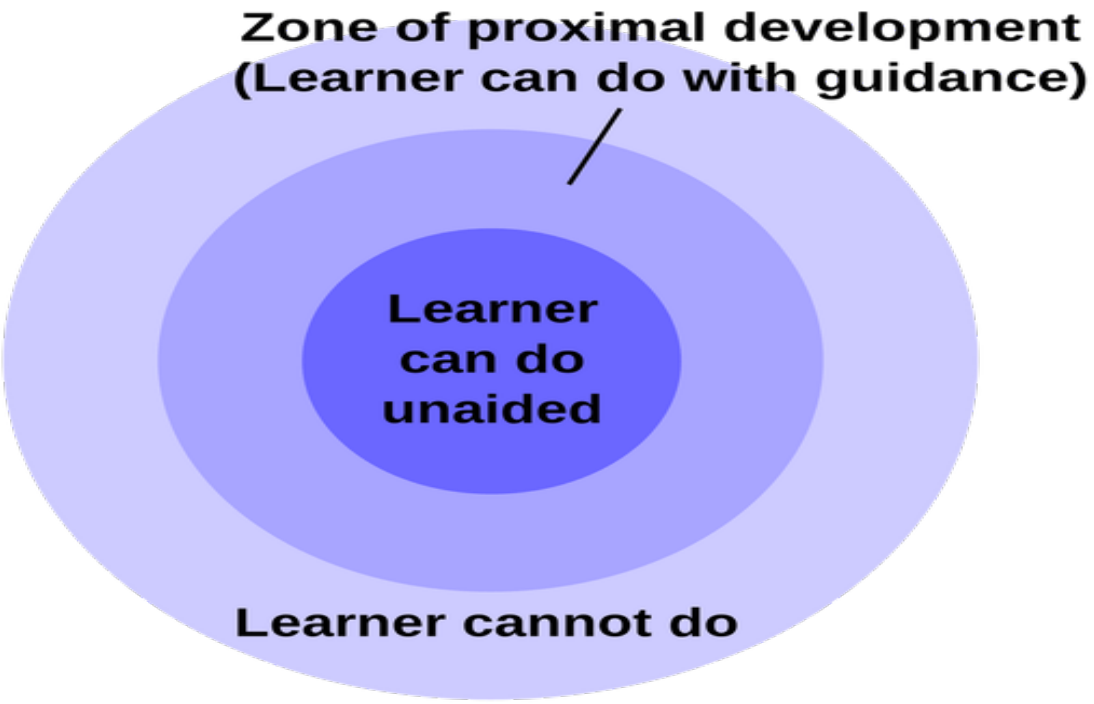


Figure 1.1: Vygotsky Zone of Proximal Development (ZPD)

This theory is relevant to the study because, by applying Vygotsky's idea to learning Mathematics, the growth of mathematical understanding occurs through a process of connecting earlier thoughts with new mathematical language to create more meaning. In other words, bridging Mathematics students will add new knowledge to their existing knowledge from Grade 12. In the bridging Mathematics module, students will use their previous knowledge as a foundation and build on it with new things they learn from the university.

1.6 PRELIMINARY LITERATURE REVIEW

According to Rylands and Coady (2009:741), “students lack the appropriate mathematical background to cope with first-year Mathematics and Science subjects, and that increases the failure rate. Bridging courses are designed to increase the

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academic success of students with low prior knowledge and to reduce the dropout rate". According to Eitemüller and Habig (2020:561), "bridging course participants achieve significantly better examination results than their fellow students who did not enrol in the bridging course".
Johnson and Keeffe (2016:233) found "statistically significant increases in self-efficacy scores across some, but not all, of the mathematical topic areas and an increase in the retention rates of adult learners who participated in Head Start Mathematics compared to those who did not".

In East Africa at the Kampala International University, Ssempebwa, Eduan and Mulumba (2012:140) showed that "there is no significant difference in the academic performance of students who enrolled through the university bridging programme and those who just enrolled straight".

According to Rylands and Coady (2009:741), "students lack the appropriate mathematical background to cope with first-year Mathematics and Science subjects, and that increases the failure rate." Nicholas, Poladian, Mack and Wilson (2015:43) argued that "the higher levels of Mathematics taken in senior secondary school are strong predictors of success in first-year science and Mathematics, but that those students who achieve in the top bands of each level of Mathematics taken in senior secondary school can and often do outperform their peers who study a higher level of Mathematics at school but achieve a lower band result."

In Australia, Robinson, Galligan, Hussain, Abdullah, Frederiks and Wandel (2019:6) found that students who transitioned through the preparatory programme felt well-prepared for their undergraduate Mathematics. However, a greater proportion of these students either withdrew from the undergraduate quantitative course that they had enrolled in or achieved lower grades when compared to other survey respondents who had entered university through more traditional pathways. Findings from Quaye (2015:59) support the view that "attitudinal variables are significant indicators of mathematical achievement."

Mata, Monteiro and Peixoto (2012) have identified important factors that contribute to students' attitudes toward learning Mathematics. These include the students

themselves, the school, the teachers' beliefs and attitudes and their teaching methods. The teachers' teaching method has a major influence on students' attitudes (Mensah, Okyere & Kuranchie, 2013). In other words, if teachers positively condition students towards Mathematics, students would have a positive predisposition for the subject. Again, suppose teachers exhibit positive behaviour and give good utterances about mathematics. In that case, students will imitate that behaviour and hence develop a positive attitude towards the study of this all-important subject.

Mathematics plays a vital role as a prerequisite for other subjects like chemistry. No wonder in Nigeria University, Akinoso (2017:40) reported that "students' attitudes to Mathematics correlate to attitude and performance in Chemistry. It was discovered that for students to do well in chemistry, they must do well in mathematics. In other words, Mathematics and Chemistry are correlated subjects. Performance in chemistry affects performance in Mathematics. Sanchal and Sharma (2016) argued that when students learn in a sporting context, their attitude, confidence, and perception of the importance of Mathematics and engagement increase, but some researchers like Anuar, Abdullah and Hod (2020:269) argued that "there was no association of learning styles and attitude towards academic achievement".

Lisciandro, Jones and Geerlings (2018) discovered that students' expectations about their future coursework did not align with the realities of their chosen degrees and professional goals. Teachers can do many things to facilitate classroom learning to alleviate students' engagement level and confidence in learning Mathematics" (Attard, 2012:9; Kele & Sharma, 2014:33). This can be achieved by implementing meaningful activities embedded in real-life contexts.

Sue and Nicholas (2012) showed that students are aware of the value of the bridging courses not only to ameliorate prior difficulties with Mathematics and improve their approaches to learning Mathematics but, less transparently, as an important opportunity to facilitate their transition into higher education, meet fellow students and help realise their potential.

1.7 DEFINITION OF KEY TERMS

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This section defines key terms in this study.

1.7.1 Academic Performance

Academic performance is the measurement of student achievement across various academic subjects. The academic performance of students is the key feature and one of the important goals of education and has always been influenced by several factors, including parental encouragement and the school environment (Narad & Abdullah, 2016). Academic performance can also be defined as the knowledge gained by the student, which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period.

Academic performance was measured in this study using test marks, final exams, and classroom performance.

1.7.2 Attitude

Attitude is a person's perspective and assessment of something or someone, as well as their inclination to react favorably or unfavorably to a certain concept, item, person, or circumstance (Vargas-Sánchez, Plaza-Mejía and Porras-Bueno, 2016). It is also regarded as a belief held by individuals that reflects their opinions and feelings and can sometimes manifest in behaviour (Joseph, 2013). It is a settled feeling about something. Attitudes, behaviour, and feelings are interrelated in such a way that people’s attitudes determine their behaviour towards objects, situations, and people. They also influence the relationships that exist among these variables with themselves (Joseph, 2013). Vygotsky's theory advocated for students’ motivation. If students are demotivated, they become negative and they begin to misbehave, making noise in class and failing to attend classes.

In this study, the researcher used classroom observations to determine students' and lecturers' attitudes toward teaching and learning of bridging Mathematics modules. The researcher observed students' and lecturers' motivation and how lecturers

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motivated students' active participation. In the classroom, the researcher observed students' participation and behaviour.

1.7.3 Bridging Course

Bridging courses are short, focused learning programmes designed to help learners bridge the gap between high school and university. This means that learners who passed Grade 12 but did not get the marks needed to get into a higher education institution can take a bridging course that will allow them to qualify and have another chance to apply. Lisciandro and Gibbs (2016) described bridging courses as pre-university enabling programmes. Bridging courses are also defined as university preparatory courses, which prepare students well before starting their degree programme (Hodges, Bedford, Hartley, Klinger, Murray, O'Rourke & Schofield, 2013).

In this study, a bridging mathematics course was conducted by students who achieved low marks in Grade 12 Mathematics and wanted to improve their marks so that they could qualify to register for the main degrees.

1.7.4 Mathematics Literacy

According to Jablonka and Niss (2014), mathematical literacy is an individual's capacity to formulate, employ, and interpret Mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognising the role that Mathematics plays in the world and in making well-founded judgements and decisions needed by constructive, engaged, and reflective citizens.

This study considered all students who took Mathematics Literacy in Grade 12 as a prerequisite for a bridging Mathematics module, either registered for the group B bridging module before enrolling in their first-year Mathematics course. Students who did mathematics literacy in grade 12 do not qualify to register for the group A bridging mathematics modules; those students who did not do mathematics literacy in grade

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12 qualify to register for Group A bridging mathematics modules, provided they have done pure mathematics in grade 12.

1.7.5 Pure Mathematics

Yadav (2017:8) defined Mathematics as the "study of assumptions, their properties and their application". Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigour. In teaching, we must maintain the order of assumptions, properties, and applications. This order must be maintained in assignments to achieve the desired aim of teaching mathematics (Yadav, 2017). When it comes to a Bachelor of Science (BSc) degree, the study considered only students who had done pure Mathematics in Grade 12, since Mathematics literacy is not considered for a B.Sc. degree. Some of the Grade 12 students who did pure mathematics registered for this programme.

1.7.6 School

A school is a place where students learn and develop knowledge and skills. Young (2012) viewed school as an institution with the particular purpose of promoting the acquisition of knowledge. All bridging mathematics module students are coming from different schools where they did their grade 12 Mathematics.

1.7.7 Undergraduate Mathematics

Undergraduate mathematics refers to the mathematics studied at the undergraduate level, before graduation. In this study, undergraduate mathematics was utilised to select participants, with bridging mathematics modules being one of the areas of undergraduate mathematics.

1.8 RESEARCH PARADIGM, DESIGN AND METHODOLOGY

This section discusses the research paradigm, design, and methodology used in this study.

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1.8.1 Research Paradigm

"The term paradigm is derived from the Greek meaning pattern" (Kivunja & Kuyini, 2017:1) and has been broadly defined by many academics. For example, a paradigm is perceived as a "way of seeing the world that frames a research topic and influences the way that researchers think about the topic" (Hughes, 2010:35).

A research paradigm is a method, model, or pattern for conducting research. It is a set of ideas, beliefs, or understandings within which theories and practices can function. A paradigm consists of the following components (Rehman & Alharthi, 2016): ontology (what is reality?), epistemology (How do you know about something?) and methodology (How do you go about finding out?). Each component is explained, and then the relationships between them are explored. Ontology is a branch of philosophy concerned with the assumptions we make to believe that something makes sense or is real or the very nature or essence of the social phenomenon we are investigating (Scotland, 2012:9). Ontological assumptions are concerned with what constitutes reality, in other words, what is reality. Researchers need to take a position regarding their perceptions of how things are and how things work.

Epistemology has its aetiology in Greek, where the word episteme means knowledge. Put simply, in research, epistemology is used to describe how we come to know something; how we know the truth or reality, and what counts as knowledge within the world. Epistemology is concerned with the nature and forms of knowledge. Epistemological assumptions are concerned with how knowledge can be created, acquired and communicated, in other words, what it means to know.

This study used an interpretivist paradigm because, with an interpretive approach, a separation between objective and subjective ideologies is impossible. The interpretive approach relies on questioning and observation to discover a rich and deep understanding of the phenomenon being investigated, which was what this study was all about.

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This study used an interpretivist paradigm because, with an interpretivist approach, a separation between objective and subjective ideologies is impossible. The interpretive approach relies on questioning and observation to discover a rich and deep understanding of the phenomenon being investigated, which was the main goal of this study.

The interpretivist paradigm endeavours to understand the subjective world of human experience. This paradigm was suitable to the current study because the researcher sought to explore the role of bridging Mathematics modules in the academic performance of students, to investigate students' attitudes towards the bridging Mathematics modules, to determine factors influencing students' academic performance of bridging Mathematics modules, to investigate the challenges students and lecturers encountered in the bridging Mathematics modules.

Understanding the situation, the feelings of persons enrolled in bridging courses, the emergence of those conscious and unconscious emotions, and the impact of new, shared meanings on their lives were the goals (McGregor & Murnane, 2010:419)

1.8.2 Research Design

The research design refers to the overall strategy that one may choose to integrate the different components of the study coherently and logically. This is done to ensure that one effectively addresses the research problem. Research design constitutes the blueprint or the roadmap for the collection, measurement, and analysis of data (McMillan, 2010:72). Research design is a plan, a roadmap and a blueprint strategy of investigation conceived to obtain answers to research questions, and it is the heart of any study. Research design also refers to the framework of market research methods and techniques that are chosen by a researcher. According to Zikmund, D'Alessandro, Winzar, Lowe, and Babin (2014), research design is also defined as a master plan specifying the methods and procedures for the collection and analysis of the needed information.

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This study adopted a research design, which is one of the designs used in the interpretive paradigm. Qualitative research can be interpreted as an "approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2014:32). Phenomenological research design was used in this study.

Merriam and Tisdell (2016:1) further affirmed that qualitative research "aims to reveal the meaning of an occurrence for people who are involved in it". Qualitative research is expressed in words. It is used to understand concepts, thoughts, or experiences. This type of research helps in gathering in-depth insights on topics that are not well understood. This type of research design was used in this study because the researcher tried to find students' and lecturers' thoughts on bridging Mathematics courses.

1.8.3 Research Methodology

Research methodology is a systematic way of researching to solve an identified problem. Research methodology, according to Antwi and Hamza (2015), is the approach taken when carrying out research. It is a rational, methodical approach to a study issue. A methodology explains how a researcher plans to conduct the study to produce valid, trustworthy findings that meet their goals and objectives.

1.9 SAMPLING

Sampling refers to a means of selecting the group that you will collect data from in your research (Satishprakash, 2020:6). Sampling is done because it is impossible to include the whole population in research. In this study, the following decisions were looked at:

1.9.1 Sampling Procedures

The sampling procedure is a process or a way of acquiring a sample. Sampling is done because it is not possible to include the whole population in research. According

to Satishprakash (2020:6), sampling procedures are “different ways of choosing a subgroup from a population to participate in the study”. In this study, a purposive sampling technique was used to select participants. Participants were selected based on their test performance. In other words, students with low, middle, and high grades were selected.

1.9.2 Population

According to Satishprakash (2020:2), population refers to “the set or group of all the units on which the findings of the research are to be applied”. In this study, the population consisted of all students enrolled in the two bridging Mathematics modules, all former students of the bridging Mathematics modules, two lecturers, and two Heads of Department (HoDs) of each bridging Mathematics module in the Department of Mathematical and Computational Sciences.

1.9.3 Sample

A sample is the number of participants selected to represent the entire population for research by the researcher. It will be impossible to include the entire population in the research due to time or financial constraints. According to Satishprakash (2020:5), a sample can also be defined as “any subset of the population, which represents all the types of elements of the population”.

A purposive sample technique was used, and participants were selected purposefully based on their test performance. This study used a total sample of 10 participants, comprising 3 students from each of the 2 bridging Mathematics modules, 2 lecturers, 2 heads of departments (HoDs), and 2 focus groups per bridging Mathematics module at a rural university. Focus groups comprised of 15 former students who completed the bridging Mathematics modules in 2023. They were selected based on their 2023 final examination results.

1.10 TRUSTWORTHINESS OF THE RESEARCH

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Researchers established the protocols and procedures necessary for a study to be considered worthy of consideration by readers (Amankwaa, 2016). There are various criteria by which you can judge the quality of quantitative and qualitative research. For qualitative research, results in this study were judged by interpretivism criteria, which are credibility, transferability, dependability, and confirmability.

1.10.1 Credibility

Nassaji (2020:28) argued that credibility is all about "the extent to which the research findings and conclusions can be viewed to be believable". In other words, it concerns the accuracy of the findings and the extent to which they accurately reflect the reality of the phenomenon being investigated. Credibility is how confident the qualitative researcher is in the truth of the research study's findings. This boils down to the question: how do you know that your findings are true and accurate? Qualitative research "must manage the risk of research reactivity and bias" (Lietz & Zayas, 2010:188). To ensure credibility, this study employed a triangulation of data methods, including interviews and observations.

1.10.2 Transferability

The nature of transferability, the extent to which findings apply to persons in other settings, differs from other aspects of research in that readers determine how applicable the findings are to their situations (Houghton, Casey, Shaw, & Murphy, 2013). Transferability refers to how the qualitative researcher demonstrates that the research study's findings can be applied to other contexts. In this case, other contexts can refer to similar situations, populations, and phenomena. Researchers support the study's transferability with a rich, detailed description of the context, location, and participants studied, as well as transparency regarding analysis and trustworthiness. Researchers need to provide a vivid picture that informs and resonates with readers (Amankwaa, 2016). To demonstrate that the researcher's conclusions are applicable to various contexts, scenarios, and conditions, this study employed the triangulation approach.

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1.10.3 Confirmability

Confirmability concerns the extent to which others confirm the researcher's interpretations and conclusions (Nassaji, 2020). Confirmability refers to the neutrality or the degree to which the findings are consistent and can be replicated. Confirmability is concerned with establishing that the researcher's interpretations and findings are derived from the data, requiring the researcher to demonstrate how conclusions and interpretations have been reached. The researcher must provide evidence of their methodology. The results of this study were guaranteed to be derived from participant responses rather than from any internal incentive.

1.10.4 Dependability

The constancy of data across time and in many contexts is referred to as dependability (Polit & Beck, 2010). To evaluate the generalizability of the results to different situations, it is crucial to outline the selection criteria and principles, as well as the key attributes of the participants (Moretti, Van Vliet, Bensing, Deledda, Mazzi, Rimondini, & Fletcher, 2011).

This study ensured that all documents related to the investigation were stored securely. An outside researcher can then study such paperwork to assess its accuracy and the degree to which the findings are supported by the data.

1.11 DATA COLLECTION

Kabir (2016:211) defines data collection as "the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes".

As stated by Creswell (2014), procedures in data collection include the research plan, gathering data or information through unstructured or semi-structured monitoring and dialogue, as well as records and visual resources, and creating an agreement to document the information. This unit covers procedures for data collection obtained from the interview process.

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Data was collected in September and October 2024. The researcher collected data through individual interviews, focus group interviews, and classroom observations. Focus group interviews were used because the researcher wanted to draw upon respondents' attitudes, feelings, beliefs, experiences, and reactions from former bridging Mathematics module students in a way that would not be feasible using other methods.

Individual interviews were important because the researcher sought to gain a deeper understanding of people's knowledge, practices, experiences, emotions, beliefs, opinions, and ideas. Thus, the researcher applied the following procedures to collect the data:

1.11.1 Data Collection Procedure

Procedures in data collection comprise the plan for the research, which involves collecting data or information through unstructured or semi-structured monitoring and dialogue, as well as records and visual resources, and constructing an agreement to record the information. This unit comprises procedures for data gathering that are obtained from the interview process. The researcher obtained the information by using a structured interview.

The participants were interviewed in the researcher's office in their own free time to collect primary data. In other words, 6 students, 2 focus groups (9 students for group A module and 6 students for group B module), and 2 lecturers were interviewed, along with 2 Hods. The duration of the interviews was between 30 to 40 minutes. Secondary data was collected through classroom observations.

1.11.2 Data Collection Instruments

Research instruments in qualitative research encompass two types of instruments: primary and secondary. Creswell (2012) stated that research instruments are devices for assessing, monitoring, and recording data. The researcher uses a secondary instrument to verify the results. Data collection instruments are tools employed to

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gather data, including questions, observations, field notes, and sound recording devices or voice recorders. In this study, interviews were documented in field notes and through a voice recorder. An interview schedule and observation schedule were created. Each data collection instrument is briefly described below.

1.11.2.1 Interviews

Interviewing is the process of asking questions and getting answers from participants in a study. Interviews can be structured, semi-structured, or unstructured (Kabir, 2016).

An interview (Individual and focus group) schedule was utilized to gain insight into students' attitudes regarding the teaching and learning of the bridging Mathematics modules, the role of the bridging Mathematics module, factors influencing students' academic performance, challenges encountered by students and lecturers in teaching and learning the bridging Mathematics module, and strategies that influence can be used to improve students' academic performance.

1.11.2.2 Classroom observation

Observation is a key tool for collecting data in qualitative research. According to Creswell (2013), the observations are based on the research purpose and questions, and the researcher may watch the physical setting, participants, activities, interactions, conversations, and behaviours during the observation. Creswell (2013:166) "emphasised the use of senses, including sight, hearing, touch, smell, and taste, and the researcher should realise that writing down everything is impossible. Thus, the researcher may start the observation broadly and then concentrate on the research questions.

In this study, the researcher served as a participant observer, observing and taking notes directly in the classroom. The researcher observed the interactions between Mathematics lecturers and their students during the teaching and learning of the mathematics bridging module. The researcher also observed students' and lecturers' attitudes towards teaching and learning of bridging Mathematics modules.

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1.12 DATA ANALYSIS

Data analysis involves investigating participants' data, arranging it, forming it, and interpreting the information, as the classification of findings constitutes key components of data analysis (Creswell, 2014). Once the data has been collected, it is analysed using various qualitative data analysis techniques. These techniques include coding, categorisation, and interpretation. Similarly, there is no single methodology for data collection in qualitative research, and likewise, there is no single right way to analyse data (Aborisade, 2013).

Several techniques are used to analyse data. Thematic analysis was used in this study. The goal of thematic analysis is to identify themes or patterns within the data that are significant or noteworthy. Those identified themes are then used to address the research.

Data was organised, coded, analysed, and interpreted using thematic analysis. Thematic analysis was the best option in this study because it allows different people to apply personalised approaches to their analysis, and it also makes learning meaningful. It provides flexibility for approaching research patterns in two ways (inductively and deductively). Thematic analysis is a very subjective technique, and it relies on the researcher's judgement.

This study explored lecturers' and students' experiences and perspectives regarding bridging mathematics modules, with the aim of identifying key factors that influence students' academic performance.

1.13 SIGNIFICANCES OF THE STUDY

Mathematics plays a vital role in everyday life. It also serves as a prerequisite for many modules, and as such, learners, when coming to university, realise that they do not meet the minimum requirement to register for what they planned because of low achievement in Mathematics. Students will then be compelled to start to bridge the mathematics.

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According to the Department of Basic Education (DBE) framework (2018:10), "teaching and learning of Mathematics in South African schools is not yielding the intended outcomes of South Africa's education policies and curricula". This is evident from research from many studies conducted by the Department of Basic Education (DBE), universities, and other research agencies in South Africa. Low learner achievement levels are revealed by national and international assessments, such as the Trends in Mathematics and Science Study (TIMSS). The South African government itself has accepted the challenges it is facing and is always coming up with a plan to remedy the situation.

The National Development Plan (NDP) target is to provide all learners in schools with quality education by 2030, especially in literacy, Mathematics, and science. To this effect, the acceptable level of performance to be achieved by the year 2030 has been determined and set at least 50%, and the target of learners and schools performing at this level has also been determined and set at 80%.

Furthermore, the NDP opposes the idea that 450,000 learners should be eligible to study Mathematics at university by 2030, which is good news for South African universities, which are currently struggling to admit more students with high achievement in Mathematics and Science subjects. Hence, universities are settling for students with low achievement in Mathematics, but they allow them to start from a bridging programme or to bridge Mathematics only. Because of that, the transition between school and university studies is a difficult one. The gap between school and university seems to be larger in Mathematics than in other subjects. Bridging courses are very important in assisting those students who do not qualify to register for degrees of their choice because of low achievement in Mathematics. Students cannot do first-year modules if they do not qualify or lack prior knowledge.

By exploring students' academic performance in bridging the mathematics module at university, policymakers and Mathematics lecturers could be assisted in formulating strategies aimed at improving the performance of students at university. This study also came up with some recommendations to the relevant department and even the university itself.

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Students will benefit because bridging modules are designed to increase the academic success of students with low prior knowledge and to reduce dropout rates. By identifying factors that facilitate the performance of university Mathematics bridging module students, policymakers and Mathematics lecturers could be assisted in formulating strategies aimed at improving the performance of students at the university. The findings will also be of practical importance for universities and policymakers who need to decide on the entry requirements for prospective students who intend to study undergraduate degrees that prescribe bridging Mathematics modules. After all these objectives have been achieved, policymakers and Mathematics lecturers could be assisted in formulating strategies aimed at improving the performance of students in a rural university.

1.14 DELIMITATION OF THE STUDY

The study was conducted in one of the rural universities in Limpopo Province. There are many faculties at that university where there are bridging modules, but this study was limited to only one faculty, namely, the faculty of science, engineering and agriculture. No other data was collected from other faculties.

1.15 ETHICAL CONSIDERATIONS

The following steps were considered to ensure that ethical protocols were observed.

1.15.1 Permission to Conduct the Research

The researcher sought permission from the Executive Dean of the Faculty of Science, Engineering and Agriculture to engage with two groups of Mathematics bridging modules. The letter of permission is attached as an appendix.

1.15.2 Informed Consent

Informed consent is one of the founding principles of research ethics. It intends that human participants can enter research freely (voluntarily) with full information about what it means for them to take part and that they give consent before they enter the

research. Mandal and Parija (2014:2) mentioned that "the purpose of informed consent is intended to protect the subject's well-being throughout the trial/research by ensuring that a person understands the nature, purpose and risks involved in giving a biological sample or undergoing a medical intervention".

An explanation of the research was given to the participants, and all the necessary information was also given to them. It was clearly explained that this interview was voluntary, nobody was forced to participate, and selection was based on their academic performance, and they could leave the research at any time without facing any consequences; hence, the participation consent form was signed by the participants.

1.15.3 Confidentiality

Confidentiality refers to a condition in which the researcher knows the identity of research participants but takes steps to protect that identity from being discovered by others (Bos, 2020). The information received from students, lecturers, or the university was confidential. According to Bos (2020:153), "the principle of confidentiality entails an obligation on the part of the researcher to ensure that any use of information obtained from or shared by human subjects respects the dignity and autonomy of the participant and does not violate the interests of individuals or communities."

A document sent or received was encrypted to promote confidentiality. Maintaining the confidentiality of research subjects and research data is essential to the research process (Stiles & Petrila, 2011). The information received from either students, lecturers, or the heads of departments (HoD) was kept confidential by not mentioning or even recording participants' names throughout the research.

1.15.4 Anonymity

Anonymity is a condition in which the identity of individual participants is not known to researchers (Bos, 2020).

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1.16 STRUCTURE OF THE RESEARCH PROJECT

Chapter 1: Introduction and Background to the Study

This chapter presents the background to the study, the statement of the problem, the aim of the study, the research questions, the research objectives, the definitions of key concepts, the significance of the study, and the structure of the research project.

Chapter 2: Theoretical Framework

This chapter exposes the study's Theoretical Framework, which is Vygotsky's 1978 constructive theory. It covers the Zone of Proximal Development (ZPD), Meaningful learning, the Implications of Vygotsky's social constructivism on students' learning, and Vygotsky's social constructivism on teaching methods.

Chapter 3: Literature Review

Empirical literature is reviewed on students' academic performance in bridging Mathematics modules. This includes a description of the bridging course, a preview of bridging courses in some of the universities, locally and internationally, roles played by bridging Mathematics modules in the academic performance of students, attitudes of students towards bridging Mathematics modules, and factors that influence students' academic performance in bridging Mathematics modules. The literature also covers the challenges encountered during the teaching and learning of the mathematics bridging module. Critiques of literature are also discussed in this chapter, and a summary of the chapter is presented.

Chapter 4: Research Methodology

This chapter presents the research paradigm, research design, research methodology, population and sampling, research instrumentation, data collection procedure, data treatment and analysis, ethical considerations, trustworthiness, and summary.

Chapter 5: Presentation, Interpretation, and discussion of findings

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In this chapter, the data collected is analysed and interpreted. Biographical information, contextual analysis, interpretation of qualitative data, and triangulation of data are outlined.

Chapter 6: Summary, Conclusions and Recommendations.

This chapter summarises the study, alluding to the background of and rationale for the study, its findings, the contributions it makes and its implications. Suggestions for future research are also made.

1.17 CONCLUSION

This chapter presented the background to the study, the statement of the problem, the aim of the study, research questions, research objectives, definitions of concepts, the significance of the study and the structure of the research project.

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CHAPTER 2

THEORETICAL FRAMEWORK FOR THE STUDY

2.1 INTRODUCTION

A theoretical framework is a roadmap or foundation of research. Grant and Osanloo (2014:12) define the "theoretical framework as the theory that a research project aligns itself with." Adom, Hussein and Agyem (2018:438) define a theoretical framework as a "blueprint that the researcher often borrows to build his/her research enquiry." According to Swanson (2013), the theoretical framework provides the theoretical assumptions for the larger context of a study and is the foundation or 'lens' by which a study is developed. This framework helps to ground the student's research focus within theoretical underpinnings and to frame the enquiry for data analysis and interpretation.

This research is grounded on Vygotsky's constructive theory, which is based on constructivism, social constructivism, and scaffolding. This study explains constructivism and social constructivism before looking at Vygotsky's theory in detail. The rationale for using this theory is that this study sought to address the gap in teaching and learning Mathematics bridging modules at a rural university.

2.2 CONSTRUCTIVISM

Vygotsky (1978) defined constructivism as an important learning theory that educators use to help their students learn, and this theory is based on the idea that people actively construct their knowledge. This means that learners use their previous knowledge as a foundation and build on it with new things they learn. In other words, learners create new meanings by relating new information to concepts they already understand or know.

According to Vintere (2018:1), the constructivist approach is based on the idea that "knowledge can never be passed from one person to another. The only way to acquire knowledge is to create or construct it". The constructivist approach also changes the

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role of the teacher in the educational process. The task of teachers is to organise the environment so that the student himself can construct the cognitive forms that the teacher wants to give him.

Kalpana (2014:27) argued that constructivism is a "view that emphasises the active role of students in building understanding and making sense of the information and viewed constructivist teaching as learner-centred where students are actively involved in knowledge construction rather than mere passive listeners". Constructivists' views can be organised in two forms: psychological and social.

2.3 SOCIAL CONSTRUCTIVISM

This study has considered social constructivism because it is underpinned by Vygotsky's 1978 constructivist theory. Social constructivism is also called collaborative learning because it is based on interaction, discussion, and sharing among students. Social constructivism focuses on the collaborative nature of learning. Knowledge develops from how people interact with each other, their culture, and society at large (Vygotsky, 1978).

This teaching strategy allows for a range of groupings and interactive methods. These may include total class discussions, small group discussions, or students working in pairs on given projects or assignments. The underlying factor of the theory is that learners work in groups sharing ideas, brainstorming, trying to discover cause and effect, answers to problems, or just creating something new to add to existing knowledge (Akpan, Igwe, Mpamah & Okoro, 2020).

2.4 VYGOTSKY 1978 CONSTRUCTIVE THEORY

In the epigraph to his 1968 book, Ausubel stated: If I had to reduce all educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly (Novak, 2011:65. Vygotsky continues with the work done by Ausubel in the 1968 book, which is more meaningful learning.

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Ausubel believes that learning new knowledge relies on what is already known. That is, the construction of knowledge begins with our observation and recognition of events and objects through concepts we already have. We learn by constructing a network of concepts and adding to them. Ausubel theorised that “people acquire knowledge primarily by being exposed directly to it rather than through discovery” (Çeliköz, Erişen and Şahin, 2019).

Ausubel also believes that new knowledge, learning and maintaining efficiency depend on the adequacy of cognitive structure, whereas the formation of the appropriate cognitive structure is also dependent on effective ways of learning (Adhikari, 2020:1). In Ausubel's view, learning meaningfully, students must relate new knowledge (concepts and propositions) to what they already know (Adhikari, 2020).

This study is underpinned by Vygotsky’s (1978) constructive theory. Vygotsky argued that all cognitive functions originate in and must, therefore, be explained as the product of social interactions and that learning was not simply the assimilation and accommodation of new knowledge by learners; it was the process by which learners were integrated into a knowledge community” (Vygotsky, 1978:3).

Vygotsky believed that the lifelong process of development is dependent on social interaction and that social learning leads to cognitive development. In other words, all learning tasks (irrespective of the level of difficulty) can be performed by learners under adult guidance or with peer collaboration. Vygotsky believes that learners learn meaningfully by doing and experiencing things for themselves. Additionally, constructivists believe that learning should be scaffolded or supported for students to be successful. In Vygotsky’s constructivist theory of learning, learners actively construct their understanding of the world through their interactions with others. This social interaction is essential to cognitive development, as it allows learners to internalise new ideas and concepts. Scaffolding from more experienced or knowledgeable others is also important in this process, as it provides support for learners as they attempt to master new skills or concepts.

The constructivist approach has been applied to education, where it emphasises the importance of students constructing their knowledge rather than simply receiving

information from teachers. It also recognises the role that experience plays in learning, and students need opportunities to explore and interact with their environment to learn effectively. A social constructivist approach influenced by Vygotsky's work emphasises "the social contexts of learning and that knowledge is mutually built and constructed. By interacting with other students, they get the opportunity to share their views and thus generate a shared understanding related to the concept (Bodrova & Leong, 2012:241).

2.5 ZONE OF PROXIMAL DEVELOPMENT (ZPD)

Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), as seen in Figure 1.1 (Chapter 1). This concept highlights the difference between what a learner can achieve independently and what they can achieve with the guidance and support of a more knowledgeable person (Vygotsky, 1978). Vygotsky believes that learners learn best by doing and experiencing things for themselves. Additionally, constructivists believe that learning should be scaffolded or supported for students to be successful.

Vygotsky's theory is important in this study because Vygotsky developed the Zone of Proximal Development (ZPD), which is the difference between what a student can do independently and what the learner can do with the help of a more knowledgeable person. Students who are bridging mathematics modules require gradual guidance until they can function independently. A bridging course aims to address the gap between a student's current knowledge and the required knowledge for a specific program or field. The ZPD helps pinpoint the specific areas where students need support to progress.

For bridging courses, the Zone of Proximal Development (ZPD) is essential because it enables lecturers to comprehend the difference between what students can accomplish on their own and what they can accomplish with aid and to assist students within their zone of proximal development (ZPD), teachers employ scaffolding strategies, including giving more relevant examples, breaking down assignments, or giving tips.

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2.6 MEANINGFUL LEARNING

Social constructivism is a learning theory that "views learning as a social process where students collaborate by engaging in group activities for meaningful learning to take place" (Akpan, Igwe, Mpamah & Okoro, 2020:55).

Kalinowski, Massoquetti, Peres, Larocca, Cunha, Gonçalves and Calixto (2013:959) defined meaningful learning as the provision of a new knowledge structured logically; the existence of knowledge in the cognitive structure that enables the connection with new knowledge, as well as the explicit attitude of apprehending and connecting knowledge with the one that it intends to absorb.

Meaningful learning can be contrasted with rote learning, as seen in the following diagram (Figure 2.1), which is adopted from Novak (2011).

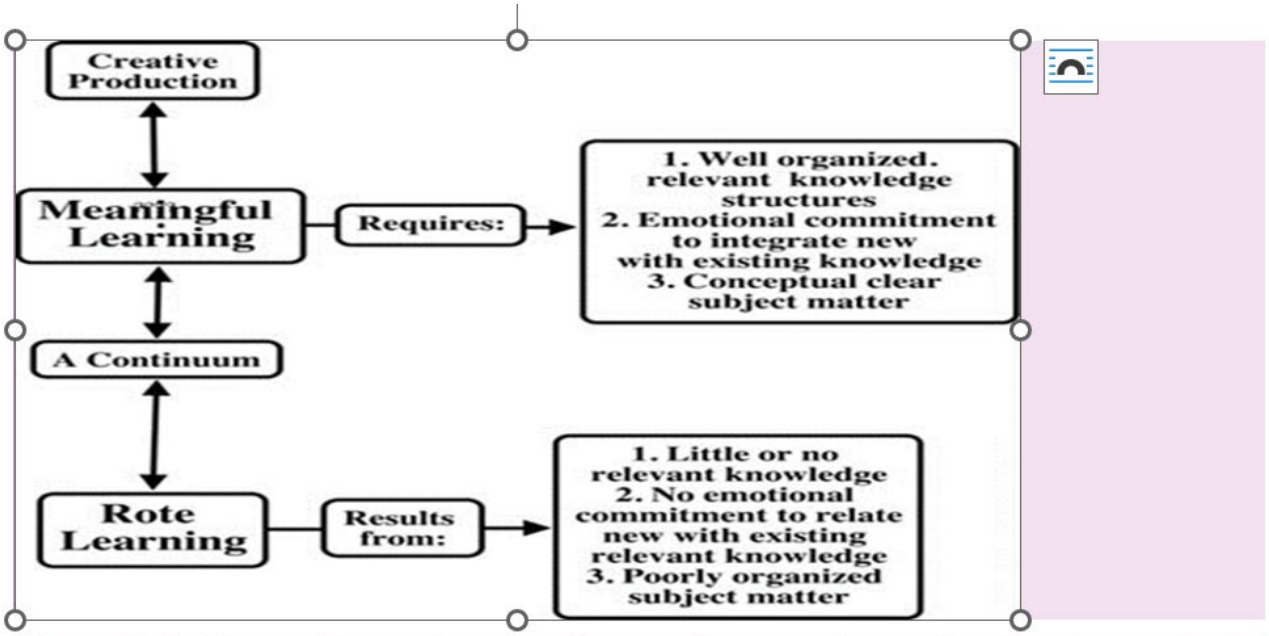


Figure 2.1. The rote-meaning learning continuum shows the requirements for meaningful learning

In Figure 2.1, creativity is seen as essentially very high levels of meaningful learning. Students must demonstrate a positive attitude towards meaningful learning, that is, to show a disposition to relate the new material to their cognitive structure; in other words, learners must choose to learn meaningfully.

The present study explores the attitude of bridging Mathematics students towards teaching and learning Mathematics. What is their attitude towards the meaningful learning of the bridging Mathematics module? If bridging Mathematics modules, students choose to relate the new knowledge with old knowledge, and there is no way they cannot succeed academically. In other words, there will be continuity from Grade 12 work to university work. Information will be stored in long-term memory, and this will help students not to forget what they have been taught in Grade 12, which is the old knowledge. When new information comes, it will be stored not in an empty memory; it will be stored in a memory where there is old knowledge already, and then it will be simple for students to connect new information with old knowledge. Learning itself will be meaningful to the students' everyday lives.

Meaningful learning is relevant to the present study because it encourages active participation and interaction among learners, the teacher, and other components of the teaching-learning process. It also encourages the development of skills, allowing students to develop and use their initiative. It discourages rote learning and passivity on the part of students, stimulates interest and aids retention, develops critical thinking and problem-solving capacity, promotes individual and cooperative learning in the classroom, promotes team spirit among students as they work in groups, and triggers curiosity on the part of learners with activity-based teaching methods employed by the teacher.

The other thing is that the knowledge acquired meaningfully is retained for much longer or for a lifetime. When students retain what they have learnt much longer, their chances of performing academically are enhanced. Most students fail because they cannot recall what they have learnt previously. The information that students learnt meaningfully can be applied in a wide variety of ways to solve new problems or contexts, and students can transfer knowledge in a transferable way.

Bognar, Gajger and Ivic (2015:1) described the following aspects that have recently emerged for constructivism in higher education.

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- Learning is a process of interaction between what we know and what we still need to learn. In learning, the previous knowledge and students' cognitive structure must be considered.

- Learning is a social process- it is not in leads, but in relations between people. By bridging Mathematics, students will observe the behaviour of other students and check the acceptable behaviour to learn from it. Learning through observing will help Mathematics students to adapt and approach situations with confidence.

- Learning is a situational process, meaning participation in certain social and cultural circumstances.

- Learning is a metacognitive process that includes understanding the skills and strategies that enable successful resolutions of problems and using these skills and strategies to learn effectively. Learning is based on the student's activity and autonomy.

2.7 IMPLICATIONS OF SOCIAL VYGOTSKY'S CONSTRUCTIVISM ON STUDENTS' LEARNING

According to Akpan, Igwe, Mpamah, and Okoro (2020:54), the following are the implications of Vygotsky's social constructivism theory.

- They no longer sit down to be informed or loaded by the teacher but discover lesson contents by themselves as they respond to the teacher's promptings in the form of questions, assignments, and project works.

- Students now learn to work in groups as organised by the teacher for effective collaboration or cooperative learning. Bridging Mathematics students will learn to work in groups as this will help them to understand better when discussing with other students.

- Students become co-custodians of knowledge as they share and build on their previous experiences to create new knowledge.

Bridging Mathematics students are those students who come from Grade 12 with low achievement in Mathematics, and they come with Grade 12 experiences in mathematics. In other words, they have little knowledge of mathematics, which they will share with others as they are working in groups.

They take responsibility for learning by actively participating and collaborating in the process. Students should learn to consider the opinions of others by appreciating and investigating new ideas and lessons learnt from their colleagues. They should value every experience, learn from them and be ready to share with their groups to improve their cognitive ability continuously (Akpan, Igwe, Mpamah & Okoro, 2020:54).
The teacher's role in the social constructivist classroom is to facilitate.

2.8 VYGOTSKY'S TEACHING METHODS THAT SHOULD BE ADOPTED BY TEACHERS

The most important single factor influencing learning is what the learner already knows. He further emphasised that teachers must teach learners according to what they know (Ausubel, 1968: iv).

This section presented the most preferred methods that teachers should adopt when teaching Mathematics. According to Akpan, Igwe, Mpamah and Okoro (2020:53), teachers can choose one of the following teaching methods for learning to be meaningful.

- Learner-centred: here, the focus is on the students rather than the teacher. This means the students are urged to be actively involved in their process of learning. They are allowed to come up with their ideas, questions, and definitions.

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Teaching will be learner-centred, where teachers will facilitate and give guidance to students who are bridging Mathematics. These students will be allowed to learn and develop at their own pace.

- Collaborative: here, emphasis is placed on learning through social interaction. This is done by making students work in groups to solve problems, investigate and explore topics/situations to arrive at conclusions. By so doing, they discover or construct knowledge by themselves.

  Teachers will allow bridging Mathematics students to work in groups to solve problems and investigate and explore topics so that they will be able to construct or discover new knowledge. These students are used to social interaction, and it will continue in Grade 12. Offering students feedback and positive encouragement when they make errors will improve their ability to learn and hang onto knowledge gained in school, which will help them to begin to understand where they made mistakes and how to make corrections. Giving students a chance to figure out problems on their own builds their confidence, self-worth and independence, which is a learning strategy that must be explored in any mathematical class.

  If students begin to understand where they have gone wrong and be able to correct themselves, that on its own can improve their chances of success. The present study seeks to develop a tool that will help them find out what students already know and what they don't know. This will also assist the lecturer to know what kind of learning material can be prepared that will be beneficial in bridging Mathematics students.

- Teacher guided: In social constructivist classrooms, collaborative learning is a process of peer interaction that is mediated and structured by the teacher. Discussion can be prompted by the presentation of specific concepts, problems, or scenarios.

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Teachers must prepare teaching guides that will help students to relate their old knowledge with the new knowledge. For example, in Grade 12, learners used either substitution or elimination methods to solve simultaneous equations, that is, the old knowledge they possessed when entering university or tertiary level. At university, students will be taught that simultaneous equations can even be solved by using matrices, which will be a piece of new knowledge for them. This means that lecturers' notes must also include a small part of Grade 12 work and the university work so that students will be able to relate the two. Teachers should use materials that connect with prior knowledge while establishing new knowledge (Adhikari, 2020).

This theory is relevant to the study because by applying Vygotsky's idea to learning Mathematics, the growth of mathematical understanding occurs through a process of connecting earlier thoughts with new mathematical language to create more meaning. In other words, bridging Mathematics students will add new knowledge to their existing knowledge from Grade 12. Bridging Mathematics module, students will use their previous knowledge as a foundation and build on it with new things that they learn from university. The following examinations help students learn better with the help of the teachers or other students. This kind of examination promotes the interaction between students and teachers.

Example: KWL Chart (Application of Vygotsky's Theory in Class)

Before the beginning of a lesson, students may be asked to divide a page into 3 columns. Then, students use the first column to write what they believe they already know (K) about differentiation as an example. In the second column, students add what they would like to know (W) to know about differentiation. Finally, students write what they have learnt (L) in the third column. Creating a KWL chart makes students think about what they already know. That makes them feel comfortable with the new content they are learning. Their interest and focus may expand.

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2.9 CONCLUSION

This chapter presents Vygotsky's theory of constructivism, which underpinned the study. Teaching and learning mathematical concepts are very challenging. Social constructivism, Zone of Proximal Development (ZPD), meaningful learning, implications of Vygotsky's social constructivism on students' learning, and Vygotsky's teaching methods were introduced.

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CHAPTER 3

LITERATURE REVIEW

3.1 INTRODUCTION

This chapter provides an in-depth literature review on students' academic performance in bridging Mathematics modules. A literature review is a survey of scholarly sources on a specific topic. A literature review aims to understand the existing research and debates relevant to a particular topic or area of study and present that knowledge in the form of a written report.

According to Paré, Trudel, Jaana and Kitsiou (2015), literature reviews are essential for identifying what has been written on a subject or topic, determining the extent to which a specific research area reveals any interpretable trends or patterns, aggregating empirical findings related to a narrow research question to support evidence-based practice, generating new frameworks and theories and identifying topics or questions requiring more investigation.

3.2 BRIDGING COURSE

This section provides definitions and explanations of bridging courses in general, universities that offer bridging courses and some of the reviewed literature.

Bridging courses are short, focused learning programmes designed to help learners bridge the gap between high school and university. This means that learners who passed matric but did not get the marks needed to get into a higher education institution can take a bridging course that will allow them to qualify and have another chance to apply. Some universities offer bridging courses as a foundation programme and some as an extended degree programme.

Hochmuth (2020:77) mentioned that "bridging courses in university mathematics education are courses provided by mathematicians for students who do not study

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Mathematics as their major subject but Engineering, Natural Sciences, Informatics, Economics, Social Sciences, Psychology, and Medicine or Life Sciences, to mention a few.

In the University of Sydney (USYD), "participation in the chemistry bridging course is associated with 'bridging the gap' in academic performance between students with no prior Chemistry background and those with a strong background and while the content of the bridging course is a significant contributor to academic success, so too is the confidence in their learning that the course engenders among participants" (Spencer-Briggs & Rourke, 2023:554). Even students themselves are aware of the value of the bridging courses not only to ameliorate prior difficulties with Mathematics and improve their approaches to learning Mathematics, but less transparently, as an important opportunity to facilitate their transition into higher education, meet fellow students and help realise their potential dreams (Gordon & Nicholas, 2012).

A bridging course in Mathematics is necessary and is needed to address academic deficiencies through learning strategies applicable to Mathematics and the student's lack of prior Mathematics knowledge. Bridging courses are also needed to ease the transition from school to university. Now, the study looks at different universities offering bridging courses.

3.2.1 Preview of Bridging Programmes in Some of the Universities Locally and Internationally

This section introduces some of the local and international universities that have bridging programmes and explains how they do it.

3.2.1.1 University of Auckland Park (UAP)

In New Zealand, the University of Auckland Park had the background to the foundation mathematics course for many years, and the basic Mathematics course had provided students whom they felt were under-prepared for the Introductory Mathematics course, with a front end to this course. Upon successful completion of basic Mathematics, students would then embark on Introductory Mathematics, beginning it in Week 6 of

the same (18-week) semester. The same lecturer would teach the class over the semester. Over the last few years, however, as the programme grew and provided access to more students, it was evident that the basic course had become a "five-week sprint" for some. So, though it still assisted many students to regain their confidence with numbers, there appeared to be other (less able) students who still struggled at this level, with the pace and the ideas (University of Auckland Park (UAP) & International College, 2023:6).

3.2.1.2 Northwest University

"If a prospective student lacks only one point on his or her APS, or if it is only the lower-than-required mark for Mathematics that prevents admission, such a student can be admitted provisionally. Then, after passing the Bridging the Mathematical Gap programme at the beginning of an academic year, the student may enrol in ordinary programmes within the BCom field and BSc IT. If a student does not pass the bridging programme but has a final mark of between 40% and 49%, he or she may enrol in one of the extended programmes offered on the campus. In an extended programme, students spread their courses over four rather than three years" (Northwest University Media News on Mathematical Gap, 2017:2).

3.2.1.3 University of Pretoria

"The BCom – Extended Programme has lower entrance requirements than other three-year BCom programmes and is designed to accommodate students who are academically less prepared, but who are willing to work hard to correct chinks in their academic armour, thus earning success and eventually a degree. This programme caters to students whose National Senior Certificate (NSC) results do not comply with the minimum admission requirements for their degree of first choice or who are uncertain about what to study when enrolling at UP. Many students who embark on the BCom Extended Programme have excelled in their academic programmes as they successfully bridged the gap between school and university" (University of Pretoria Yearbook, 2022:1).

3.2.1.4 University of Limpopo (UL)

The University of Limpopo offers a bridging programme called the Extended Curriculum Programme (ECP). "This programme is linked to the corresponding

approved regular undergraduate degree programmes but allows students an additional year to achieve the learning outcomes. The results of the Placement Tests are relevant to gaining access to these programmes" (University of Limpopo Undergraduate Prospectus, 2024:2).

3.2.1.5 Central University of Technology (CUT)

In CUT, a "bridging programme is called Extended Curriculum Programmes (ECPs), "and it is designed to equip students who do not meet the minimum requirements with the necessary competencies to be successful in their studies. Academic support and skills development are integrated with regular academic work. The key role of extended provision is, therefore, to support educationally disadvantaged students who are underprepared despite meeting minimum admission criteria by enabling them to be placed in an extended curriculum programme that will provide them with the academic foundation to complete their studies. A student must pass all instructional offerings of the first year of the ECP to continue with the subsequent year of study in the ECP. A student enrolled in the ECP may not change to the regular programme even after completing the first year of the ECP. The student must complete the ECP in full" (Central University of Technology (CUT) & Free State, Media News on Extended Bridging Programme (ECP), 2024:1).

3.2.1.6 Nelson Mandela Metropolitan University (NMMU)

In this University, the bridging programme has been renamed the Extended Curricula Programme (ECP). ECP has been designed to equip students who do not meet the minimum admission requirements with the necessary competencies to be successful in their studies at this university. Academic support and skills development are integrated with regular academic work. In the first two years of the extended programme, students are equipped with the necessary skills and competencies needed to complete their studies successfully (Nelson Mandela University, Extended Curricula Programme, 2022:1)

3.2.1.7 Vaal University of Technology (VUT)

VUT provides a bridging programme called the Extended Curriculum (EC). The purpose of the Extended Curriculum (EC) is to improve the academic performance of students who are at risk due to their educational backgrounds. The key role of the

extended qualification is, therefore, to support educationally disadvantaged students who are underprepared despite meeting minimum admission criteria by enabling them to be placed on an extended curriculum that will give them the academic foundations for completing their studies (The Department of Higher Education and Training (DHET) - Foundation Provision in Ministerial Approved Programmes, 2012: 1-5).

3.2.1.8 University of South Africa (UNISA)

UNISA provides a bridging programme called the "Extended Programme (Agricultural Business and Management Stream). To enter a degree, a student must comply with all admission requirements, including the minimum APS of 20, and must be eligible for admission into degree studies. Applicants who are admitted to the degree with an APS of 20 to 24 will be placed in the extended (+1 year) Degree curriculum. Applicants who do not comply with the above requirements should consider applying for a lower-level qualification for which they meet the statutory and additional requirements (University of South Africa extended Science Pathway, 2023:4).

3.2.1.9 University of Venda

University of Venda (UNIVEN) provides a bridging programme called the Foundation Programme (FP). It is offered to any student who does not qualify for the degree programme of his/her choice and has met the requirements for a bachelor's degree or Grade 12 with university exemption plus an APS of 28 to 32, excluding life orientation, an opportunity to be considered for admission into the extended bridging programme. This extended bridging programme is done for one year only, and then for students to proceed to the first year, they should have obtained at least 120 credits.

All students with low achievement in Grade 12 Mathematics and who want to do a Bachelor of Commerce degree must start with a bridging Mathematics module called MAT0143/0543 or MAT0144/544. These modules are done in the first semester. If they fail, they still have another chance during the second semester to repeat those modules, but with different codes (MAT0243/0643 or MAT0144/0644). The Department of Mathematical and Computational Sciences has a BSc Foundation Programme for students with low achievement in Grade 12 Mathematics who want to do a Bachelor of Science degree. This is a semester programme (University of Venda (UNIVEN) Undergraduate Student Information Brochure, 2023:19).

3.3 ROLES OF BRIDGING MATHEMATICS MODULES IN BRIDGING MATHEMATICS MODULES STUDENTS' ACADEMIC PERFORMANCE

Bridging Mathematics modules play a vital role in students' academic performance because some students cannot cope with first-year modules when attending university. According to Rylands and Coady's (2009:741) study, "students lack the appropriate mathematical background to cope with first-year Mathematics and Science subjects, which increases the failure rate. This means that without a mathematical background, most students cannot succeed in first-year Mathematics and even in modules related to Mathematics."

Bridging courses are designed to increase the academic success of students with low prior knowledge and reduce the dropout rate. According to Eitemüller and Habig (2020:561), bridging course participants achieve significantly better examination results than their fellow students who did not enrol in the bridging course. Poladian and Nicholas (2013) also confirmed the findings from Eitemüller and Habig (2020:561), who also found that "students who transitioned through the preparatory programme felt well-prepared for their undergraduate Mathematics. Students who are well prepared achieve better than those who are not well prepared, and according to Poladian and Nicholas (2013), students who are not well prepared are those who did not attend the preparatory programme.

Sue and Nicholas (2012:1) showed that "students are aware of the value of the bridging courses not only to ameliorate prior difficulties with Mathematics and improve their approaches to learning Mathematics but, less transparently, as an important opportunity to facilitate their transition into higher education, meet fellow students and help realise their potential."

Chances of success in and engagement with Mathematics for students who enter university with a weak Mathematics background were analysed by Varsavsky (2010), and his findings were not different when compared to students who enter university with an intermediate Mathematics preparation. The biggest contrast in performance and engagement is with those students who have studied Mathematics in senior secondary school to an advanced level.

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In Germany, all universities complain that the Mathematics skills of students entering the higher education system do not meet the level demanded by universities, which is a major problem, particularly in Mathematics-related study programmes such as Economics, Engineering, or Science, then to bridge the gap, almost all universities offer some bridging course called Remedial Mathematics courses (Büchele, 2020).

Bridging courses seem to be an appropriate remedial measure to raise students' skills to a level matching that of their non-treated fellow students. However, even if remedial courses have positive effects and can reduce heterogeneity, students are often still not adequately prepared for higher education, especially in Mathematics (Büchele, 2020:8).

According to Dekkers, Adams and Elliott (2011:2), Central Queensland University (CQU) assists with the transition of students from secondary to university by providing a bridging programme (CQUniACCESS) to prepare students for entry into university regardless of their former skills and educational achievements. CQU also provides dedicated academic support centres to assist undergraduate students with Mathematics, and in 2011, CQU examined a new readiness programme to identify and assist students at risk before the commencement of their undergraduate programme.

Furthermore, in Australia, Central Queensland University introduces “a Mathematics Learning Centre (MLC) just to deliver Mathematics courses into a bridging programme and to provide academic assistance and resources to undergraduate students having trouble with a mathematical component of their programme” (Dekkers, Adams & Elliott, 2011:2).

Gordon and Nicholas (2013) looked at prior decisions and experiences about Mathematics of students in bridging courses, and their findings showed that the major reasons for students taking lower levels of Mathematics in senior year(s), or dropping Mathematics, include finding enough time for non-Mathematics subjects, confidence in mathematical capability, advice and maximising potential ranking for university admission.

Newman, Lloyd and Thomas (2007:33) argued that students who entered engineering degree programmes through the bridging technology with Mathematics route performed better than their fellow students in both mathematical and non-mathematical module assessments. Johnston and Keeffe (2016:233) found that there were statistically significant increases in self-efficacy scores across some, but not all, of the mathematical topic areas and that there was an increase in the retention rates of adult learners who participated in Head Start Mathematics compared to those who did not.

The performance of those students who enter university through the bridging programme is good compared to those who did not go through the bridging programme. It was also confirmed by Eitemüller and Habig (2020:561), who researched and found that bridging course participants achieved significantly better examination results than their fellow students who did not enrol in the bridging course.

Ssempebwa, Eduan and Mulumba (2012) found no significant difference in the academic performance of students who enrolled through the university bridging programme and those who just enrolled straight. Most of the researchers discovered that there is a big difference in the academic performance of students who enrolled through bridging programmes.

Knowing and understanding the importance and roles played by bridging courses, Raines (2012:1) introduces the preliminary summer bridging programme on Pre-College stems (PCR) majors, and his study suggests that student participation in the summer bridge programme positively impacted academic performance and persistence rates of the students involved. The mathematics instruction participants received in the summer appeared to benefit these students in their college Mathematics course, and survey findings indicated students seemed to have positive reactions to the summer bridge programme. The overall performance of students who enrolled in the bridging/foundation programme was positively associated with increasing Grade Point Average (GPA) and passing all courses in the first year (Curtis, Wikaire, Jiang, McMillan, Loto, Fonua, Herbert, Hori, Ko, Newport & Salter, 2017:151).

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Mathematics plays a vital role as a prerequisite for other subjects like Chemistry. Akinoso (2017:40) reported that students' attitudes towards Mathematics correlate with attitudes and performance in Chemistry. It was discovered that for students to do well in Chemistry, they must also do well in Mathematics. In other words, Mathematics and Chemistry are related subjects. Performance in Mathematics affects performance in Chemistry.

Badmus and Jita (2023:389) revealed that further Mathematics is a strong predictor of students' performance in Physics. This position advises that students should be encouraged to undertake further Mathematics as studies have found it to be useful in tertiary education, especially in STEM fields. According to Lake, Wallin, Woolcott, Boyd, Foster, Markopoulos and Boyd (2017:285), pre-university Mathematics skills were identified as significant in student retention and Mathematics success at university, and a specific focus on student pre-university Mathematics skill level was found to be more effective in providing help, rather than simply focusing on a particularly at-risk group.

Shaban (2015:41) revealed that mathematics subjects' grades have a significant positive effect on the academic performance of the accounting department students. In other words, there is a correlation between Mathematics and Accounting. In Indonesia, the University of Sumatera Barat, at the Faculty of Economics, Syahrial and Hendra (2023:303) discovered that there is a significant relationship between numerical ability and the results of learning Economics and Mathematics.

3.4 ATTITUDES OF STUDENTS TOWARDS BRIDGING MATHEMATICS MODULES

Attitude can be defined as how a person views and evaluates something or someone, a predisposition or a tendency to respond positively or negatively towards a certain idea, object, person, or situation (Cherry, 2018:1). According to Cherry (2018:1), attitude is traditionally structured along three dimensions: cognitive (perceptions and beliefs), affective (likes and dislikes, feelings, or evoked emotions), and behavioural

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(actions or expressed intentions towards the object based upon the “cognitive” and “affective” responses (Vargas-Sánchez, Plaza-Mejía & Porras-Bueno, 2016:52).

Students’ attitude towards Mathematics influences the efforts they put into understanding and practising mathematical concepts and skills, which was supported by Hwang and Son (2021:6), who showed that students with positive attitudes towards Mathematics had higher Mathematics achievement than students with negative attitudes. Students with a positive attitude towards Mathematics tended to have high achievement in Mathematics.

Mathematics must be taught for understanding, not just to cram, pass, and forget. Teaching methods must be in such a way that students will be able to understand the lesson and hence get more knowledge and more skills; otherwise, students will develop a negative attitude towards Mathematics. Some researchers have identified important factors that contribute to students’ attitudes towards learning Mathematics (Attard, 2012:9; Mata, Monteiro & Peixoto, 2012:1). These include the students themselves, the school, the teachers’ beliefs and attitudes, and their teaching methods.

It was also confirmed by Mensah, Okyere and Kuranchie (2013:1), who discovered that teachers’ teaching methods have a major influence on students’ attitudes. Students' attitudes can be formed by how teaching and learning take place. In other words, how students learn and how teachers present their lessons can influence the attitude of students towards the subject, in this case, Mathematics. That is why when students learn in a sporting context, their confidence, seeing the importance of Mathematics, and engagement increase and hence maximise their chances of success in Mathematics (Sanchal & Sharma, 2017:34). Researchers like Odogwu and Benedicta (2015:153) argued that there is a direct link between students’ attitudes towards Mathematics and student outcomes.

Researchers like Attard (2012:9) and Mata, Monteiro and Peixoto (2012:1) identified important factors that contribute to students’ attitudes towards learning Mathematics. These include the students themselves, the school, the teachers’ beliefs and attitudes and their teaching methods. The teachers’ teaching method has a major influence on

students' attitudes (Mensah, Okyere & Kuranchie, 2013:1). Kele (2018:65) found that 'factors associated with individual students' knowledge of the subject and their classroom experience, as well as the attitudes of their teachers and peers, had a negative and positive impact on what students knew and how they thought about their Mathematics learning'.

Ndifor and Ngeche (2017) researched a significant relationship between student attitudes and performance in Mathematics, and their findings specifically revealed that the cognitive, affective, and behavioural attitudes of students influence their performance in Mathematics.

According to Komarraju and Nadler (2013:67), students' belief about themselves have been consistently demonstrated to play significant and positive roles in influencing students' performance. Ajisuksmo and Saputri (2017:486) investigated the influence of attitudes towards Mathematics and metacognitive awareness on Mathematics achievements, and their results revealed that attitudes towards mathematics and students' Mathematics achievement were significantly correlated ($r = 0.505$; $p < 0.001$).

Núñez-Peña, Pellicioni and Bono (2013:36) showed that low performance on the Mathematics course was related to Mathematics anxiety and negative attitudes towards mathematics, and they further suggested that these factors may affect students' performance and should therefore be considered in attempts to improve students' learning processes in methodological courses of this kind. Lecturers must always have a positive attitude towards teaching Mathematics; otherwise, it will hurt students. Ekperi, Onwuka, and Nyejirime (2019:205) discovered that the attitudes of lecturers correlated positively and significantly with students' academic performance.

Mazana, Montero and Respickius (2019:207) showed that students exhibit a positive attitude towards Mathematics at the beginning of their studies. Still, their attitude becomes less positive as the students move forward to higher levels of education and a significant positive weak correlation between students' attitudes. Performance was established, and their studies further found that Mathematics enjoyment and attitude significantly predicted students' performance.

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Leong and Alexander (2014:609) argued that students with lower and average Mathematics achievement hold more positive attitudes towards using a web-based homework platform compared to higher-achieving students. Based on their results, it was noted that web-based homework platforms served an important role in student learning and attitudes towards Mathematics in developmental courses, likely because the immediate feedback given helped to improve student understanding.

Yee (2010:641) indicated that students had positive attitudes towards Mathematics but lacked intrinsic motivation to do Mathematics, and students were extrinsically motivated to study Mathematics, but the relationship between extrinsic motivation and achievement was weak. However, there was a significant positive correlation between intrinsic motivation and achievement. Al-Agili, Mamat, Abdullah and Maad (2012) showed that the teacher's attribution and students' attitude towards Mathematics were the highest and lowest factors influencing the students' achievement, respectively.

Abdelkarim and Abuiyada (2016:124) conducted research on the effect of peer teaching on the academic achievement of undergraduate students in Mathematics, and their study found that the peer teaching strategy is an active tool to increase mathematical achievement. According to Rylands and Coady (2009:741), students lack the appropriate mathematical background to cope with first-year Mathematics and Science subjects, which increases the failure rate.

Nicholas, Poladian, Mack and Wilson (2015:43) argued that the higher levels of Mathematics taken in senior secondary school are strong predictors of success in first-year science and Mathematics, but that those students who achieve in the top bands of each level of Mathematics taken in senior secondary school can and often do outperform their peers who study a higher level of Mathematics at school but achieve a lower band result.

Poladian and Nicholas (2013:1) find that students who transitioned through the preparatory programme felt well prepared for their undergraduate Mathematics. However, a greater proportion of these students either withdrew from the undergraduate quantitative course that they had enrolled in or achieved lower grades

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when compared to other survey respondents who had entered university through more traditional pathways.

Researchers like Attard (2012:9) and Mata, Monteiro and Peixoto (2012:1) identified important factors contributing to students' attitudes towards learning Mathematics. These include the students, the school, the teachers' beliefs and attitudes and teaching methods. The teachers' teaching method has a major influence on students' attitudes (Mensah, Okyere & Kuranchie, 2013:2).

Akinoso (2017:40) reported that students' attitudes to Mathematics correlate with their attitudes and performance in Chemistry. It was discovered that for students to do well in Chemistry, they must also do well in Mathematics. In other words, Mathematics and Chemistry are related subjects. Performance in Chemistry affects performance in mathematics.

Teachers can do many things to facilitate classroom learning to alleviate students' engagement level and confidence in learning Mathematics (Attard, 2012:9; Kele & Sharma, 2014:33). This can be achieved by implementing meaningful activities embedded in real-life contexts (Kacerja, 2012).

Most students who transitioned through the preparatory programme felt well-prepared for their undergraduate Mathematics. However, a greater proportion of these students either withdrew from the undergraduate quantitative course that they had enrolled in or achieved lower grades when compared to other survey students who had entered university through more traditional pathways (Robinson, Galligan, Hussain, Abdullah, Frederiks & Wandel, 2019). Quaye (2015:59) supports the view that attitudinal variables are significant indicators of mathematical achievement.

Anuar, Abdullah and Hod (2020:269) showed that there was no association between learning styles and attitudes towards academic achievement. Lisciandro, Jones and Geerlings (2018:13) found that there was an incongruity between students' expectations of what future study would entail and the realities of their degree choices and career aspirations.

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Students' well-being in the university environment is very important, especially to those students who are starting their degrees from bridging programmes. Eloff, O'Neil and Kanengoni (2021:1) found that university lecturers play a substantive role in the well-being of undergraduate students. In other words, university lecturers' attitude plays a big role in undergraduate students' well-being, especially the first-year students who are coming from the secondary level. Undergraduate university students need lecturers' support, lecturers' competence, lecturers' availability, interaction, and the lecturer's attitude towards their work (Eloff, O'Neil & Kanengoni, 2021:1).

We now focus on an important part of the bridging course, students' prior decision-making: their understandings of 'assumed knowledge' for their Mathematics units at university. In other words, when new notations and other mathematical concepts are introduced at university, some students develop an attitude. Now, we look at different factors that can influence the way attitudes are formed and the reason why attitudes are formed.

3.4.1 Factors that influence the formation of attitudes towards bridging modules

3.4.1.1 Students experience

Attitudes form directly because of experience. Johnson, Martinez-Berman and Curley (2022) argued that attitudes are key to understanding individual experiences. They may emerge due to direct personal experience, or they may result from observation (Cherry, 2018:2). This study focuses on what students are experiencing in bridging Mathematics class because their experiences can form an attitude, either positive or negative. What bridging Mathematics students encounter in their classrooms is a strong determinant of attitude formation.

Kaur, McLoughlin, and Grimes (2022) explored factors that influence students' experiences of Mathematics and science transition from primary to secondary school, the implications of these experiences, and measures that have been used to support students during these transitions. They showed factors such as student self-regulation, school and academic-related, and social factors that contribute to shaping

students' positive or negative experiences of Mathematics and science transitions influence students' experiences of Mathematics and Science transition.

3.4.1.2 Social factors

According to Cherry (2018), social roles and social norms can have a strong influence on attitudes. Social roles relate to how people are expected to behave in a particular role or context, and social norms involve societies in terms of what behaviours are considered appropriate.

According to Wang and Zhang (2021), social factors such as family support and friends' support influence in formation positive attitude. Mathematical classroom rules can influence students' behaviour and hence form students' attitudes towards teaching and learning, bridging mathematics. How students are expected to behave in mathematical classrooms may form attitudes.

3.4.1.3 Observation

Students also learn attitudes by observing the people around them; in this case, the people around students will be the lecturers and other students. When someone you admire greatly espouses a particular attitude, you are more likely to develop the same beliefs. According to Creswell (2013), the observations are based on the research purpose and questions. For example, students will spend a great deal of time observing the attitudes of their lecturers towards bridging Mathematics modules and may begin to demonstrate similar attitudes towards bridging mathematics modules. Students will observe their lecturer's behaviour before, during, and even after teaching.

3.4.1.4 Conditioning

According to Cherry (2018:2), operant conditioning can also be used to "influence how attitudes develop." Feedback from other students who have already taken Mathematics bridging courses can form an attitude towards students. Negative feedback or positive feedback from other students who are not taking bridging Mathematics courses can cause students to develop negative or positive opinions about teaching and learning bridging Mathematics courses.

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3.4.1.5 Learning

Attitudes can be formed in a variety of ways. The method lecturers use in Mathematics bridging courses can influence students' attitudes toward teaching and learning Mathematics. Sanchal and Sharma (2016) reiterated that when students learn in a sporting context, their attitude, confidence, and understanding of the importance of Mathematics and engagement increase. In other words, students develop positive attitudes when learning in a sporting context. The method of teaching can help students develop positive or negative associations with Mathematics bridging courses.

3.4.2 Factors that Influence Students' Academic Performance in Bridging Mathematics Modules

This section describes academic performance and establishes some factors that contribute to the student's academic performance.

3.4.2.1 Academic Performance

Talib and Sansgiry (2012:265) defined academic performance or achievement as "the extent to which a student, teacher, or institution has attained their short or long-term educational goals and is measured either by continuous assessment or Cumulative Grade Point Average (CGPA)." William (2020) argued that academic performance extends to achievement outside the classroom. Some of the brightest students don't earn straight as but are extremely well-rounded, succeeding at everything from music to athletics. The ability to master a diverse set of skills illustrates intelligence, curiosity and persistence, qualities attractive to universities and employers.

In the Australian Catholic University (ACU), Social Sciences such as Psychology and Economics require statistical skills, which also require knowledge of Mathematics. Even business students, such as marketing and accounting students, need the necessary mathematical skills to complete their degrees at university. Stenberg, Varua and Yong (2010:1) suggested that "student success in a core business subject is dependent on their mathematical aptitude, attitude and type of secondary schooling, whether in government or non-government schools" (Stenberg, Varua & Yong, 2010:1).

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Nowadays, you need a post-secondary education to get a job. Most institutions, if not all, have a strategic plan wherein student success is emphasised. The overall academic performance of the university will attract many students to come and join the institution. This is like at UNIVEN, where there is a strategic plan (2021-2025), where the university plans to increase students' success rate, graduation rate, and throughput rate by 85%, 22% and 65%, respectively.

Academic achievement is important for the successful development of young people in society, and students who do well in school are better able to make the transition into adulthood and achieve occupational and economic success.

3.4.2.2 Factors that Influence Students' Academic Performance

(i) Teaching methods

Lecturers must be able to choose the best possible methods for teaching Mathematics to students in bridging programmes, as teaching methods can also influence students' academic performance. This is why Ganyaupfu (2013:29) demonstrated that the teacher-student interactive method was the most effective, followed by the student-centred method, while the teacher-centred approach was the least effective teaching method.

Ganyaupfu (2013:29) researched teaching methods and students' academic performance and discovered that the teacher-student interactive method was the most effective teaching method, followed by the student-centred method, while the teacher-centred one was the least effective. According to Zakariya and Bamidele (2015:1), factors attributed to poor academic performance include poor infrastructure, emotional problems, and weakness in the Mathematics background, among others.

In Islamic Azad University, Kazemi and Ghoraishi (2012:1) showed that the problem-based learning (PBL) teaching approach is more effective than traditional methods in teaching Mathematics. In other words, students learn better when the lecturer uses the problem-based approach (PBL) method in teaching Mathematics. According to

Kazemi and Ghoraishi (2012:1), the Problem-based Learning (PBL) approach could influence students' performance and attitude towards Mathematics.

When the academic performance of students is poor, a good lecturer must introduce another teaching method to enhance students' performance, like what Acelajado (2011:2) did. He used blended learning as a strategy for improving the Mathematics achievement of students in a bridging programme. The findings revealed a significant difference in the mean achievements of the two groups in all topics under consideration, favoring the blended learning strategy. Students' general reactions to using the blended learning strategy highlight the benefits of having multiple learning alternatives, an improved attitude and confidence in Mathematics, and the increased motivation and enjoyment this strategy provides in understanding the lessons. Mushtaq and Khan (2012) found that factors such as teaching skills, study hours, family size, and parental involvement are associated with students' academic performance.

(ii) Motivation

Afzal, Ali, Khan, and Hamid (2010:80) showed that student motivation is an important factor in success. Tadese, Yeshaneh, and Mulu (2022:1) investigated the determinants of academic performance. Their findings indicated that only two-thirds (66%) of university students achieve good academic grades. Age, faculty, and cigarette smoking were found to have a statistically significant association with academic performance. When students are motivated, they begin to believe in themselves, and this belief has been consistently demonstrated to play significant and positive roles in influencing students' performance (Komarraju & Nadler, 2013). Furthermore, students' motivation will lead to more hours of study, which will then influence their academic performance.

Enu, Agyman and Nkum (2015:268) revealed that inadequate teaching and learning materials, as well as the lecturer's method of instruction, are some of the factors that affect students' performance, and they further argued that teachers' and students' self-motivation also influences Mathematics performance.

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(iii) Classroom environment

Any environment influences academic performance, whether in the classroom or outside of it. In Northern China, Yin, Shi, Yi Tam, and Lu (2020) analysed a sample of 1443 undergraduate students from a university. Their study not only found that the mathematics classroom environment was associated with both affective and cognitive Mathematics outcomes but also confirmed the mediating role of Mathematics beliefs. Specifically, a desirable classroom environment was related to students' cohesive conceptions, enhanced self-efficacy, and higher Mathematics achievement.

On the other hand, Gordon and Nicholas (2010:38) found that almost all teachers expressed views indicating that the distinctive environment of a Mathematics bridging course presented singular challenges for developing appropriate teaching approaches. They discussed the challenges they faced in teaching a group of students with diverse mathematical backgrounds in such a short timeframe. It was discovered that students' learning of new notations and mathematical concepts was daunting, and they reported difficulty adjusting to independent study and learning in the 'university way' (Gordon & Nicholas, 2013:115). Abubakar, Bada and Adegboyega's (2012:110) study showed that age and gender could not be regarded as determinants of the academic success of Mathematics students.

(iv) Tutorials

According to McKay (2016:58), attending tutorials had a positive effect on the academic performance of the students; however, a poor or weak tutor can negatively affect learning. In other words, a good tutor improves the performance of students, and a weak tutor will not improve the performance of students. Ganyaupfu (2013:7) revealed that students build a better understanding of the main concepts more effectively when they are engaged in solving problems during class activities.

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(v) Class attendance

Students' class attendance contributes to their performance, as shown by Guleker and Keci (2014:3), who discovered that students who attend classes always perform better than those who do not attend classes. This was also confirmed by Sothan (2019), who showed that class attendance is one of the factors that influence students' academic performance.

(vi) Class size

Another determinant of academic success was discovered by Peter and Ligembe (2022:109), whose findings indicated that big or small class size has an impact on students' performance, and students do not perform well in big classes as it causes resources to be inadequate, lowers student performance, and ineffective classroom instructions.

(vii) Time management

Time management is the process of organising and planning how to divide your time between different activities. Gupta and Chitkara (2018:7) showed that both long-term time management and short-term time management are significant predictors of academic performance. Thus, the good predictor of academic achievement was found to be the combined effect of long-term and short-term time management.

According to Gordon and Nicholas (2013), students do not have enough time for non-Mathematics subjects and lack confidence in mathematical capability, advice, and perceived strategies for maximising potential ranking for university admission, which are contributing factors to the academic performance of students.

Guinocor, Almerino, Mamites, Lumayag, Villaganas and Capuyan (2020:11) conducted research on the mathematics academic performance of students at a Philippine State University (PSU) and found that most of the students academically performed well because they managed time very well and had more time to study

Mathematics. Furthermore, the study orientation of the students had a very significant relationship to their academic performance, wherein students with high study orientation tended to achieve more compared to the students with lower study orientation.

(viii) Prior mathematical knowledge

According to Vygotsky (1978), constructivism is an important learning theory that educators use to help their students learn. It is based on the idea that people actively construct or make their knowledge, and that reality is determined by their experiences as learners. Learners use their previous knowledge as a foundation and build on it with new things that they learn.

Kiwanuka, Van Damme, Noortgate, Anumendem and Namusisi (2015) argued that prior Mathematics achievement and class mean of prior Mathematics achievement were significant predictors of mathematics achievement, which is also confirmed by Kizito, Munyakazi and Basuayi (2016), who tested and found that factors such as prior academic knowledge were described as a student's confidence in the ability to perform mathematical tasks successfully stands out as an important factor in improving student mathematical performance.

According to Rylands and Coady (2009), students lack the appropriate mathematical background to cope with first-year Mathematics and Science subjects, which increases the failure rate. Teachers can do many things to facilitate classroom learning to alleviate students' engagement level and confidence in learning Mathematics (Attard, 2012:9; Kele & Sharma, 2014). This can be achieved by implementing meaningful activities embedded in real-life contexts.

3.5 CHALLENGES ENCOUNTERED WHEN TEACHING AND LEARNING BRIDGING MATHEMATICS MODULES

Teaching and learning are the processes that take place between learners and teachers. In this study, the learners were students, and the teachers were lecturers. Teaching can be explained as engagement with learners to enable their understanding

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and application of knowledge, concepts, and processes, while learning is the acquisition of knowledge or skills through study, experience, or being taught. Lecturers teach, and students acquire knowledge and skills.

Like any module, the teaching and learning mathematics bridging module has challenges affecting student performance. The Bridging Mathematics module has its challenge of many topics to be covered within a concise space of time, as pointed out by Gordon and Nicholas (2010:38), who revealed that almost all teachers expressed views indicating that the distinctive environment of a Mathematics bridging course presented singular challenges for developing appropriate teaching approaches. They discussed the challenges they faced in teaching a group of students with diverse mathematical backgrounds in such a short time frame.

Another challenge, as mentioned by Mulwa (2015:27), is that students have difficulties in using mathematical terms and their related concepts. Mulwa (2015:27) added the way these notations can be introduced to learners.

3.5.1 Teaching Methods

Most students, when they go to university, fail to cope with the lecturing method the lecturer is using. They are used to teaching methods from Grade 12, but at the university level, more work is done by the students. Not only do students encounter challenges, but teachers also face challenges as they teach Mathematics. Literature comes up with challenges teachers encounter in teaching Mathematics online, and it was found that older teachers found it difficult to develop interesting content, describe, and provide feedback using e-learning systems (Bontogon, 2022:324)

3.5.2 Language Barrier

Many students at university have problems with communication. The language barrier is a challenge that students encounter. Literature pointed out that lecturers encouraged students to communicate in English; however, not all of them managed to do that, and this is supported by this literature (Hugo & Lenyai, 2013:9).

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3.6 CRITIQUE OF LITERATURE

Literature showed the importance of bridging Mathematics courses or modules. Most of the literature showed that those students who went through the bridging programme performed better than those who did not go through the bridging programme. According to Eitemüller and Habig (2020), students who went through the preparatory programme felt well-prepared and the students who take bridge courses do noticeably better on examinations than their peers who did not take the course. Poladian and Nicholas (2013) corroborated these findings. Well-prepared students achieve better than those who are not well-prepared. According to Poladian and Nicholas (2013), students who are not well prepared are those who did not attend the preparatory programme. On the other hand, Sempebwa, Jude, Eduan, Wilson, Mulumba, Fawz and Nassi (2012) demonstrated that there is no significant difference in the academic performance of those who enrolled through the university bridging programme and those who just enrolled straight at Kampala International University in East Africa.

Literature asserts that students' attitude has a major influence on academic performance. This is confirmed by Quaye (2015), who supported the view that attitudinal variables are significant indicators of mathematical achievement. It was discovered through a literature review those factors such as teaching methods, environment, time management, and others have a major influence on students' academic performance. It was also confirmed by Mensah, Okyere and Kuranchie (2013), who found that students' attitudes are significantly influenced by the way teachers teach.

The literature revealed some challenges that teachers encountered when teaching Mathematics bridging courses. According to Gordon and Nicholas (2010), nearly all teachers expressed opinions that the unique setting of a Mathematics bridging course presented unique challenges for creating effective teaching strategies. This highlights the difficulty of covering a lot of material in a short amount of time. They talked about the difficulties they encountered when instructing a group of pupils with varying backgrounds in Mathematics in such a short amount of time. Mulwa (2015) noted another difficulty, which demonstrated that pupils struggle with the use of

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mathematical words and related concepts. Mulwa (2015) also developed a method for introducing these notations to students.

According to the literature review, several factors, including teaching strategies, attitudes, and the learning environment, affect Mathematics students' academic achievement and can also shape their attitudes towards Mathematics. This study was conducted since the educational performance of bridging mathematics students was not considered in any of the evaluated literature.

3.7 CONCLUSION

This chapter reviewed the literature according to the aim of the research, which is to explore factors that influence students' academic performance in bridging Mathematics modules at a rural university. The literature review found that factors such as teaching methods, attitudes, and learning environments influence the academic performance of Mathematics students and can also form an attitude towards students. None of the literature reviewed considered the educational performance of bridging Mathematics students; hence, this study focuses on Most studies showed that, to succeed in first-year Mathematics, students must have previous knowledge of Grade 12 Mathematics. Otherwise, they will have to start from a bridging Mathematics programme to acquire that knowledge. According to Vygotsky's learning theory, learning new knowledge relies on what is already known. Any learning is a process, and students learn better when interacting with others.

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CHAPTER 4

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter focused on the research methodology adopted in this study. Antwi and Hamza (2015) define research methodology as the method used in conducting research. It is a logical, systematic plan to resolve a research problem. A methodology details a researcher's approach to the research to ensure reliable, valid results that address their aims and objectives. It encompasses what data they will collect, where it comes from, and how it is collected and analysed. Research methodology includes the complete research process, meaning the research approaches, procedures, and data collection or sampling methods used (Cohen, Manion & Morrison, 2011:261).

This chapter discusses the research paradigm, research design, data collection methods, sampling procedure, instrumentation, data collection procedures, and data analysis.

4.2 RESEARCH PARADIGM, DESIGN, AND METHODOLOGY

4.2.1 Research Paradigm

The term paradigm is derived from the Greek word for pattern (Kivunja & Kuyini, 2017) and has been broadly defined by many academics. A research paradigm is a method, model, or pattern for conducting research. Hughes (2010:35) defines paradigm as a "way of seeing the world that frames a research topic and influences the way that researchers think about the topic". A research paradigm is a method, model, or pattern for conducting research. It is also a set of ideas, beliefs, or understandings within which theories and practices can function.

This study used an interpretivist paradigm because, with an interpretivist approach, a separation between objective and subjective ideologies is impossible.

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The interpretive approach relies on questioning and observation to discover a rich and a deep understanding of the phenomenon being investigated, which was the main goal of this study. The interpretivist paradigm endeavours to understand the subjective world of human experience. This paradigm was suitable to the current study because the researcher sought to explore the role of bridging Mathematics modules in the academic performance of students, to investigate students' attitudes towards the bridging Mathematics modules, to determine factors influencing students' academic performance of bridging Mathematics modules, to investigate the challenges students and lecturers encountered in the bridging Mathematics modules.

The intention was to understand what was happening, how people who were doing bridging courses felt about it, how those conscious and unconscious feelings came to be, and how new, shared meanings affected their lives (McGregor & Murnane, 2010:419). Rehman and Alharthi (2016) mentioned that a paradigm consists of the following components: ontology (what is reality?), epistemology (How do you know about something?), and methodology (How do you go about finding out?). Each component is explained, and then the relationships between them are explored.

- **Ontology**

The field of philosophy known as ontology studies the presumptions, we make to think that something is real, makes sense, or is the fundamental component of the social phenomenon we are studying (Scotland, 2012:9). What makes up reality—or, more simply put, what is reality—is the focus of ontological assumptions. Regarding their opinions on how things are and operate, researchers must have a stance.

- **Epistemology**

Epistemology has its aetiology in Greek, where the word episteme means knowledge. Put simply, in research, epistemology is used to describe how we come to know something, how we know the truth or reality. Epistemology is concerned with the nature and forms of knowledge. Epistemological assumptions concern how

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knowledge can be created, acquired, and communicated - in other words, what it means to know.

4.2.2 Research Design

The term research design refers to the overall strategy that one may choose to integrate the different components of the study coherently and logically. This is done to ensure that one effectively addresses the research problem. Research design constitutes “the blueprint or roadmap for the collection, measurement, and analysis of data” (McMillan, 2010:72).

Research design is a plan, a roadmap, and a blueprint strategy of investigation conceived to obtain answers to research questions, and it is the heart of any study. Research design also refers to the framework of market research methods and techniques that are chosen by a researcher. According to Zikmund, D'Alessandro, Winzar, Lowe, and Babin (2014), the research design is also defined as a “master plan specifying the methods and procedures for collecting and analysing the needed information.”

This study employed a qualitative research design, which is an appropriate approach for the interpretive paradigm. Qualitative research design can be described as a systematic and subjective approach used to describe life experiences and give them meaning. Creswell (2014:32) interpreted qualitative research design as an “approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem.” Furthermore, Merriam and Tisdell (2016) further affirmed that qualitative research aims to reveal the meaning of an occurrence for the people involved in it. Qualitative research is expressed in words. It is used to understand concepts, thoughts, or experiences. In other words, it describes experiences as they are lived. Hence, this study used a phenomenological research design.

The goal of the phenomenological study design, a qualitative methodology, is to comprehend the essence of human experiences by investigating how people interpret and make meaning of them. Without imposing preconceived notions or theories, it

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seeks to describe the participants' real experiences. This design aims to capture each person's distinct viewpoints through inductive and descriptive methods.

This type of research design was employed in this study because the researcher sought to gather students' and lecturers' perspectives on their experiences in teaching and learning bridging Mathematics modules. The researcher also wanted to explore factors that influence students' academic performance in bridging Mathematics modules.

4.2.3 Research Methodology

According to Antwi and Hamza (2015), the research technique refers to the approach used to conduct the study. It is a methodical, rational approach to solving a research issue. A methodology outlines a researcher's strategy for conducting the study, ensuring accurate and legitimate findings that meet their goals and objectives. It encompasses what data they are going to collect and where it is coming from, as well as how it is being collected and analysed. Research methodology encompasses the entire research process, including the research approaches, procedures, and data collection or sampling methods used (Cohen, Manion, & Morrison, 2011, p. 261).

4.3 SAMPLING

Sampling is a technique for choosing which group to use for data collection in your study (Satishprakash, 2020:6). Since it is impossible to include the entire population in a study, sampling is done. This section covers the population, sample, and sampling technique.

4.3.1 Sampling Procedure

Sampling refers to the process of selecting the group from which data will be collected in your research (Satishprakash, 2020). Sampling can be defined as "the act, process, or technique of selecting a suitable sample or a representative part of a population to determine parameters or characteristics of the whole population" (Creswell, 2009:79).

Sampling is done because it is impossible to include the whole population in research. According to Satishprakash (2020), sampling procedures are different ways of choosing a subgroup from a population to participate in the study. In this study, a purposive sampling technique was used to select participants. This study selected students based on their performance in the 2023 final examination, and the focus groups consisted of former students who had completed bridging Mathematics modules.

4.3.2 Population

The population, as defined by Satishprakash (2020:2), refers to the collection or grouping of all units to whom the research findings are to be applied. Students, a lecturer, and the head of the department of two bridging mathematics module groups (Group A and Group B) under the Department of Mathematical and Computational Science in the Faculty of Science, Engineering, and Agriculture made up the population of this study. Group A is divided into two modules, which are completed in the first and second semesters. In contrast, Group B is a semester-long module that students can retake if they do not pass the first semester.

4.3.4 Sample

A sample is the number of participants selected to represent the entire population for research purposes by the researcher. According to Satishprakash (2020), a sample can also be defined as any subset of the population that represents all the types of elements of the population. One of the key considerations when selecting a sample for research is to simplify the process, making it faster and less expensive (Satishprakash, 2020:5).

The study's sample comprised 10 participants: 6 students (3 from each bridging Mathematics module), 2 lecturers (one from each bridging Mathematics module), 2 heads of departments (HoDs) (one from each bridging Mathematics module), and 2 focus groups (one from each bridging Mathematics module) for the two bridging Mathematics modules. The focus groups consisted of 15 former students (9 for group A module and 6 for group B module) who had taken the bridging Mathematics modules

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(those who wrote the 2023 bridging Mathematics module examination). Data were collected from students, focus groups, lecturers, and heads of departments (HoDs) of the two bridging Mathematics modules within the Department of Computational and Mathematical Sciences, located in the Faculty of Science, Engineering, and Agriculture.

A purposive sampling technique was employed to select participants for the study. Students were chosen based on their 2023 test marksheet. The selected students included low-achieving, middle-achieving, and high-achieving individuals. Focus groups consisted of low, middle, and high-achieving former students from the 2023 bridging mathematics modules. Students' achievement levels were categorized as follows: low-achieving (0-50), middle-achieving (50-80), and high-achieving (80-100).

4.4 TRUSTWORTHINESS OF THE RESEARCH

In each study, researchers should establish the protocols and procedures necessary for a study to be considered worthy of consideration by readers (Amankwaa, 2016). There are various criteria by which you can judge the quality of quantitative and qualitative research. For qualitative research, results in this study were judged by interpretivism criteria: credibility, transferability, dependability, and confirmability.

4.4.1 Credibility

According to Nassaji (2020), credibility is mostly determined by how credible the study's findings and conclusions are. The findings' veracity and their degree of reflection of the phenomenon under investigation are at issue, to put it another way. The degree to which the qualitative researcher believes that the research study's conclusions are accurate is known as credibility. "How do you know that your findings are true and accurate?" is the simple question that these raises. Managing the risk of bias and research reactivity is essential for qualitative research (Lietz & Zayas, 2010:188).

To ensure credibility, this study used triangulated data collection method, namely, observation and interviews with reviewed literature.

4.4.2 Transferability

The nature of transferability, the extent to which findings are useful to persons in other settings, differs from other research aspects in that readers determine how applicable the findings are to their situations (Houghton, Casey, Shaw & Murphy, 2013:). Transferability refers to how the qualitative researcher demonstrates that the research study's findings can be applied to other contexts. In this case, "other contexts" can refer to similar situations, populations, and phenomena. Researchers support the study's transferability with a rich, detailed description of the context, location, and participants studied, as well as transparency regarding analysis and trustworthiness. Researchers need to provide a vivid picture that will inform and resonate with readers (Amankwaa, 2016:121).

This study employed the triangulation method to demonstrate that the research findings applied to other contexts, circumstances, and situations.

4.4.3 Confirmability

The degree to which other people agree with the researcher's interpretations and conclusions is known as confirmability (Nassaji, 2020). Confirmability can be defined as neutrality, or the extent to which the results are repeatable and consistent. The goal of confirmability is to show that the researcher's conclusions and interpretations are supported by the data; to do this, the researcher must provide evidence of their methodology. The results of this study were guaranteed to be derived from participant observations and replies rather than from individual motivation.

4.4.4 Dependability

Dependability relates to the consistency of data over time and across different conditions (Polit & Beck, 2010:1). Therefore, it is important to state the principles and criteria used for selecting participants and to describe their main characteristics so that the dependability of the results in other contexts can be evaluated (Moretti et al.,

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2011:420). This study ensured that all research documents, including activities, conclusions, and any potential changes, were securely kept. The study also employed member checking, where the researcher verified whether the transcription accurately reflected the participants' views and vice versa.

4.5 DATA COLLECTION

Kabir (2016:211) defines data collection as “gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes”. As stated by Creswell (2014), data collection procedures consist of the research plan, collecting the data or information through unstructured or semi-structured monitoring and dialogue, records, and visual resources, as well as constructing an agreement to record the information.”

Data collection methods are important because structured interviews and classroom observations.

4.5.1 Interviews

Interviewing involves asking questions and getting answers from participants in a study. Interviewing has a variety of forms, including individual, face-to-face interviews and face-to-face group interviews. The asking and answering of questions can be mediated by the telephone or other electronic devices (e.g., computers). Interviews can be structured, semi-structured, or unstructured (Kabir, 2016:211).

This study has used individual, focus group interviews, lecturers, and HoD interviews. Focus groups were comprised of former 2023 bridging mathematics module students. All interviews with students and lecturers were conducted face-to-face at the researcher's office and took about 30 to 40 minutes, whereas HoD interviews were conducted in their offices at work. All interviews were either conducted in the morning or afternoon, depending on participants' availability.

All interviews were recorded and transcribed. An interview schedule was used to gain insight into students' attitudes towards the teaching and learning of the bridging Mathematics module, the role it plays, factors that influence students' academic performance, and challenges that students and lecturers encounter when teaching and learning the bridging Mathematics module.

4.5.2 Classroom Observation

Observation is a key tool for collecting data in qualitative research. According to Creswell (2013:166), "the observations are based on the research purpose and questions, and the researcher may observe the physical setting, participants, activities, interactions, conversations, and behaviours during the observation." Creswell (2013) further emphasised the use of the senses, including sight, hearing, touch, smell, and taste, and the researcher should realise that writing down everything is impossible. Thus, the researcher can start the observation broadly and then concentrate on the research questions.

In this study, the researcher observed four classes (two per each bridging mathematics module) in September and October 2024. The researcher was a participant observer because they observed and took notes directly in the classroom. In other words, the researcher lived as a member of the subjects of the study, observing and taking notes on the attributes of the subjects being researched, so that the researcher could directly experience the phenomenon being studied.

The researcher observed the interactions between Mathematics lecturers and their students, as well as the use of the zone of proximal development (ZPD) during the mathematics bridging module class, as documented in the attached appendix. The researcher observed whether lectures are a scaffolding method in mathematics classrooms. That is lecturer provides temporary support to students as they learn a new concept or skill. As students gain proficiency and the ability to work independently, this support is gradually reduced. The goal is to help students learn things they could not learn on their own by providing them with just the appropriate amount of assistance.

4.6 DATA COLLECTION PROCEDURE

An ethical clearance certificate was granted to the researcher by the Research Ethics Social Sciences Committee (RESSC) to conduct the study at the University of Venda, as shown in the appendix. The researcher also sought permission to gain access to the relevant faculty to collect data. That permission to gain access to the faculty was granted by the Dean's office; see the appendix.

To gather primary data, the participants were questioned in the researcher's office during their own spare time. In other words, interviews were conducted with six students, two lecturers, and two HoDs. The interview lasted for thirty to forty minutes. Classroom observations were used to gather secondary data. Lecturers' teaching aids and student attendance records were gathered from the pertinent lectures.

4.6.1 Data Collection Instrument

Research instruments in qualitative research cover two kinds of instruments: primary and secondary instruments. Creswell (2012:141) states that a "research instrument is a device used in assessing, monitoring, and recording of data". The researcher adopts a secondary instrument to ascertain the result. A data collection instrument is a device used to collect data, such as questions, observations, field notes, and a sound recorder or voice recorder.

The researcher developed an interview schedule for HoDs, lecturers, students, focus groups and classroom observation. Data were recorded on field notes and a voice recorder. These data collection instruments are attached as appendices.

4.7 DATA ANALYSIS

Analysing data involves examining participant data, data organisation, data creation, and data interpretation, as the categorisation of results interprets the components of data analysis (Creswell, 2014). Once the data has been collected, it is analysed using

various qualitative data analysis techniques. These techniques include coding, categorisation, and interpretation. In this study, thematic analysis was employed.

Data was organised, coded, analysed, and interpreted using thematic analysis. According to Clarke and Braun (2017:297), "thematic analysis is a method for identifying, analysing, and interpreting patterns of meaning ('themes') within qualitative data." The study followed these thematic analysis steps: familiarising (the researcher listened and re-listened to the audio recording several times to familiarise themselves with the data). Each data set was merged during the analysis process, and the analysis was conducted manually.

(i) Code the Selected Data

A code is a word or brief phrase that encapsulates the meaning of quotations. To identify several themes, the data were labelled and arranged, and the codes emerged.

(ii) Generating Themes

A theme highlights a significant aspect of the data related to the study's goal. It also illustrates a trend or connection across the collection of data. Iteratively, going back and forth between the codes to find commonalities is how one searches for common themes between codes. Various themes were found.

(iii) Reviewing Themes

This review process helped identify new themes that might have been overlooked and ensured that these themes were accurate and useful representations of the data. This study ensured that each theme had sufficient data to be convincing and revealed patterns across the dataset. The name of each theme was identified.

(iv) Produce the Report Findings: The identified themes were defined and named.

(v) Lastly, the Report is Produced: The research findings were produced.

Each data set was merged during the process of analysis, and the analysis was conducted manually.

4.8 CONCLUSION

This chapter describes the research paradigm, research design, data collection methods, sampling procedure, instrumentation, data collection procedures, and data analysis to justify the choice of a qualitative approach. This included the methods that were employed to address the research problem as formulated. A complete research process (research approaches, procedures, and data collection or sampling methods) was also outlined in this chapter.

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CHAPTER 5

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

Chapter Four provides a detailed discussion of the research design and methodology adopted and used in conducting the study. Issues of the research paradigm and the research methodology employed were discussed in detail. The methodological issues, such as methods applied in collecting and analysing data, trustworthiness, and ethical considerations, were fully discussed.

The current chapter presents data, analyzes and interprets the data, and discusses the findings based on data collected through interviews and observations.

5.2 BIOGRAPHICAL INFORMATION OF THE PARTICIPANTS

This section provides the biological information of all the study participants, that is, age, gender, qualifications, and teaching experience, where S_{iA} and S_{iB} represent represents group A and group B students and (i=1, 2, 3); L_A and L_B represent lecturers for group A and B bridging mathematics modules respectively, and HoD_A and HoD_B represent heads of departments for group A and B bridging mathematics respectively, and F_{iA} (i=1, 2,3……,9) and F_{iB} (i=1,2,……,6) represent focus group for group A and B bridging mathematics modules respectively.

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Table 5.1: Participants' Biographical Information

Participants	Age	Gender	Highest Qualifications	Work Experience
S_{1A}	19	Female	Grade 12	
S_{2A}	19	Male	Grade12	
S_{3A}	18	Female	Grade 12	
S_{1B}	20	Female	Grade 12	
S_{2B}	19	Female	Grade 12	
S_{3B}	18	Female	Grade 12	
L_A	34	Male	Msc	4
L_B	36	Male	Bsc honours	3
HoD_A	52	Male	PhD	18
HoD_B	64	Male	PhD	24
F_{1A}	19	Male	First year	
F_{2A}	19	Male	First year	
F_{3A}	20	Male	First year	
F_{4A}	21	Male	First year	
F_{5A}	19	Female	First year	
F_{6A}	19	Female	First year	
F_{7A}	19	Female	First year	
F_{8A}	20	Female	First year	
F_{9A}	19	Female	First year	
F_{1B}	19	Female	First year	
F_{2B}	19	Female	First year	
F_{3B}	21	Female	First year	
F_{4B}	20	Female	First year	
F_{5B}	29	Male	First year	
F_{6B}	20	Male	First year	

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Table 5.1 indicates that 6 students in the bridging Mathematics modules were interviewed, and they were composed of 1 male and 5 females. That is, 83,3% (5) of the 6 participants who attended the individual interview were females, and 16.7% (1) of the participants were male. Their ages ranged from 18 to 20, and they were all first-time registered students.

Two male lecturers who taught bridging mathematics modules were interviewed, as shown in Table 5.1 above. Their ages ranged from 30 to 40. One lecturer was full-time, holding a Master of Science degree in Applied Mathematics, while the other lecturer was part-time, with a Bachelor of Science honours degree in Applied Mathematics. Their teaching experience ranged from 2 to 5 years.

Table 5.1 also depicts that two heads of departments (HoDs) were interviewed, and both were males. Their age ranges from 50 to 65 years, with teaching experience of 15 to 25 years, as seen in Table 5.1 above. Both heads of the department had a PhD in applied Mathematics, but one of them was a professor of applied Mathematics with more than 100 published articles.

Focus groups consisted of 15 former students of the bridging Mathematics modules. For Group A, nine former students were invited, and all of them attended. They were selected based on their 2023 final examination results. The group consisted of former students: 4 males and 5 females, with 3 high-performing, 3 middle-performing, and 3 low-performing students. Thus, 44,4% (4) of the participants were male while 55.6% (5) were female, and their ages ranged from 19 to 25.

For the Group B bridging Mathematics module, nine participants were invited for the interview, but only six were able to attend. They were selected based on their 2023 final examination results. This group comprised six former students: two males and four females; specifically, two high-performing, two middle-performing, and two low-performing students. Additionally, 33.3% (2) of the participants were male, while 66.7% (4) were female. Their ages ranged from 19 to 21.

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Table 5.2: Classroom Observation Schedule

Module code	Lecturer code	Number of registered students	Number of students who attended	Topic of the lesson	Date	Time
A	L_A	249	146	Integration	09 September 2024	11h-12h00
A	L_A	249	189	Matrices	23 October 2024	12h00-13h00
B	L_B	453	130	Percentages	03 September 2024	14h56-15h56
B	L_B	453	180	Simple interest	17 October 2024	14h00-15h00

Table 5.2 shows the classroom observation schedule for both group A and group B modules. Both observations took place in October and November 2024. The lecture for group A was on integration, and the next day, he covered matrices. Group B's lectures focused on percentages and simple interest. All lessons lasted one hour. Observations revealed that only a small number of students attended the classes when there was no test, but they came in large numbers when they were about to write a test.

5.3 PRESENTATION OF QUALITATIVE DATA

This section presents qualitative data collected through interviews and observations. Before presentation of data, research questions and source of answer are presented, and a summary of the emerged themes is presented in Tables 5.3 and 5.4, respectively. Data were coded as follows:

S : students (Low-achieving students, middle-achieving students, high-achieving students),

F_A : Focus group for Group A module

F_B : Focus group for Group B module

L_A : Group A module lecturer

L_B : Group B module lecturer

HoD_A : Group A module head of department

HoD_B : Group B module head of department

Coding of data from observation: Since there are 5 indications, Observation data were coded as O_1, O_2, O_3, O_4, and O_5 to indicate that these were answers to indicators 1, 2, 3, 4, and 5, respectively.

- **Research questions and sources of the answers**

This section presents the data source for each of the study's research questions, as seen in Table 5.3 below. The sources of answers are interviews and observations.

Table 5.3: Research Questions and Sources of Answers

Research Questions	Data Source	
1. What role does bridging Mathematics play in the student's academic performance in bridging Mathematics modules?	Interviews X	Class Observation
2. What attitude do students have towards the bridging of Mathematics modules?	X	X
3. What are the factors that influence students' academic performance in bridging Mathematics modules?	X	X
5. What are the challenges that students and lecturers encounter in bridging Mathematics modules?	X	X
5. Which strategies can be used to motivate first-entering students with low Grade 12 Mathematics performance to enrol for bridging Mathematics modules or programmes?	X	

- **Summary of Emerged Themes and Subthemes**

This section presents a summary of emerging themes and subthemes of bridging Mathematics modules, as seen in Table 5.3 below.

Table 5.4: Summary of Emerged Themes and Subthemes

Research Questions	Themes	Subthemes
1. What role does bridging Mathematics play in the students' academic performance in bridging Mathematics modules?	Closes the gap Laying strong mathematical foundations Helps in the next Mathematics level Helps in other bridging modules as well	• Closes the gap • Laying strong mathematical foundations • Helps in advanced mathematics • Helps in other modules as well
2. What attitude do students have towards the bridging of Mathematics modules?	Students exhibit a positive and negative attitudes	Attitude
3. What are the factors that influence students' academic performance in bridging Mathematics modules?	Failure to manage time Discipline and seriousness of students Relevance of course content or syllabus Clashes of this module with other modules	• Time management • Tutors • Language barrier • Student workload • Timetable clashes • Teaching method

		University environment
4. What are the challenges that students and lecturers encounter in bridging Mathematics modules?	Lack of a bigger venue that can accommodate many students The need for tutors Stable venue that can accommodate many students	overcrowding, lack of individual attention, unstable venue, Timetable clashes, class attendance
5. Which strategies can be used to improve students academic performance of bridging mathematics modules or programmes?	Sharing more information about this module with Grade 12 students Changing syllabus Relevance of syllabus	Bridging the modules that students have failed only Changing of syllabus (50% pure mathematics and 50% mathematics literacy)

5.3.1 Data from the interview

5.3.1.1 What do you think is the role that bridging mathematics modules play in the academic performance of students?

Participants demonstrated that the bridging Mathematics modules helped them acquire a basic understanding of the next level of Mathematics. Participants added that the bridging Mathematics module is helping them to reduce their struggle in the future and lay a strong Mathematical foundation. For example, one participant highlighted:

> *"Bridging Mathematics modules help those who want to continue with Mathematics and reduce the struggle in the future because of the relevance of the course content or syllabus. This participant mentioned calculus as an example, and he also said that the calculus they are doing now will help them in first-year Mathematics* ***(S_{1A})****."*

The above response indicates that if the bridging Mathematics module is structured properly, it will aid students in their future studies, as some of the content will already be familiar to them when they progress to the next level of study.

Participants understood the importance of this mathematical knowledge, which is crucial because Mathematics underpins many subjects; in other words, Mathematics is a prerequisite for many modules, such as Chemistry and Physics. For example, one participant responded:

> *"This bridging Mathematics module will help me answer questions in other modules. This module will help me more in physics since there are a lot of calculations in Physics. This module is also helping in other bridging modules as well because the integration we are doing in the bridging Mathematics module is helping me and other students in Physics* ***(S_{3A})."***

Participants' responses indicated that this bridging module is also helping them with other bridging modules, as modules like Physics and Chemistry require a lot of calculations.

Participants indicated that they aimed to pursue a main degree after Grade 12, but due to low achievement, particularly in the mathematics module or another subject, they ended up with a bridging programme. Another participant mentioned that this module would give them a more in-depth introduction to what is coming in the mainstream. For example, one participant alleged:

> *"This module closes the gap between Grade 12 Mathematics and university Mathematics* ***(S_{2A})."***

This response indicated that this Mathematics module bridged the gap between university and Grade 12 Mathematics by laying down a strong foundation of what is coming ahead.

Participants' responses indicated that this module is not helping them in any way. They further indicated that this module should be done by those students whose

degrees require Mathematics. They do not see its relevance at all. They cannot see any role played by this module in their academic performance. For example, one of the participants retorted as follows:

> *"This module is not helping me because I was doing mathematics literacy in Grade 12, and this module is full of pure Mathematics, which I did not do in Grade 12. He further mentioned that the contents of this module are full of pure Mathematics. It should have been 50% pure Mathematics and 50% Mathematics literacy* ***(S_{1B})."***

This response showed that some participants were confused. It seems as if they were caught by surprise; they had not expected this kind of Mathematics since they had completed Mathematics Literacy in high school.

Participants indicated that they did not know the importance of this bridging Mathematics module; no wonder one participant mentioned that:

> *"I don't see any role played by this module. It does not go hand in hand with other modules. In other words, it relates to other modules. He further said that he did not expect to do Mathematics when he came to university. He just wanted a degree without any Mathematics* ***(S_{2B})****."*

Responses showed that participants were not aware of what they would be doing in this bridging module. Participants expected to do a degree without Mathematics, but it should have been clear to students during orientation.

This bridging module must be structured in such a way that it helps students somewhere, somehow. Students must bridge the gap between Grade 12 and university. Another participant responded:

> *"This module is helping me to be open-minded. It helps me in other modules like Accounting and Economics. He further gave an example of straight-line graphs, which helped him in the Economics module* ***(S_{3B})****."*

This response indicated that some participants were helped by this module, even in other modules they had registered.

Participants indicated that this bridging Mathematics module is helping them to perform better in their first-year modules. For example, one participant said that:
This module helped me not to encounter difficulties in my first-year modules, like Mathematics, Physics, and Chemistry ***(F_{1A}).***

Another participant mentioned that:

> *"This module served as a foundation because we are outperforming those students who did not do this module. We are performing better than they are; we don't struggle like them* ***(F_{5A})."***

Furthermore, another participant added that:

> *"I am excelling because of the strong foundation of this bridging Mathematics module. I did integration and matrices, which were not there in Grade 12, and they are helping me in my first year* ***(F_{8A})."***

Participants of this focus group mentioned that had it not been for this module, it would have been difficult for them to perform well. For example, these participants revealed:

> *"Compared to the way I would have performed if I hadn't done this module, it was going to be difficult for me* ***(F_{1B})."***

> *"Personally, this module boosted me because, from my perspective, I did mathematical literacy in high school. I do not know pure Mathematics, so it helps by giving me enough knowledge to apply when I go to the next level of Mathematics (****F_{4B}****)."***

> *"Topics like factorisation, logarithm, transpose, and simultaneous equations are things I've never done before, so bridging modules just creates a foundation for me to apply certain formulas in other modules as well (****F_{6B}****)."*

The above responses showed that students were performing well because of this module. They further said this module boosted their confidence and laid down a strong foundation because, in high school, some of them did Mathematics Literacy.

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Another participant from this focus group further said:

> *"This module helped me to get 100% in test 1 of Mathematics (**F_{2B}**)".*

This response indicated that students who go through this module are doing well in first-year modules, especially in modules that are related to Mathematics.

The above responses indicated that this bridging Mathematics module helped students to do well in first-year modules like Physics and Chemistry. Their response also showed that this bridging Mathematics module laid a strong foundation, and these foundations helped them to do better than students who went straight to the first year without going through this bridging Mathematics module.

Participants indicated that this bridging Mathematics module helps students get a strong foundation that will make them perform better in their first-year modules. For example, this is what this participant expressed:

> *"Former students come to show me their results, and they are performing better in their first year and even in higher modules **(L_A).**"*

The above response indicated that students from the bridging programme have a strong background in Mathematics, and they are performing better.

This participant further indicated that this bridging Mathematics module helps students at least get admission to the university. For example, this participant hinted:

> *"This foundation programme helps students to get university admission instead of staying at home **(L_A).**"*

This response shows that had it not been for this foundation programme, some students would have been sitting at home waiting to be admitted to the degrees they planned for.

Participants indicated that this bridging Mathematics module helps students build confidence to the next level. For example, this participant shared:

> *"This bridging module helps students attain the numerical skills required for their qualifications and plays a vital role in building confidence **(L_B).**"*

The above response showed that this module plays a big role in building the confidence of students before they go to the mainstream modules.

Participants further indicated that this module is laying down a strong foundation for what is coming in the next Mathematics modules, such as business Mathematics. For example, this participant asserted:

> *"Topics that are taught here are giving students some basic Mathematics and laying down a strong foundation* ***(LB)."***

This response showed that students who are doing this module are benefiting by getting some basics and tests of what is coming ahead.

Participants mentioned that this module lays down a strong foundation in such a way that students will be able to understand first-year Mathematics and even some modules that are related to Mathematics. For example, this is what this participant said:

> *"Gives students a better understanding of university Mathematics as they are introduced to all first-year Mathematics modules at the foundation level* ***(HoDA)."***

This response showed that this bridging Mathematics module gives students more understanding of what is coming ahead in all first-year Mathematics modules. Students will have a little background in first-year Mathematics modules.

Participants mentioned that this module bridges the gap and helps those students who do not meet the minimum requirements to register for the degrees they applied for. For example, one participant explained:

> *"The role of bridging modules, in this case, is very clear; it bridges the gap and helps students who come without satisfying entry requirements into the programmes in which they hope to register* ***(HoDB)."***

This response shows that this module bridges the gap between Grade 12 and first-year Mathematics modules and assists those students who are not admitted to the main degree to get admission.

5.3.1.2 What attitudes do students have towards the bridging of the mathematics module?

For students to pass any module, they must like and appreciate it; otherwise, they will not have enough time to study the module, and it will also affect their academic performance. Students must see the bridging module as a bridge that is taking them to the next level. For example, one participant said that:

> *"I appreciate this module. I like this module, and I enjoy its content and the way the lecturer presents his lessons, which is why I got 100% on the test. I see learning this module as a good opportunity for me to lay a strong foundation for what is coming ahead. When I go to the first year, I will know the integration and differentiation rules, which I did not do in Grade 12, and hence, I will be much better equipped than those students who did not do this module* ***(S_{3A})****."*

The above response showed that participants had positive attitudes because they came to know more about this module. Participants were aware of laying strong foundations of what is coming ahead by doing this module.

On the other hand, another participant asserted that:

> *"He has a negative attitude towards this module* ***(S_{1B})."***

This response confirmed why the participants got low marks. A negative attitude lowered the performance.

Perception and attitudes are very important if one needs to achieve something. These students still want to do degrees of their choice. For example, one participant admitted that:

"I still need to do a Bachelor of Science in Computer Science. I have a positive attitude, and this module is achievable. Maybe students should be allowed to do the module they failed in Grade 12 only, instead of doing all modules, including the modules that passed with high marks in Grade 12. He further mentioned that he was there because of Mathematics only, but he was also doing Life Science and Physical Sciences, which he passed well in Grade 12 ***(S_{2A})***."

The above response showed that participants had a positive attitude. Participants still needed to do the degree of their choice, and he accepted that he was doing a bridging programme.

There are things in life that no one can undo; you must accept them and move on with life. The same applies here; if students did not get the marks or symbol they were expecting in Grade 12, they must just accept it and register for the bridging module so they can end up doing what they planned a long time ago. When asked about the attitude towards this module, this is the response from one of the participants:

"I have accepted that I am doing a bridging Mathematics module. I have a positive attitude, which is why I am getting high marks. I am positive because if I become negative, my marks will also be negative ***(S_{3B})***."

This response showed that participants were positive about this module, and participants were aware of the impact of being negative. For example, another participant mentioned that:

"I don't think I will pass this module at the end of the semester because I don't understand this module at all. I did Mathematics Literacy in Grade 12, and I don't see any correlation with this module I am doing now. I did not expect to do this module, and hence, I don't like it ***(S_{2B})***."

The above response indicated that participants had given up. They had a negative attitude because participants did Mathematics literacy in Grade 12, and they could not see any relationship with this module.

Sometime during the first year, students have a lot of modules to do, and some modules can maybe be done later, maybe in the second year, third year, or even fourth year. However, in this module, students have the option to do it in either the first semester or second semester. If they fail in the first semester, they have another chance to repeat this module during the second semester. For example, one of the participants indicated that:

> *"I thought of removing this bridging module and adding it later in the third year because I have a lot of modules I am doing now. In the third year, I will be doing only two modules, and it would be good for me to add this module so that I can do three modules. I did not plan to do this degree where there is Mathematics because I know that I am not good at Mathematics at all* ***(S_{1B})****."*

The responses from the participants showed that they wanted this bridging module to be done later in the third year. Participants were caught by surprise; they wanted a degree without Mathematics.

Participants had mixed reactions to this; some had positive attitudes, and a few had negative attitudes. For example, the following are their responses:

> *"I had a positive attitude because I felt like being admitted to university was better compared to repeating Grade 12* ***(F_{1A})."***

> *"I had a negative attitude at the beginning until I realised that this bridging Mathematics module would help me in my first-year modules* ***(F_{3A})."***

> *"During the first class, the lecturer motivated us and tried to encourage us, and that made me positive about this bridging Mathematics module* ***(F_{2A})."***

These responses indicated that some participants were happy just to be admitted to the university, but doing the bridging module was not a problem for them if they were admitted to the university, and only a few were not happy. They had a negative

attitude at the beginning. However, as time goes on, they develop a positive attitude through motivation.

Participants of this focus group said they had a negative attitude towards this module because other students who are not doing this module look down on them. They also indicated that they are intimidated by these unknown variables, like x, y, z, and so on. They further said they have a negative attitude, but they are trying to be positive about this module. For example, these participants said:

> *"I hate this module, but I am trying to be positive about this module even though it is not related to what I am doing (**F_{1B}**)."*

> *"I cannot see the practicality of this module in a real-life situation (**F_{3B}**). I had a negative attitude because I was afraid of other students who might look down on me. After all, you are doing small Mathematics, which is even lower than the Grade 12 standard (**F_{5B}**)."*

Those responses revealed that most students were negative about this module at the beginning, but as time went on, they developed a positive attitude, and again, participants' responses showed that mathematics must be taught with understanding so that students will be able to see the practicality of those unknown variables like x, y, and z as mentioned by the participant.

The participant indicated that the students were positive about this bridging Mathematics module because when he looked at them, he saw that they were enjoying learning new things. For example, this is what this participant said:

> *"My students are all happy about this module, and they are happy about being at university and learning new things instead of staying at home (**L_A**)."*

This response shows that students are positive about learning new things in this bridging Mathematics module.

Participants mentioned that students put less effort into this bridging module; they put more effort into major subjects. This participant further said students concentrate more on major subjects than this bridging module. For example, this participant responded: *Students always focus on major subjects and put less effort into Mathematics modules* ***(L_B)***

The above response indicated that students must balance this module with the major subjects for them to produce good results.

Participant further mentioned that some of the new students begin to undermine this module when they see small topics like arithmetic operations like 1+1=2, -3+4=1, -1-5=-6. They begin to have negative attitudes toward the module. This participant further said that repeaters are positive; they now realise that they will not graduate if they don't pass this module. For example, this is what this participant said:

> *"New students are very serious at the beginning, but when small Mathematics classes are introduced, they begin to run away from attending classes. This participant further indicated that most of the repeaters are positive; it is just that they don't attend because of clashes* ***(L_B)."***

The above response showed that negative attitudes developed through what students experienced in class.

Participants mentioned that all bridging at the mathematics module are happy and show a positive attitude towards learning this module. This is what this participant revealed:

> *"Through orientation and the way our bridging Mathematics modules are, our students have good attitudes towards the modules* ***(H_A)."***

This response indicates that students of this module were oriented at the beginning, and which made them develop a positive attitude towards this module, and they are all happy.

Participants indicated that most lecturers hesitate to teach this module, maybe because of the standard, which is very low and even lower than the Grade 12 standard. For example, this participant responded:

> *"I have no idea. You would have to ask students. However, most lecturers don't want to teach this module* ***(HoD$_B$)."***

This response shows that the students' attitude is known to the lecturer who is teaching them. This participant mentioned that the lecturer does not want to teach this module.

5.3.1.3 In your opinion, what are the factors that influence the Academic Performance of Students?

Participants mentioned some factors that they thought contributed to the academic performance of students. There are contributing factors behind any performance, either positive or negative. For example, one participant said that:

> *"I don't give this module more time to study because I don't like this module, in other words, time management. He further mentioned the issue of not prioritising schoolwork and a lecturer who is good but too fast and too slow to understand* ***(S$_{1A}$)****."*

The above response showed that participants were failing to manage time, and they were not disciplined enough to prioritise schoolwork.

Participants indicated that they are getting the marks because of ill-discipline. At universities, students are independent from their parents. They are far away from their parents. They must be serious and know what they are here for. For example, one participant responded that:

> *"Had I been disciplined and serious, I would not be getting the marks I am getting, even though the university standard is too high* ***(S$_{2A}$)****."*

This response showed that participants were not disciplined enough to get higher marks in this module. They are now realising their mistakes. In other words, discipline affects performance.

Tutorials are there to help students understand better with the help of tutors who further attend to the individual problem. Participants showed the importance of tutors in the bridging Mathematics module. For example, one participant said that:

> *"There are no tutors at all, but the lecturer does some tutorials. He further said he got high marks because of the assistance of tutorials. Even people around me always encourage me, which is why I am excelling in this module; however, he mentioned that there should be official tutors appointed to assist students, not lecturers alone* ***(S_{3A})***."

Participants' responses showed the need for tutors to assist lecturers. A lecturer cannot work alone with a group of more than 230 students.

Participants indicated that they attend and write everything but still fail Mathematics, as one participant bemoaned:

> *"I attend classes and write tests and assignments but still fail. I don't understand some topics in the syllabus, and the lecturer is even too fast* ***(S_{1B})***."

This response showed that more tutors are needed to assist students, and even lecturers must slow down to accommodate slow learners.

Participants indicated that they planned to do a degree in industrial psychology, but ended up registering for this bridging Mathematics module because of low achievement in Grade 12 Mathematics. Grade 12 results forced them to register for this bridging module. This is confirmed by this participant, who indicated that:

> *"I am so discouraged; I was forced to do this module, which is not even aligned with my course or my degree. He further asked: Where do you apply Mathematics to Industrial Psychology? I don't even consult or discuss this module with others; I hate this module* ***(S_{2B})***."

The above response showed that participants were not aware of what they would be doing in this module. The practicality of this module in real-life situations or even in other modules they were doing was also a concern to the participants.

Participants mentioned that they accepted that they were starting from this bridging module, and they were positive about it, which is why their performance was good. For example, another participant explained:

> *"I am getting high marks because I have accepted that I must bridge Mathematics. I manage my time properly in all modules I am doing, attending classes and tutorials, discussing with others, and even consulting lecturers, but this module clashes with other subjects like ECS* ***(S_{3B})****."*

This response showed that if participants are positive about this bridging Mathematics module, they will perform well in this module and even in other modules. They further indicated that timetable clashes are affecting their performance.

Most participants mentioned these as some of the contributing factors: help from tutors and the head of department (HoD), group work, overcrowding, workload, and environment. For example, this is what participants share:

> *"The reason why I performed well was the group work with my friends. Tutors played a big role in my academic performance. Tutors were there for us without putting any pressure. In the absence of lecturers, the HoD used to come and teach us* ***(F_{1A})."***

Another participant in this group mentioned that workload management is the key to success here at the university. This is what this participant advised:

> *"Those who did not perform well were not used to the university environment. They fail to manage workload* ***(F_{3A})."***

This response showed that some students are failing because of workload management.

Participants of this group mentioned other contributing factors like venue and students' punctuality. thus:

> *"If you come late to class, you will sit or stand at the back, where you cannot hear the lecturer properly. An unstable venue is also a problem for them and the lecturer* ***(F_{9A})."***

The above response from focus group participants indicated that the punctuality of students, small venues, and unstable venues also contribute to the academic performance of students.

Participants of this focus group came up with some factors that contribute to the academic performance of bridging Mathematics module students. For example, the following are their responses:

> *"Time management, like in university, students have more free time not attending classes and lifestyle. Scheduling of classes is very tight in high school, but here at university, there is not that much time, clashes of classes …scheduling of tests on the same day, doing Mathematics module before students even passed its pre-requisite, audibility of lecturers, teaching style, over 500 students in one class, many topics to be covered within short space of time (****F_{6B}****)."*

They further said that:

> *"With over 500 students in one class, it was not easy for the lecturer to monitor each student. It became difficult for students to understand while they were overcrowded (****F_{4B}****)."*

These responses indicated that this module must be split into different groups, which will be taught in different lectures to avoid overcrowding. Over 500 students in one venue are unteachable; teaching and learning cannot run smoothly in such an environment.

A participant mentioned that he has only one 2-hour physical class, and the other classes are only online. Only a few students, fewer than 50, according to the lecturer,

log in to attend online classes. In other words, students do not attend. For example, this is what this participant remarked:

> *"Students do not attend classes, especially online classes. Less than 50 students attend online classes* ***(L_A)."***

The above response indicates that more face-to-face classes must be introduced to increase students' attendance.

This participant continued by mentioning time management, discipline, and the fact that students are too shy to ask questions as some of the contributing factors. For example, this participant further said:

> *"Some students are not disciplined, they misbehave, and they do not submit the task on time. This participant further said some students make noise in class while I am teaching* ***(L_A)."***

Participants mentioned availability as the main factor that influences students' performance. For example, this participant revealed:

> *"Students do not attend classes; they don't write tasks and submit them on time. He further mentioned that only 30% attend classes* ***(L_B)****."*

This response indicated that to produce good results, students must attend classes; those who do not attend produce bad results. For example, this participant responded:

> *"Participants further indicated that those students who are getting high marks are students who did pure Mathematics in high school; those who get middle marks are those who did pure maths in Grade 10 and then did Mathematics literacy in Grades 11 and 12. He further mentioned that those who got low marks in this module were those who did Mathematics literacy from Grades 10 to 12. They don't have a strong background in pure Mathematics, and when they come to university, they struggle* ***(L_B)."***

The above response indicated that for students to perform well in this module, they must come with a strong background in Grade 12 pure Mathematics; otherwise, they will struggle.

Participants indicated that lazy lecturers also contribute to students' academic performance. This participant further mentioned that most students want to learn Mathematics through cramming, and the lecturer must change those perceptions by emphasizing the practical part of Mathematics more. For example, this is what this participant alleged:

> *"Mathematics requires hard-working lecturers who will lecture or teach in such a way that students will develop a liking for Mathematics* ***(HoD$_A$)****."*

The above response indicated that a hard-working lecturer would teach Mathematics for understanding in such a way that students would not just cram but understand first before cramming.

Participant further mentioned that most students come to university with a fear of Mathematics; they do not want to understand Mathematics. They just want to cram and pass. These students were misled and told that Mathematics is a difficult subject, which it is not. For example, this participant further said:

> *"Most students want to learn Mathematics through cramming without really understanding the concepts. There's a perception that Mathematics is a difficult subject, which is not only wrong but misleading, and this creates fear within students* ***(HoD$_A$)."***

The above response shows that fear affects the performance of bridging Mathematics module students.

Participants mentioned that students undermine this module, as they do not attend classes and are overcrowded. Those factors contribute to the student's academic performance. For example, this participant said:

"Timetable clashes, non-attendance of students, and maybe ignorance from students are the contributing factors to the students' academic performance ***(HoD$_B$).***"

This response shows that students of this module are ignorant of this module, maybe because of the standard, which is lower than Grade 12. This makes them to miss classes.

5.3.1.4 What are the Challenges that you encounter when Learning the Bridging Mathematics Modules?

In life, there are challenges everywhere. We live with challenges. Even in this module, there are some challenges students encounter when learning this bridging Mathematics module. Participants indicated that it was not easy to understand what was being taught the first time, especially in an overcrowded environment. For example, one participant elucidated:

"Lectures put in 40% of the effort, and students put in 60% of the effort, which we are not used to. That means that more work is done by students, with lectures doing less work. Even overcrowding in class is a challenge, and students cannot hear the lecturer properly because some students make a lot of noise, and when you are seated at the back. You cannot hear what the lecturer is saying ***(S$_{2A}$)."***

The above response showed that overcrowding in class is still a challenge, and students do more work than students are used to.

Another participant reiterated that:

"Overcrowding is a problem because when you are late to class, you sit in the back, and you cannot see. You stand because there are not enough chairs in the lecture rooms, and students begin to lose focus and make noise ***(S$_{1A}$)****."*

This response showed that participants are not comfortable learning this module in an overcrowded environment.

This made another participant seek help from private classes, which are too expensive for students. For example, one participant indicated that:

> *"I did not understand the lecturer at the beginning, and I ended up attending private tutorials. It helped me, which is why I got 100% in a test* ***(S_{3A})****."*

Participants suggested that lecturers must be clear to tutors about what and how they are approaching this module so that they can be on one page. For example, one of the participants clarified that:

> *"Tutors and lecturers explain the same things differently, and this brings confusion to students. Covering many topics within a short time.* ***(S_{2B})****."*

The above response showed that to avoid confusing students, lecturers and tutors must discuss all the possible methods of dealing with those tutorials so that they will be on one page.

Participants indicated that tests and assignment scripts must be brought back in time so that students will be able to see their mistakes before going to another topic. For example, another participant responded:

> *"Delaying in bringing feedback on time becomes a challenge to students and even lecturers* ***(S_{3B})****."*

Participants indicated that most first-year students struggle to understand the teaching style, but they are still used to high school teaching methods, where teachers sometimes use their language to explain some of the concepts. For example, here follows a response from another participant:

> *"In the beginning, I failed to understand the lecture, so I decided to go for extra classes and private tutorials. This helped me to understand the module better* ***(S_{1B})."***

This response showed that participants were struggling to understand at the beginning, and it would be helpful to students if lecturers could start teaching those small things that are not that difficult, just to motivate students.

Participants mentioned challenges they are facing in teaching and learning Mathematics bridging modules. For example, participants' responses are as follows:

> *"Overcrowding is a problem; when you are late, you sit at the back where students are making noise, and you cannot hear the lecturer properly* ***(F_{2A})."***

Participants further said:

> *"We used one venue to share it with students from another department, and this made us sometimes move around looking for a venue only to find the venue after 15 to 20 minutes had elapsed. This made the lecturer teach fast so that he could finish what he had prepared* ***(F_{1A})."***

The above responses indicated that overcrowding, non-attendance of students, and venue problems are the biggest challenges they are facing.

Participants in this focus group mentioned these as the challenges they encountered when learning this module: overcrowding, students being afraid to ask the lecturer some questions because of many students in that class, language barriers, teaching venue, students' class attendance, and writing tests over the weekends, especially on Sunday. These participants expanded:

> *"There were too many students in one class, which was overcrowded, and students were afraid to ask lecture questions because of the many students in that class (****F_{5B}****)."*
>
> *"We don't attend classes because of clashes in the timetable. This module clashes with almost all the modules I was doing (****F_{6B}****).*
> *We did not want to write tests over the weekends, especially on Sunday* ***(F_{4B})."***

*"Some of us don't know how to speak English, and lecturers use English only when presenting their lessons. We cannot ask questions because of a language barrier (**F_{3B}**)."*

This response indicated that tests must be written during the week, too many students in a small venue is a challenge to both students and the lecturer, and language barriers and timetable clashes are also a challenge.

Participants mentioned unstable venues as the challenge they are facing. This participant further said he moves around with students looking for a free venue, and it takes our time. For example, this is what this participant said:

*"The venue is a problem, and other lecturers from different schools want to use this venue as well. Sometimes, when we come, we find the venue occupied, and we must move around looking for a free venue **(L_A)**."*

This participant further revealed other challenges, such as chairs not being enough in the venue, students not being disciplined, copying, or cheating on assignments. For example, this participant further responded:

*"There are not enough chairs, and students are not disciplined. They come to class 20-23 minutes after the class has started, and they ask someone to write an assignment for them **(L_A)**."*

This response showed that teaching and learning cannot run well while other students are standing, which is why they begin to misbehave and start making noise.

A participant mentioned the issue of students not attending classes. This participant further said students' attendance is found when they are about to write a test or at the beginning. Approximately 30% attend this module daily. For example, this participant said:

*"Students' class attendance is the biggest challenge; they don't attend classes, but they attend at the beginning and when there is a test. **(L_B)**."*

This response showed that students do not attend the bridging Mathematics module classes.

Participants mentioned other challenges, such as overcrowding, the fact that most students lack a pure Mathematics background, clashes of timetables, and venue problems when virtual classes are changed into physical classes. For example, this participant further said:

> *"Most students did Mathematics literacy in high school, and this participant further mentioned overcrowding and clashes of timetable and venue as some of the challenges they are facing in this module* ***(L_B)."***

This response indicated that most students do not have a strong background in pure Mathematics. They did Mathematics Literacy; hence, they are struggling. This response further indicates that overcrowding, clashes of timetable, and venue are other challenges of this Mathematics bridging module.

Participants indicated that more students are admitted to the foundation programme, and the venue we have cannot accommodate all of them. For example, this participant claimed:

> *"Lack of bigger venues, as we have more students than the venues can accommodate. We also need to have all the lecturers appointed permanently* ***(HoD_A)."***

This response indicated that the department registers many students, but no venue accommodates them. In other words, it is a small venue with many students. This response further shows that uncertainty about the lecturers' contract is also a challenge.

A participant mentioned that the standard of this module is low and is even lower than the Grade 12 Mathematics standard. This is what this participant said:

> *"The standard for this module is even lower than the Grade 12 standard. Maybe we struggle with numbers, as numbers are always large* ***(HoD_B)."***

This response indicated that this module's standard must be improved, possibly by readjusting its contents.

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5.3.1.5 Which Strategies can be used to improve students' academic performance in bridging mathematics modules?

Participants said that to encourage more students to do bridging Mathematics modules, the university or department should allow students to bridge only the modules they failed in their grade. That, on its own, will give students more time and energy to focus on one or two modules, which will lessen their burden.

More information about bridging programmes or bridging modules must be passed on to Grade 12 students before they come to university. It seems like students are afraid to do bridging programmes. For example, one participant said:

> *"It must be explained to Grade 12 students that it is better to do bridging instead of repeating or rewriting Grade 12 because bridging prepares you for what is coming in your first year. It must also be explained during career guidance* ***(S_{1A})****."*

This response suggested that more information about this bridging programme must be passed to learners while they are still in Grade 12, or maybe during career guidance, or by sending former students to different schools.

Participants indicated that experiences from former students can be used to motivate and convince students to register for this bridging Mathematics module. For example, one participant said that:

> *"Information about bridging modules must be shared with Grade 12 students before they come to university, maybe by former students. It must be made clear that bridging the programme is easier than repeating Grade 12 or rewriting the module you failed in Grade 12* ***(S_{3A})****."*

The participants' responses were all about convincing Grade 12 learners to register for this bridging programme.

Students come to university having passed maybe life sciences or physical sciences but failed Mathematics. When students register in this bridging programme, they register for all modules instead of Mathematics, which they failed in Grade 12. That is why another participant suggested that:

> *"Students must only bridge the module they failed in Grade 12 instead of doing many modules. If you fail Mathematics, you must repeat Mathematics only* ***(S_{2A})****."*

That might make students become positive about this bridging programme and will attract many students to register for this bridging programme. The above response gives suggestions on how this bridging programme can be structured.

Participants mentioned that teachers must explain to convince learners about the bridging programme rather than rewrite Grade 12 or repeat Grade 12. The advantages of doing bridging modules must be explained to learners to encourage them. For example, one participant suggested that:

> *"Teachers must convince learners to do this bridging module instead of taking a gap year or staying at home* ***(S_{1B})***."

This response suggested that teachers, if used properly, can thoroughly explain this bridging programme to learners. Teachers are learners' parents at school, and therefore, learners will be able to listen and understand better.

Participants mentioned the issue of this module's contents or syllabus. Good strategies, if put in place and implemented, can encourage learners to register for this bridging Mathematics module. For example, this is one of the participants' responses:

> *"They must change the syllabus of this module so that it must be 50% pure Mathematics and 50% Mathematics Literacy* ***(S_{2B})****."*

The above response showed that participants are struggling to cope with the bridging module contents, and they want it to be changed. Maybe if this module can be restructured as the participant suggested, many students will begin to consider registering for this module.

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"It was difficult to get a response from one of the participants. When asked about the strategies that can be used to encourage students with average achievement in Mathematics to register for this module, this participant remained quiet without any response. This participant said that I hate Mathematics, but I don't like it ***(S_{3B})****."*

Participants mentioned similar strategies that they thought could be used to encourage students with average achievement to register for this bridging module. For example, these are their views:

"The university must make sure that the information about the bridging programme is shared with students during career guidance, which the university always has every year ***(F_{1A})."***

"The university must make sure that learners know about the bridging programme before they even come to the university. In other words, former students might even assist in this regard ***(F_{5A})."***

The above response shows that the information about this bridging module must be shared with different high schools, maybe by former students, lecturers, or HoD. They can also use the university career guidance platform to share the message.

According to the former students, these are the strategies that might be used to recruit students with average achievement in Mathematics to register for this bridging module. For example, this participant said:

*"The university or department must introduce the top achiever award for this module and make it compulsory for every first-year student so that no students will laugh at one another. Afternoon classes for this module must be cancelled because we are tired in the afternoon, which means we need a hundred percent concentration (****F_{2B}****)."*

This response suggested that this module should be compulsory for all students so that students will not laugh at each other. Participants of this focus group further mentioned that this module must be taught in the morning, and all afternoon classes must be cancelled.

A participant suggested that the department and former students must go to schools to encourage learners about the bridging programme, and the information about this bridging programme must also be passed on to students during career guidance. For example, this participant said:

> *"In my view, former students and even our department must go to different schools to speak about this bridging programme* ***(L_A).***

The above response suggested that if information can be passed to learners while they are still at school, it can help encourage them to register for this bridging module rather than sit at home.

Participants mentioned that re-alignment of the syllabus or topics to be covered in this module can be of interest to students. Hence, many students will come to register for this module. He further mentioned timetable clashes with other major modules, if resolved, can make many students register for this bridging module. For example, this participant responded:

> *"This bridging module must have topics that are related to what students will be doing in their main degrees* ***(L_B)."***

This response indicated that realignment of topics or syllabi and putting topics that will help students in their first-year degree is one of the strategies. For example, this participant further said:

> *"Learners must be encouraged in high school to choose pure Mathematics because Mathematics literacy is not related to this module. Tutors, former students, and lecturers must go out in full force, passing the information about this bridging module to students in high school and even during career guidance here at university* ***(L_B)."***

The above response showed that doing mathematics literacy will lead to this bridging module regardless of the symbol you get in the final Grade 12 results.

Participants mentioned that students are not encouraged to register for this module; students are encouraged to go to the main degree if they qualify, but if admitted into

the foundation programme, they are encouraged to register. For example, this participant responded:

> *"It's not about encouraging students to register for bridging Mathematics modules, but all qualifying students want to register for the programme* ***(HoD$_A$)."***

The response shows that the department wishes for students to go straight to the mainstream, but if they do not qualify, our Mathematics foundation department encourages them to register for this module if they are admitted, instead of staying at home.

Participants indicated that the institution encourages students to perform well in Grade 12 Mathematics so that they end up registering for the main degree instead of bridging Mathematics. For example, this participant said:

> *"As an institution, we do not demand that they register for bridging modules if they satisfy the entry requirements into the programmes they want to follow* ***(H$_B$)."***

The above response shows that students are encouraged to study hard so that they go straight to the mainstream modules instead of bridging, but those who fail Grade 12 Mathematics are encouraged to register for this module if they get admitted.

5.3.2 Data Collected through Classroom Observation

The researcher observed two classes for each bridging mathematics module. All of them were in September and October 2024, as seen in the classroom observation schedule attached as an appendix. The researcher observed two classes per bridging mathematics module, totalling four classroom observations.

5.3.2.1 Motivation of students and lecturers during a lesson (O_1)

Through all my observations (O_1), it was evident that lecturers and students are highly motivated to continue with the lessons. It appeared that students had accepted the reality of participating in a bridging programme or bridging mathematics modules.

Additionally, the lecturer expressed concern about students' low attendance and their engagement during lessons, which compelled him to adjust his teaching style (O_2). However, some students arrived in class after the lecturer had begun the lesson. They entered the classroom at a leisurely pace and seemed untroubled by their lateness; they appeared demotivated.

It was observed (O_2) in group A that lectures showed mastery of bridging Mathematics content during teaching. He demonstrated a good understanding of Mathematics. The lecturer was positive about this module because he came to class prepared. Even though the lecture guide was available, the lecturer came with handwritten notes containing various examples that were not included in the lecture guide.

On the other hand, it was observed (O_1) that the morals of some students were down. A small number of students attend classes, and these classes are always held in the afternoon to accommodate the lecturer, who works on a part-time basis. He is only available in the afternoon after schoolwork. It can be observed that the attitude of most students is positive; a small number of students' attitudes is negative; they simply sit, as if watching television, without even copying notes or writing anything.

According to Vygotsky's theory of constructivism, most students in the bridging mathematics module were aware of how they would learn and used that knowledge to optimise their learning. Some students are unaware of this, and hence they misbehave in class. Most of the students were motivated, but there were a few students who seemed demotivated; it was as if they were attending class against their will.

5.3.2.2 How do lecturers motivate students' active participation (O_2)?

Upon realizing that a small group of students were demotivated, in all four observations, the lecturers tried their level best to apply Vygotsky's constructivist theory in class so that students could become motivated. According to Akpan, Igwe, Mpamah, and Okoro (2020:54), “students no longer sit down to be informed or loaded by the teacher but discover lesson contents by themselves”. Students now learn to work in groups as organised by the teacher for effective collaboration or cooperative learning. Students become co-custodians of knowledge as they share and build on their previous experiences to create new knowledge. Students take responsibility for

learning by actively participating and collaborating. In the process, students should learn to consider the opinions of others by appreciating and investigating new ideas and lessons learned from their colleagues.

In group A, the first observation was that students sat down, ready to be informed by the lecturer. However, they were not working in groups, not participating, and did not appreciate others' ideas, as shown by their laughter when classmates raised new points. The lecturer used the lecture-student method, which proved ineffective that day. (Vygotsky, 1978) emphasizes that learning is a process of connecting prior knowledge to new knowledge; however, the lecturer did not relate the lesson to the previous one. He should have started by asking questions about what students did in the last lesson so they could connect old knowledge to new.

Again, according to Vygotsky (1978), learning is a social, situational, and metacognitive process. The lecturer (L_A) understood that students learn better as they interact with each other and observe their behaviour. The method that the lecturer (L_A) used that day was learner centred.

It was further observed that when the lecturer used a lecturing style that was not learner-centred, it discouraged students from being actively involved. The lecturer started his lesson by imposing on students, but when he changed to a learner-centred method, students began to participate. Students were given time to come up with their ideas, questions, and definitions.

For example, it was observed in Group A class that students discovered the integration formula by themselves. The lecturer was there to guide them as he asked them questions:

During one observation, the lecturer was teaching Integration. The lecturer explained to students that this topic of integration is the opposite of differentiation. He said, “Now that you know how to differentiate from Grade 12, you will not have more problems. To go back to the original function, you must integrate.”

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The students responded that the derivatives of x^2 and x^3 were 2x and $3x^2$, respectively, when he asked them what they were. In response to his subsequent question on which functions could be differentiated, we received 2x and $3x^2$, respectively. Students responded that x^2 and x^3 are correct, which is accurate given that their corresponding derivatives are 2x and $3x^2$, respectively. Additionally, the Lecturer (L_A) requested the students to determine the derivatives of x^2+2 and x^2-5. The students' responses were 2x and $3x^2$, respectively.

Students then realised that they could generalise by saying that the answer is x^2 plus a constant and x^3 plus a constant. The lecturer then said, “Very good”. We can now generalise. “He wrote x^2+c and x^3 +c, where c is a constant of integration, which can sometimes be solved if other conditions are given.

They then discovered that $\int x^n\,dx = (x^{n+1}/(n+1)) + c$. The above teaching style is learner-centred; students discover new ideas as they interact with others. Students and lecturers (L_A)' interactions revealed the above formula, which aligns with Vygotsky's theory. It was also evident that most students struggled to communicate in English during the interaction between students and the lecturer, and the language barrier posed a significant challenge for them.

The lesson about percentages was given to group B the other time. He was employing the lecture-student approach. Although this approach is likewise beneficial, it does not encourage active engagement. 10% of R100 is (10/100) * R100, or R10, the lecturer (L_B) informed the students. This instructor introduces numerous instances while continuing to use this teaching methodology. Using a lot of examples, he continued to explain to the kids.

The method did not encourage active participation, but it was also effective in its approach. Even if the lecturer can use the student-centred method, who will participate? By merely looking, these students are afraid to raise their hands and ask a lecturer a question. One student attempted to ask a question to the lecturer, but the student failed to complete the question because, when the student began to mix their

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mother tongue with English, other students laughed at them. From then on, no one ever asked the lecturer anything.

The lecturing style used by the lecturer (L_B) in teaching Integration motivated students to participate, even those who were initially uncooperative; they cooperated because they wanted to understand what was happening. In addition, the lecturer divided the students into smaller groups and assigned them an exercise to complete while he monitored, which, on its own, encouraged students to actively participate as they interacted with one another. The lecturer (L_B) employed a learner-centred method, which aligns with Vygotsky's (1978) approach (O_4). Sometimes, the lecturer allows students to learn through social interaction by grouping them into small groups to solve problems.

5.3.2.3 Challenges encountered during the teaching and learning of the mathematics bridging module (O_3)

The researcher observed two classes for each bridging mathematics module. One observation for each group A and B module was made when students were about to write a test. According to Vygotsky's Theory of constructivism, a lecturer's role is to monitor, coach, guide, advise and facilitate learning. Bridging mathematics modules, students came to university with social and environmental challenges. It was observed that some students arrived late to class, while others were punctual. Those who arrived late sometimes remained standing while the lecture was in progress. It was further observed that students were struggling to answer questions that a lecturer asked them, and maybe they did not understand the lesson.

Another challenge that was observed is that of overcrowding in the class. Overcrowding was a challenge because when students were late, they would sit or stand at the back, where they could not hear the lecturer properly and began to make noise. Another challenge that the researcher observed is students' class attendance; sometimes, they attend in large numbers, and sometimes, there are very few who attend.

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The first observation was when there was no test to be written closely. It was observed in the group B module that about 180 out of 450 would attend classes, and for the group A module, about 100 out of 230 would attend classes. But when students were about to write a test, they came in large numbers, and the venue was too small to accommodate all of them for both groups.

The unstable venue was a big challenge, which the researcher observed. The lecturer (L_B) moved around looking for the venue because the venue that was supposed to be used was occupied by other lecturers from different departments. This then made the lecturer (L_B) and students move around hunting for a venue. The lecturer and students themselves caused this challenge by changing a virtual class into a face-to-face class. The lecturer changed a virtual class to a physical class because students were failing to attend online because of network challenges, and another reason was that students were not comfortable with online classes, according to the lecturer (L_A)

It was then observed that students do not attend classes. Closer to half the class does not attend the bridging mathematics classes. It was also observed that some students stand outside still smoking even when the class has started. It is a challenge to the lecturer and other students as well; if other students come to class late smelling of cigarettes, it disturbs other students because not all students smoke.

Overcrowding was seen as a challenge. Too many students taught by one lecturer was a challenge because the lecturer could not monitor all of them since there were too many, and they were uncontrollable. The researcher noticed that students were hesitant to ask questions, possibly due to overcrowding. Some students struggled to ask questions fluently in English and often mixed their native languages with English when interacting with the lecturer.

In such circumstances, how can other students learn? Other students come and attend for around 15 minutes, and they go out. Maybe it is because of timetable clashes. As other students go out, others come in to attend, which disturbs the smooth running of teaching and learning. Most students did not do the work given to them in class by the lecturer. They were just sitting down and doing nothing. However, there were very

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few positive students; they interacted with the lecturer throughout, and they wrote what was given to them. In other words, they showed cooperation.

Taking attendance register daily in a large class like this was also a challenge. Students sign for other students who are not in class, and if a lecturer tries to monitor that, it will consume much of their teaching time. This module was taught by a part-time lecturer; therefore, he was sometimes unavailable for class. The lesson started well, but when the lecturer started to get fast, the students began to make noise. When students begin to make noise, others who are behind cannot hear what the lecturer is saying.

The other challenge observed was the audibility of lecturers when students are making noise. Another challenge which was seen was that of a new learning style, which some of the students were failing to follow. Vygotsky's Theory of constructivism, the idea of learning through collaboration, could not work effectively because of overcrowding; in other words, learning could not be a social process in this case. Vygotsky's Theory of constructivism works effectively with a small number of students.

5.3.2.4 The use of the zone of proximal development (ZPD) in the classroom(O_4)

The lecturer (L_A) was expected to first assist students by coaching them through their mathematical problems. Next, the lecturer slowly removes the scaffolding by only providing brief descriptions of how to proceed. Finally, students would be expected to develop and carry out their mathematical problems independently.

It was observed that the lecturer (L_A) tried to motivate students by introducing methods that promote active participation, such as student-centred methods, collaborative methods, and teacher-guided methods. The lecturer (L_A) understood that students learn better as they interact with others. He gave them an exercise, explaining first what should be done so that they could discuss it with others in class, but very few of them cooperated, and many did not. It seemed as if the students were used to an old type of learning, which is the teacher-centered method. The lecturer (L_A) came to class ready to deliver, and he always opted for teaching methods that promoted social

constructivism, but without success because there was no cooperation from students. Others came 20-30 minutes after class started.

As stated by Kalpana (2014:27), “constructivist teaching emphasises the active role that students have in building understanding and making sense of the content. It is learner-centred and involves students actively constructing information rather than passively absorbing it.” Teaching started well. Before the lesson ended, the lecturer tried to divide students into small groups so that they actively interact with each other. However, some participated, while others decided not to participate.

Data collected from observations revealed that lecturers tried their best to use teaching methods that were learner-centred, collaborative in nature, and teacher-guided. Lectures started with teaching, and then after teaching, he grouped students into small groups so that they could learn by interacting with other students, but this was not done every time. It was done sometimes. This is supported by Akpan, Igwe, Mpamah and Okoro (2020) and the theory used in this study (Vygotsky, 1978). Vygotsky promotes social constructivism, where students construct new ideas as they interact with others.

In both Group A and Group B, it was observed that the lecturers had knowledge and understanding of what they were teaching. He also understood that students learn better when they interact with others, as lecturers introduced small groups and assigned exercises, to which some groups responded positively, while others did not. This is confirmed by the literature (Bodrova & Leong, 2012). By interacting with other students, they get the opportunity to share their views, thus generating a shared understanding of the concept (Bodrova & Leong, 2012).

Social constructivism is a learning theory that views learning as a social process where students collaborate by engaging in group activities for meaningful learning to take place (Akpan, Igwe, Mpamah & Okoro, 2020).

In one of the group B observations, the lecturer (L_B) was using lecturer-centered method and it did not encourage active participation. Even if the lecturer can use the student-centred method, who will participate? By merely observing, these students are

afraid to raise their hands and ask a lecturer a question. One student tried to ask a question to the lecturers, but the student failed to complete the question because when that student began to mix the home language with English, other students laughed at that student and from then on, no one ever asked the lecturer anything.

5.4 ANALYSIS AND INTERPRETATION OF DATA COLLECTED THROUGH INTERVIEWS AND OBSERVATIONS

The analysis and interpretation of data collected through interviews and observations were presented in this section.

5.4.1 Theme 1: Roles played by bridging mathematics modules on students' academic performance

Participants showed that the bridging Mathematics module helps them to gain basic knowledge of the next level of Mathematics. Participants further said that this module would help them reduce their struggle in Mathematics in the future. For example, one participant said:

> *"Bridging Mathematics modules help me and even help those who want to continue with Mathematics, reducing the struggle in the future because of the relevance of the course content or syllabus. This module will help me with calculus. For example, he also said that the calculus they are doing now will help them in first-year Mathematics* ***(S_{1A})****."*

Participants' responses show that if the bridging Mathematics module is structured properly, it will help them in their future studies, and some of the content will already be known by students when they go to the next level of study.

Participants indicated that this bridging mathematics module is helping them to perform better in their first-year modules. For example, most participants said that:

> *"This module helps me not to encounter difficulties in my first-year modules, like Mathematics, Physics, and Chemistry. It laid down a strong foundation* ***(F_{1A})."***

The above response showed that this Mathematics module bridged the gap between university and Grade 12 Mathematics by laying down a strong foundation of what is coming ahead.

Participants mentioned that this module lays down a strong foundation in such a way that students will be able to understand first-year Mathematics and even some modules that are related to Mathematics. This is what this participant spelt out:

> *"This module gives students a better understanding of university Mathematics as they are introduced to all first-year Mathematics modules at the foundation level* ***(HoD_A)."***

This response showed that this bridging Mathematics module gives students more understanding of what is coming ahead in all first-year Mathematics modules. Students will have a little bit of background in first-year Mathematics modules.

Participants' responses differed, and some indicated that this module was not helping them in any way. They further indicated that this module should be done by those students whose degrees require Mathematics. They do not value this module. For example, one participant clarified:

> *"This module is not helping me because I was doing Mathematics literacy in Grade 12, and this module is full of pure Mathematics, which I did not do in Grade 12. He further mentioned that the contents of this module are full of pure Mathematics. It should have been 50% pure Mathematics and 50% Mathematics Literacy* ***(S_{1B})."***

The above response indicates that participants cannot see any relevance of this module to other modules.

However, some participants indicated that this module helps them understand other modules like Economics and Accounting. This is what another participant elucidated:

> *"This module is helping me to be open-minded; it also helps me in other modules like Accounting and Economics. He further gave an example of straight-line graphs, which helped him with the Economic module* ***(S_{3B})****."*

This response indicated that some participants were helped by this module, even in other modules for which they had registered.

This is also confirmed by another participant who said that:

> *"Topics that are taught here give students some basics of Mathematics and lay down a strong foundation, which will help them in their first-year Mathematics and even in other modules* ***(L_B)."***

Another participant added that:

> *"This module helped me to get 100% on test 1 of the Mathematics I am doing now (****F_{1B}****)."*

This response indicated that students who go through this module are doing well in first-year modules, especially in modules that are related to Mathematics.

Another participant of the focus group added:

> *"This module helped me to get the necessary Mathematical basics, which are now helping me in the first-year modules I am doing (****F_{3B}****)."*

The above response shows that this module is helping students get the necessary Mathematical basics, which will help them as they continue with their studies, especially in Mathematics. The roles that the Bridging Mathematics module plays are as follows:

5.4.1.1 Lay down a strong foundation

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Qualitative data collected through interviews revealed that most students understood the importance of the mathematics module. Data from interviews with students, lecturers, and heads of departments indicated that most students understood that the bridging Mathematics module laid the foundation for first-year Mathematics. It was also confirmed by Eitemüller and Habig (2020) that bridging course participants achieved significantly better examination results than their fellow students who did not enrol in the bridging course.

Focus group data revealed that bridging the mathematics module helped students to get 100% in test 1 of the second-semester Mathematics. This is confirmed by researchers who mentioned that the overall performance of students who enrolled for the bridging/foundation programme was positively associated with increasing Grade Point Average (GPA) and passing all courses in the first year (Curtis et al., 2017).

Participants knew and understood the importance of bridging Mathematics modules in their next level of study or first-year modules, as Raines (2012) knew and understood the importance and roles played by bridging courses. Raines (2012) then introduces a preliminary summer bridging programme for pre-college STEM (PCR) majors, and his study suggests that student participation in the summer bridge programme positively impacted the academic performance and persistence rates of the students involved.

5.4.1.2 Helps students perform better in other subjects

Data from the interview showed that the bridging Mathematics module is helping them to perform better even in non-mathematical subjects like Physics and Chemistry. This is supported by Newman, Lloyd and Thomas (2007), who argued that students who entered engineering degree programmes through the bridging Technology with Mathematics route performed better than their fellow students in both mathematical and non-mathematical module assessments. Data from individual interviews showed that students who performed well in the bridging Mathematics module also performed well in Accounting and Economics, and those who performed badly also performed badly in Accounting and Economics. This is supported by Shabanᵅ (2015), who revealed that Mathematics and Accounting are correlated. It was also supported by

Syahrial and Hendra (2023), who discovered a positive correlation between Mathematics and Economics. Participants revealed that it would have been difficult for them to perform well If they had not done this bridging module. In other words, this module helps them to perform better in other subjects like accounting. It was also confirmed by Eitemüller and Habig (2020), who discovered that bridging course participants achieved significantly better examination results than their fellow students who did not enrol in the bridging course.

Through interview data, it was revealed that some students are not getting any help from this module; they cannot see any relevance of the contents to other modules and even the modules they will do in the first year. Very few researchers, like Sempebwa, Jude, Eduan, Wilson, Mulumba, Fawz and Nassi (2012), found no significant difference in the academic performance of students who enrolled through the university bridging programme and those who just enrolled straight.

However, some students are getting help from this module, and they even mentioned Accounting and Economics as examples. This was also confirmed by Rylands and Coady (2009), who discovered that students lack the appropriate mathematical background to cope with first-year Mathematics and science subjects, which increases the failure rate.

5.4.1.3 Helps students in the next mathematics level

Focus group interview data showed that most students were boosted in their first-year mathematics modules by the knowledge they got from this bridging Mathematics module, and they got 100% on test 1. Students who are well prepared achieve better than those who are not well prepared, and according to Poladian and Nicholas (2013), students who are not well prepared are those students who did not attend the preparatory or bridging programme. Personally, this module boosted me because I did mathematical literacy in high school. Thus, I do not know pure Mathematics at all, so it helps me with the knowledge to apply when I go to the next Mathematics level.

5.4.1.4 Bridge the gap

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It was also revealed through interview data that the bridging Mathematics module bridges the gap between high school and university Mathematics. One participant even mentioned that in high school, there is no integration, but in this bridging module, integration is there, which means it is for the bridging Mathematics module students when they go to their first year. This is supported by all universities in Germany that complained that the Mathematics skills of students entering the higher education system do not meet the level demanded by universities, which is a major problem, particularly in math-related study programmes such as Economics, Engineering or Science, then to bridge the gap, almost all universities offer some bridging course called Remedial Mathematics courses (Büchele, 2020).

Individual interview data revealed that bridging Mathematics students benefit from the knowledge they got from topics like factorisation, logarithms, transpose, and simultaneous equations, which some students have never done before. Therefore, bridging Mathematics modules creates a foundation for students to apply certain formulas in other modules as well. This is in line with the literature by Poladian and Nicholas (2013), who found that students who transitioned through the preparatory programme felt well-prepared for their undergraduate Mathematics.

5.4.2 Theme 2: Attitudes of students towards Bridging Mathematics

Participants exhibited a range of attitudes; some were positive and very few were negative. Data from individual interviews revealed that most participants had positive attitudes towards learning this bridging Mathematics module. For example, one participant expressed that:

> *"I appreciate this module. I like this module, and I enjoy its content and the way the lecturer presents his lessons, which is why I got 100% on the test. I see learning this module as a good opportunity for me to lay a strong foundation for what is coming ahead." When I go to the first year, I will know integration and differentiation rules, which I did not do in Grade 12, and hence, I will be much better equipped than those students who did not do this module* ***(S_{1A})***."

Furthermore, another participant said that:

"I still need to do a Bachelor of Science (BSc) in Computer Science. I have a positive attitude, and this module is achievable. Maybe students should be allowed to do the module they failed in Grade 12 only, instead of doing all modules, including the modules that passed with high marks in Grade 12. He further mentioned that he was there because of Mathematics only, but he was also doing Life Science and Physical Sciences, for which he passed well in Grade 12 ***(S_{2A})****."*

The above responses indicated that most students had a positive attitude. Participants still needed to pursue the degree of their choice; they had accepted that they were registered for this bridging programme.

Former students mentioned that they had a positive attitude towards this module because they had a goal of doing their mainstream degrees. A participant from the group said:

"I had a negative attitude, but this then changed to be positive the moment I realised that what I am doing now is also helping me in other modules ***(F_{1A})."***

A participant mentioned that most students in the bridging Mathematics module are happy and show a positive attitude towards learning this module. This is what this participant shared:

"Through orientation and the way our bridging Mathematics modules are, most of our students have good attitudes towards the modules ***(HoD_A)."***

This response indicates that students of this module were oriented at the beginning, which made them develop a positive attitude towards this module, and most of them are all happy.

However, a few participants had negative attitudes towards learning this bridging Mathematics module, thus:

"I don't think I will pass this module at the end of the semester because I don't understand this module at all. I did Mathematics Literacy in Grade

12, and I don't see any correlation with this module I am doing now. I did not expect to do this module; hence, I don't like it ***(S_{1A}).***"

The above response indicated that participants had given up. They had a negative attitude because participants did Mathematics Literacy in Grade 12, and they could not see any relationship with this module.

Participants indicated that this module should be done in the second year, third year, or even fourth year. However, in this module, students have the option to do it in either the first semester or the second semester. If they fail in the first semester, they have another chance to repeat it during the second semester. For example, one of the participants specified that:

"I thought of removing this bridging module and adding it later in the third year because I have a lot of modules I am doing now. In the third year, I will be doing two modules only. It will be good for me to add this module so that I can do three modules. I did not plan to do this degree where there is Mathematics because I know that I am not good at Mathematics at all ***(S_{2A}).***"

The responses from the participants showed that they wanted this bridging module to be done later in the third year. Participants were caught by surprise; they wanted a degree without Mathematics. They thought maybe by doing mathematics literacy in grade 12, they would avoid going to bridging mathematics; in other words, they wanted a degree with no mathematics, hence they chose to do mathematics literacy in grade 12.

Participants indicated that most students are positive, and very few are negative about this module. One participant said that:

"New students are very serious at the beginning of this module, but when they see a lecturer teaching something they were not expecting, their attendance begins to decrease. Old students do not attend because of clashes. Their attitudes are good because they now realise that they will not graduate if they don't pass this module ***(L_B).***"

The above response indicated that students' attitudes change through what they are experiencing or going through.

Through classroom observation, it could be seen that most students were positive and very few were negative towards the teaching and learning of bridging mathematics modules. Other students came to class late and they could not write or even attempt the task given to them by the lecturer in class. While others were trying to discuss, those students could not do anything. They are laughing at other students, not paying attention in class, arriving late, and leaving early; that is their behaviour. Positive students came to class early; they cooperated during the lesson and completed the class task. This observation confirms what the students and the lecturer said during the individual interview. Students exhibited the following attitudes, according to observations.

5.4.2.1 Positive attitude

Data from individual interviews revealed that most students appreciate this module and are happy and positive about this bridging programme, as confirmed by the literature (Hwang & Son, 2021). Students view learning this module as a good opportunity to test what is coming in the first year. Data from interviews further indicated that students hope to achieve the degree of their choice, and they need to complete this bridging programme to pursue the degrees of their dreams.

Data from the lecturer and focus group interviews revealed that students are happy with the fact that they are admitted to university, and they are learning new things instead of staying at home. It was revealed through observation data that most students were happy, positive, and ready to learn, but a few seemed like they were negative because they came to class late, and they misbehaved, making noise standing at the back.

Data from students, lecturers, and heads of department (HoD) revealed that students of this module were happy and positive about this module. They received proper orientation, which is why they are positive about this module. It could be seen through observation that most students are motivated and a few are demotivated. At the

beginning of the semester, many, if not all, students are motivated, but when the lessons start and upon experiencing maybe lecturing style they were not expecting, they start skipping classes. Observation data also revealed that students become active when the lecturer uses a student-centered method, but when the lecturer changes to a lecture-student method, Students start making noise, and some even leave. Once again, data collected from observations revealed that lecturers made every effort to employ teaching methods that were learner-centered, collaborative in nature, and teacher-guided. Lectures would begin with instruction, and then the lecturer would group students into small teams to facilitate learning through interaction with their peers, although this practice occurred only occasionally. This is supported by (Akpan, Igwe, Mpamah & Okoro, 2020) and the theory used in this study, Vygotsky's Theory of constructivism, which promotes social constructivism, whereby students develop new ideas as they engage with others. Students with a positive attitude can be characterized by the following:

- **Enhanced motivation**

Students who have positive attitudes are more motivated to learn and succeed, which encourages them to engage fully in class, ask for assistance when necessary, and overcome obstacles.

- **Increased engagement**

Students are more likely to pay attention, concentrate, and be involved in their studies when they have a favourable attitude about the subject matter and their learning environment.

- **Increased self-confidence**

Students who have positive attitudes are more inclined to take chances, try new things, and have faith in their abilities.

- **Improved academic outcomes:**

Research has indicated a robust relationship between optimistic attitudes and improved test scores, grades, and general academic performance.

5.4.2.2 Negative attitude

Participants from the focus group interviews revealed that a small few students had negative attitudes towards this module because they were laughed at by other students who were not doing this module. The same data also revealed that most students, when they see variables x, y, and z, get intimidated.

Individual interview and focus group interview data revealed that a small number of students do not like bridging Mathematics. They hate it. This module is too unrelated to what they are studying, which is in line with Hwang and Son (2021), who showed that students with a positive attitude towards Mathematics had higher Mathematics achievement than students with a negative attitude. These findings revealed that students with a positive attitude towards Mathematics had high achievement in Mathematics. According to the lecturer and classroom observation data, only a small number of students showed up for class, which supported the idea that students disliked and had a bad attitude toward this module.

Individual interview data revealed that a small number of students had already given up on this module. They harboured a negative attitude towards it because they did not expect to pursue a degree that involved Mathematics. Studies by Ndifor and Ngeche (2017) revealed a significant relationship between student attitudes and performance in Mathematics. Specifically, they indicated that the cognitive, affective, and behavioral attitudes of students influence their performance in Mathematics. Bridging mathematics students entered university expecting to pursue main degrees, but they ended up being accepted into the bridging program, which is why some students view the bridging program negatively. Now, the lecturer must employ learning methods that encourage students to be active in class and even outside, as suggested by Vygotsky's Theory of Constructivism.

Students who display behaviors such as non-attendance, mockery of peers, tardiness, early departure, and disruptive conduct generally demonstrate a disengaged and disrespectful attitude toward learning and the academic environment. More specifically, their attitude can be characterized as:

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- Unmotivated or apathetic – showing little interest in participating meaningfully in the learning process.
- Disrespectful – particularly towards peers, especially those struggling with language barriers, which undermines inclusivity and mutual respect.
- Undisciplined – lacking in self-regulation and commitment to classroom norms and expectations.
- Counterproductive to learning – as their behaviour may hinder not only their progress but also the learning of others.

5.4.3 Theme 3: Factors that influence students' academic performance

Participants mentioned several factors that they believed contributed to students' academic performance. There are contributing factors behind any performance, either positive or negative. For example, one participant revealed that:

> *"I don't give this module more time to study because I don't like this module, in other words, time management … not prioritising schoolwork and a lecturer who is good but too fast and too slow to understand* ***(S_{1A})***."

The above response showed that participants were failing to manage time, they were not disciplined enough to prioritise schoolwork, and the lecturer was too fast in such a way that some students could not understand him.

In addition, participants mentioned that discipline plays a role in higher education. Given that students at universities are far from their parents and are therefore independent, discipline is crucial. They have to be sincere and understand their purpose.

> *"Had I been disciplined and serious, I would not be getting the marks I am getting, even though the university standard is too high* ***(S_{2A})***."

This response showed that participants were not disciplined enough to get higher marks in this module. They are now realising their mistakes. In other words, discipline affects performance.

Participants showed the importance of tutors in the bridging Mathematics module. For example, one participant said that:

> *"There are no tutors at all, but the lecturer does some tutorials. He further said he got high marks because of the assistance of tutorials. Even people around me always encourage me, which is why I am excelling in this module; however, they mentioned that there should be official tutors appointed to assist students, not lecturers alone* ***(S_{1A}).***"

Participants' responses showed the need for tutors to assist lecturers. Participants' responses highlighted the importance of tutor support in large-group settings, indicating that lecturers cannot effectively manage and engage with groups exceeding 230 students without additional assistance.

Former students narrated some factors that affect students' performance. They were discussing their experiences since they had already completed this module. These participants said:

> *"The venue was too small to accommodate many students, and because of that, we began to be disinterested in attending classes* ***(F_{1A})."***

The above response showed that overcrowding, small venues and class attendance were some of the factors that contributed to students' academic performance.

Participants said that they are not good at Mathematics. They attend and write everything, but still fail mathematics. One participant mentioned that:

> *"I attend classes and write tests and assignments, but still fail. I don't understand some topics in the syllabus, and the lecturer is even too fast* ***(S_{1A}).***"

This response showed that more tutors or another teaching strategy are needed to assist some students, and even lecturers must slow down to accommodate slow

learners. Participants said that they were discouraged because they planned to do higher degrees in their chosen fields, but because of low achievement in Mathematics, they were forced to register for a bridging module. This module is not even aligned with my degree. This is confirmed by this participant, who indicated that:

> *"I am so discouraged; I was forced to do this module, which is not even aligned with my course or my degree. He further asked: Where do you apply Mathematics to Industrial Psychology? I don't even consult or discuss this module with others; I hate this module* ***(S_{2A})****."*

The above response showed that participants were unaware of what they would be doing in this module. The practicality in real-life situations or even in other modules they were doing was also a concern to the participants. Demotivated participants are unable to attend classes.

Students must also have a positive attitude towards any module for which they register to pass. Another participant said that:

> *"I am getting high marks because I have accepted the challenge of bridging Mathematics. I manage my time properly in all modules I am doing, attending classes, tutorials, discussing with others, and even consulting lecturers, but this module clashes with other subjects like ECS* ***(S_{3A})****."*

This response showed that most participants were disciplined, attended tutorials and classes, and managed to score high marks.

Furthermore, Other participants mentioned that there are students who did not do pure Mathematics in high school; they did Mathematics Literacy. This participant alleged:

> *"Those students who are getting high marks are students who did pure Mathematics in high school; those who get middle marks are those who did pure Mathematics in Grade 10 and then did Mathematics Literacy in Grade 11 and Grade 12* ***(L_B)."***

The above response shows that a strong background in Grade 12 pure Mathematics is needed for students to do well in this module.

Observation revealed that attendance was low and that several students arrived late for class. Another issue was the venue, as the lecturer and students wandered around in search of a free venue, which affected their academic performance since by the time they found a venue, they would be tired, and they may not be active in class. The factors listed below influenced the students' academic achievement.

5.4.3.1 Overcrowding

Focus group data revealed that factors like tutors, group work, overcrowding, time management, workload, and university environment contributed to the academic performance of students. Focus group data were made up of former students, those who did this module in the first semester, and those who did this module in the second semester. Data from the focus group revealed that one lecturer could not manage a group of over 500 students alone. It was difficult for him to monitor each one of us in an overcrowded environment like that. This was supported by Peter and Ligembe (2022), who indicated that big or small class size has an impact on students' performance and students do not perform well in big classes as it causes resources to be inadequate, lowers student performance, and makes classroom instructions ineffective.

Data from classroom observation and lecturer interviews also confirmed the focus group interview findings of an overcrowded small venue with one lecturer and non-attendance of classes by students, as confirmed by Guleker and Keci (2014), who showed that students who attended classes performed better than those who do not attend classes.

5.4.3.2 Workload

Data from observation revealed that lecturers of one of the bridging mathematics modules were overloaded with work, possibly because he was a part-timer coming from work, and by the time they arrived at the university, they were already tired. Kizito, Munyakazi, and Basuayi (2016) found that factors such as prior academic knowledge,

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workload, teaching quality, teaching methods, students' Approaches to Learning (APL), assessment, teaching resources, and student support/satisfaction had some influence on student performance in first-year Mathematics (Mat 105) at the University of Western Cape.

5.4.3.3 Time management

Time management, as mentioned in individual and focus group interviews, is in line with researchers Gupta and Chitkara (2018), whose results showed that both long-term time management and short-term time management are significant predictors of academic performance. Thus, the good predictor of academic achievement was found to be the combined effect of long-term and short-term time management.

5.4.3.4 Group work

Classroom observation (O_3), individual interviews, and focus group interviews revealed that group work helped most students perform better; some even excelled. The lecturer understood learning as a social process where students collaborate by engaging in group activities for meaningful learning to take place (Akpan, Igwe, Mpamah & Okoro 2020). This lecturer understood that students build a better understanding of the main concepts more effectively when they engage in solving problems during class activities, and this is supported by literature (Ganyaupfu, 2013).

5.4.3.5 Tutorials

Data from individual interviews and focus groups revealed that tutors played a big role in the academic performance of students. Tutors were always there to assist students, which is in line with Guerra-Martn Lima-Serrano and Lima-Rodrguez (2017), who showed the effectiveness of tutoring and found that most students improved in their academic performance. It was further confirmed by McKay (2016), who discovered that attending tutorials had a positive effect on the academic performance of the students. However, a poor or weak tutor can negatively affect learning. In other words, a good tutor improves the performance of students, and a weak tutor will not improve

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the performance of students. Vygotsky's social constructivist theory endorsed group work as a learning tool.

5.4.3.6 Environment

Individual and focus group data revealed that those who did not perform well were not used to the university environment. They failed to manage their workload. If you come late to class, you will sit or stand at the back, where you cannot hear the lecturer properly, and that affects your academic performance poorly.

5.4.3.7 Teaching method

It was revealed through individual interviews that most students hate this module; they do not know what is going on, the lecturer is too fast, and they cannot see how they are going to apply this module in a real-life situation.

Data from focus group interviews revealed that the quality of teaching from lecturers helped them produce good results. It was also confirmed by Mensah, Okyere and Kuranchie (2013), who discovered that teachers' teaching methods have a major influence on students' attitudes. Vygotsky's social constructivist theory advocates for the use of a collaborative learning strategy. That strategy can make students active participants and, hence, improve their academic success.

5.4.4 Theme 4: Challenges that students encountered when learning the bridging Mathematics Module

Participants mentioned challenges they faced when learning this module, which were overcrowding at the beginning and when students were about to write a test, indiscipline, and an unstable venue. For example, one participant said:

> *"Sometimes the class is overcrowded, students who come to class late by 20-30 minutes stand at the back and begin to make a noise, misbehaving there (LA)."*

The above response showed that overcrowding in class is a challenge, teaching and learning cannot run smoothly and hence the academic performance will be affected.

Another participant shared that:

> *"Overcrowding is a problem because when you are late to class, you sit at the back, you cannot see, you stand because there are not enough chairs in the lecture rooms, and students begin to lose focus and make noise* ***(S_{1A})****."*

This response showed that participants are not comfortable learning this module in an overcrowded environment.

Former students indicated the challenges they encountered while learning this mode. These are their responses:

> *"The venue is too small to accommodate many students. The lecturer cancelled all the online classes, and this resulted in venue hunting every day before class (****F_{2A}****)."*

The above response revealed some challenges encountered by students when learning this module. Overcrowding, unstable venues, and student attendance seemed to be the biggest challenges.

It seemed as if they were sharing the venue with other departments, which was problematic because of the clashes. This participant said:

> *"I move around looking for a venue for about 10-15 minutes before I start with my class* ***(L_A)****."*

The above response suggested that to avoid student and lecturer frustrations, the Lecturer must ensure that there is a stable venue for this module.

Participants indicated that more students are admitted to the foundation programme, and the venue we have cannot accommodate all of them. For example, this participant responded:

"Lack of bigger venues, as we have more students than the venues can accommodate. We also need to have all the lecturers appointed permanently ***(HoD$_A$)."***

This response indicated that the department registers many students, but no venue accommodates them. In other words, it is a small venue with many students. This response further shows that uncertainty about the lecturers' contract is also a challenge.

Participants suggested that lecturers must be clear to tutors about what and how they are approaching this module so that they can be on one page. One of the participants said that:

"Tutors and lecturers explain the same things differently, and this brings confusion to students ***(S$_{2A}$)."***

The above response showed that, to avoid confusing students, lecturers and tutors must discuss all possible methods for solving those tutorials so that they are on the same page.

Participants indicated that tests and assignment scripts must be brought back in time so that students will be able to see their mistakes before starting another topic. One participant said:

"Delays in bringing feedback in time become a challenge to students and even lecturers ***(S$_{3A}$)."***

Participants indicated that most first-year students struggle to understand teaching style, but they are still used to high school teaching methods, where teachers sometimes use their language to explain some of the concepts. Here is a response from another participant:

"In the beginning, I failed to understand the lecture, so I decided to go for extra classes and private tutorials. This helped me to understand the module better ***(S$_{1B}$)."***

This response showed that participants were struggling to understand at the beginning, and it would be helpful to students if lecturers could start teaching those small things that are not that difficult to motivate students.

Participants further mentioned other challenges, such as overcrowding, most students lacking a pure Mathematics background, clashes of timetables, and venue problems when virtual classes are changed into physical classes. This participant said:

> *"Most students did Mathematics Literacy in high school, and this participant further mentioned overcrowding and clashes of timetable and venue as some of the challenges they are facing in this module* ***(LB)."***

This response indicates that most students do not have a strong background in pure Mathematics. They did Mathematics literacy; hence, they are struggling. This response further indicates that overcrowding, clashes of timetable, and venue are other challenges of this module. The challenges listed below influenced the pupils' academic achievement.

5.4.4.1 Timetable clashes

Some students have been seen to skip class and fail to complete the assignments that are assigned to them. In a large class, it was also evident that the lecturer found it difficult to keep an eye on the attendance records of the students. Due to time constraints and crowding, lecturers found it difficult to use scaffolding. Although scaffolding might work better in tutorial sessions, it could also work well in teaching classes if the teaching period were to be extended to at least one hour and thirty minutes.

Data from the lecturer revealed that students come to class after 20-30 minutes have elapsed, and they stand at the back, making noise that disturbs the class. Even if the class is full, there will not be enough chairs in the venue. Furthermore, observation and interview data further revealed that overcrowding (Crisianita & Mandasari, 2022) and non-attendance of some students are also big challenges in this module.

5.4.4.2 Class venue

HoD data revealed that many students registered for this module every year, but the venue was too small. Through individual interviews and observational data, it was revealed that the venue was a problem, as students and lecturers had to move around in most cases, looking for a venue before class. There was no stable venue for this module. Data from individual and lecturer interviews also highlighted this.

5.4.4.3 University environment

Students were used to spoon feeding in Grade 12, but when they came to university, they found that the opposite is the case. Individual interview data indicated that most students failed to understand the lecturer at the beginning; in other words, they failed to adjust at the beginning. This literature supported this, where students reported that learning new notations and mathematical concepts was daunting and reported difficulty adjusting to independent study and learning in the 'university way' (Gordon & Nicholas, 2013).

5.4.4.4 Language barrier

Data from students' interviews and classroom observation revealed that students were struggling to ask questions in English, some of them even used their home language when interacting in class, but the lecturer encouraged students to communicate in English. However, not all of them could manage to do that; this is supported by the literature (Hugo & Lenyai, 2013), which discovered that language barriers affect academic performance.

5.4.4.5 The use of Vygotsky's Theory

Sometimes, it could be observed that the lecturer is failing to use Vygotsky's social constructivism theory in an overcrowded class. Data from classroom observation revealed that lecturers attempted to apply Vygotsky's theory when instructing the bridging mathematics module. According to Vygotsky's social constructivism theory,

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kids learn best when they engage with others, so they encourage social connection in the classroom. However, the classroom setting was unable to support social interaction.

5.4.5 Theme 5: Strategies that can be used to improve students' academic performance

Participants suggested that to encourage more students to take bridging Mathematics modules, the university or department should allow students to only bridge the modules they failed in Grade 12. This would give students more time and energy to concentrate on one or two modules they struggled with, reducing their workload. For example, one participant mentioned that:

> *"Students must only bridge the module they failed in Grade 12 instead of doing many modules. If you fail Mathematics, you must repeat it* ***(S_{2A})****."*

The above response showed that participants can be encouraged and persuaded to register for this mathematics bridging module by using the experiences of former students.

Another strategy can be to share about bridging mathematics modules at school before learners even come to university. One student indicated that:

> *"Information about bridging modules must be shared with Grade 12 students before they come to university, maybe with former students. It must be made clear that bridging the programme is easier than repeating Grade 12 or rewriting the module you failed in Grade 12* ***(S_{1A})****."*

According to the above response, learners should be given additional information about this bridging program when they are in Grade 12, perhaps during career counseling, or by sending former students to different high schools.

Once more, participants recommended that instead of rewriting or repeating Grade 12, teachers should explain and persuade students about bridge programs. To motivate students to complete bridging courses, it is necessary to convey the benefits to them. One participant suggested that:

> *"Teachers must convince learners to do this bridging module instead of taking a gap year or staying at home* ***(S_{3A})***."

This response suggested that teachers, if used properly, can thoroughly explain this bridging programme to learners. Teachers are learners' parents at school, and therefore, learners will be able to listen to and understand them better than their parents.

The problem with the curriculum or substance of this module was also brought up by other participants. Effective tactics can motivate students to sign up for this bridging mathematics module if they are established and put into practice.

. This is one of the participant responses:

> *"They must change the syllabus of this module so that it is 50% pure Mathematics and 50% Mathematics Literacy* ***(S_{1B})***."

Participants are finding the bridge module's contents difficult to handle, as seen by the preceding remark, and they want it modified. Perhaps if this module can be reorganized as the participant proposed, a lot of students will start to think about signing up for it.

According to the participants, a realignment of the curriculum or the topics covered in this module may be of interest to students, which is why many students will sign up for it. This participant revealed that:

> *"This bridging module must have topics that are related to what students will be doing in their main degrees* ***(L_B)."***

According to this comment, one strategy to get students to register for this bridging module is to realign the topics or syllabi and include subjects that will aid them in their first year of study.

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5.4.5.1 Changing of Syllabus

Data from individual and focus group interviews revealed that there is a lack of information about this bridging programme in high school. Students must only bridge modules they failed in Grade 12 instead of bridging modules they passed in Grade 12. Individual interview data revealed that the syllabus must be changed so that it becomes 50% pure Mathematics and 50% Mathematics Literacy, since most students have done Mathematics Literacy in high school. This is what this participant said:

> *"They must change the syllabus of this module so that it is 50% pure Mathematics and 50% Mathematics Literacy* ***(S_{1B}).***"

5.4.5.2 Sharing of information

Data from interviews revealed that there is a lack of information about the bridging programme in some of the rural disadvantaged villages. Most Grade 12 students do not know about this bridging programme, their schools never spoke about it, and they don't have internet access where they can Google and find information about the bridging programme in different universities.

Data from the lecturer revealed that the foundation's Mathematics department and former students must go to different schools to share the message about this bridging programme. This data further revealed that former bridging mathematics module students and lecturers must share the message to schools before learners pass Grade 12. Data from individual interviews revealed that teachers must be used to pass information about this bridging programme to learners at high school before they come to university.

5.5 TRIANGULATIONS OF DATA

This section presents the integration of the study's empirical findings. This study triangulated the findings collected through interviews with students, lecturers, heads of department, classroom observation, literature, and theory used in the study on students' academic performance in the bridging Mathematics module. The rationale

for triangulating data was to justify trustworthiness and confidence in the findings and conclusions.

Question 1: What are the roles played by bridging mathematics modules on students' academic performance?

Qualitative data collected through interviews revealed that most students understood the importance of the mathematics module. Data from interviews with students, lecturers, and heads of departments indicated that most students were aware that the bridging Mathematics module laid the foundation for first-year Mathematics and also helped them perform better in non-mathematical subjects like Physics and Chemistry. This is supported by Newman, Lloyd and Thomas (2007), who argued that students who entered engineering degree programmes through the bridging Technology with Mathematics route performed better than their fellow students in both mathematical and non-mathematical module assessments. Data from individual interviews and test mark sheet documents showed that students who excelled in the bridging Mathematics module also performed well in Accounting and Economics, while those who struggled also faced difficulties in Accounting and Economics. This is supported by Shabanq (2015), who revealed that Mathematics and Accounting are correlated. It was also supported by Syahrial and Hendra (2023), who discovered a positive correlation between Mathematics and Economics.

Question 2: What attitudes do students have towards the Bridging Mathematics Modules?

As supported by the literature, data from focus groups, lectures, HoD, and individual interviews showed that some students valued this module and were pleased and enthusiastic about this bridging program (Hwang & Son, 2021). Information gathered from focus groups and individual interviews indicates that students want to earn the degree of their choice and must complete this bridging programme to pursue their dream degrees. Most students held positive views regarding bridging mathematics modules, while a small number expressed negative opinions. These findings were corroborated by data from classroom observations, focus groups, lecturers, and HoD interviews.

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Question 3: What are the factors that influence the academic performance of students?

Data from focus groups, lectures, and individual interviews showed that a variety of elements, including the university environment, time management, workload, group work, tutorials, tutors, overcrowding, and teaching methods, all had an impact on students' academic success. Classroom observation data validated some of the interview findings, such as congestion and unsteady locations. The classroom setting, tutorials, and group work were all validated by Vygotsky's social constructivism theory.

Question 4: What are the challenges that students and lecturers encountered when teaching and learning the bridging mathematics module?

Challenges like overcrowding, unstable venue, small venue, language barriers, class attendance, and timetable clashes were discovered to be contributing to the students' academic performance, and these findings were confirmed by classroom observation data and HoD data. From interviews (lecturer Mandasari, 2022) and non-attendance of some students is also a big challenge in this module.

Question 5: Which strategies can be used to improve academic performance in Bridging Mathematics modules?

Data from focus groups and individual interviews indicated that instructors and former students of the bridging mathematics module need to visit schools to promote awareness of the university's bridging program. Focus groups and individual student interviews further emphasized the necessity to modify the curriculum to consist of 50% pure mathematics and 50% mathematics literacy, considering that most students completed mathematics literacy in high school. Students must be allowed to bridge the modules they have failed only.

5.6 SUMMARY

The focus of this chapter was to present analysed and interpreted data obtained using interviews and classroom observations. The interview schedule was divided into two

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sections: biographical and content-based data. The interview schedule consisted of questions designed to gather the views of students, lecturers, and the department head on students' academic performance in bridging Mathematics. The study presented some insights into students' academic performance in the bridging Mathematics module.

The study revealed that bridging Mathematics modules play a significant role in laying a foundation for first-year Mathematics and other subjects, such as Chemistry and Physics. This foundation helped students outperform those who did not complete the bridging module. This module helped students to bridge the gap between high school and university.

It was further revealed that time management, language barriers, tutors, workload, overcrowding, and the university environment contributed to students' academic performance. The lecturer utilised his experience to manage a large group of students in a small venue, despite some late-arriving students making excessive noise. Students and lecturers showed good attitudes towards teaching and learning in this bridging Mathematics module.

Students revealed that most high school learners hate bridging programmes, and as such, the university must make sure that the information about this bridging module is shared during career guidance, which the university holds every year. Former students must also be sent to different high schools to pass the message about the bridging programme. Students further suggested that students must be allowed to bridge only the modules they failed in Grade 12 instead of bridging even the modules they have passed in Grade 12.

This study revealed that overcrowding sometimes occurs, especially at the beginning and when students are about to take a test. Another issue is the venue, which is too small to accommodate many students. Despite the challenges, such as overcrowding, students arriving late, and venue-hunting problems faced by both students and lecturers, teaching and learning continued, and students eventually gained the foundation they hoped for.

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Although a small group of students reported that they could not see any roles played by this bridging Mathematics module, many students view it differently. They revealed that this module bridged the gap, boosted their performance, and laid a strong foundation in such a way that they are even performing better in other modules as well, which was also confirmed by the department head and the lecturer.

Overcrowding, time management, class attendance, group work, timetable clashes, and unstable venue were revealed as the most important factors affecting students' performance in this bridging mathematics module. The absence of module outlines, study notes, or guides was also seen as a contributing factor to students' performance.

Some students had a negative attitude towards the mathematics module. They disliked this module, regarding it as irrelevant to their degree programme, and they could not see the relevance of the module to real-life situations. However, most of them had a positive attitude, as evident in class observations.

Students revealed that the syllabus of this module must change. It must include 50% pure Mathematics and 50% Mathematics Literacy to accommodate every student. Students further revealed that high school students must be encouraged to do pure Mathematics instead of Mathematics Literacy. Another strategy could be to send former students and lecturers to high schools to share information about this bridging module.

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CHAPTER 6

SUMMARY, CONCLUSION, RECOMMENDATIONS

6.1 INTRODUCTION

This section presents a summary, conclusions, and recommendations for the study.

6.2 SUMMARY OF MAJOR FINDINGS

The study's summary was informed by research questions, a literature review, and empirical findings.

6.2.1 How the study responded to research questions

The study was piloted by the main research question: What influences students' academic performance in bridging Mathematics modules?

Bridging mathematics modules play a big role in students' academic performance. They help students with low achievement in Grade 12 Mathematics to bridge the gap between Grade 12 and university first-year modules. Furthermore, bridging Mathematics modules equips students with the knowledge and skills to feel comfortable and prepared for their next academic setting. Mathematics is a prerequisite of many modules, which is why those students with low achievement in Grade 12 Mathematics register for this bridging module if they do not qualify to register for the degrees they planned. After passing bridging Mathematics modules, students can then register for the degrees of their choice. Furthermore, students should also be aware that this bridging module supports them in other modules.

Secondly, both students and lecturers should cultivate a positive attitude to facilitate effective teaching, meaningful learning, and improved performance (Odogwu & Benedicta, 2015). Research indicates that students who maintain a positive attitude towards mathematics generally achieve higher outcomes compared to those with negative attitudes.

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Thirdly, factors such as the quality of teaching and workload (Kizito, Munyakazi, & Basuayi, 2016), time management (Gupta & Chitkara, 2018), overcrowding, university environment (Yin, Shi, Yi Tam, & Lu, 2020), and group work were found to influence students' academic performance. Environment was also mentioned by Vygotsky, who mentioned that the environment affects how students learn. For example, students cannot interact well in an overcrowded class. The study established that different factors influence students' academic performance in bridging Mathematics modules. Firstly, students should understand that bridging Mathematics modules are laying a strong foundation (DHET, 2012), equipping and preparing (Robinson, Galligan, Hussain, Abdullah, Frederiks & Wandel, 2019) for their next level of study.

Fourthly, challenges such as overcrowding, students' non-attendance, as confirmed by Guleker and Keci (2014), unstable venues, and timetable clashes influence students' academic performance. The lack of a larger venue that could accommodate a larger number of students was also identified as a challenge.

Lastly, strategies such as completing the module you have only failed in Grade 12 instead of repeating the subjects you have passed in Grade 12 can be a strategy that attracts many students to this programme, and it will minimise the workload. More information about this bridging programme should be provided to learners while they are in Grade 12, or possibly during career guidance, or by sending former students to different high schools. It was also discovered that students from former bridging Mathematics modules could be sent to different schools to share messages about the bridging programme. The university's annual career exhibition was also mentioned as one of the strategies that can be used.

Research Question 1:

What role do bridging mathematics modules play in the student's academic performance in a rural university?

This study established through interview data that the bridging Mathematics module helped students to perform better even in non-mathematical subjects like Physics and Chemistry. This is supported by Newman, Lloyd and Thomas (2007), who argued

that students who entered engineering degree programmes through the bridging technology with Mathematics route performed better than their fellow students in both mathematical and non-mathematical module assessments.

Data from interviews with students, lecturers, and the head of department indicated that most students understood that the bridging Mathematics modules lay the foundation for first-year Mathematics. It was also confirmed by Eitemüller and Habig (2020), who found that participants in the bridging course achieved significantly better examination results than their fellow students who did not enrol in the bridging course.

It was also revealed through interview data that the bridging Mathematics modules bridge the gap between high school and university Mathematics, as supported by Büchele (2020:1), who mentioned that in Germany, almost all universities offer bridging courses called Remedial Maths courses to bridge the gap.

This study found that the module has been beneficial to students. Through the interview data, it was discovered that students would struggle to perform well if they had not completed the bridging module. In other words, this module helped them perform even better in other subjects, such as Accounting and Economics. It was also confirmed by Eitemüller and Habig (2020), who discovered that participants in the bridging course achieved significantly better examination results than their fellow students who did not enrol in the bridging course.

Furthermore, data collected from focus group interviews showed that students who performed well in the bridging Mathematics modules also performed well in Accounting and Economics. Those who performed badly also performed badly in Accounting and Economics, and this is supported by Shaban[q] (2015), who revealed that Mathematics and Accounting are correlated. It was also supported by Syahrial and Hendra (2023), who discovered a positive correlation between Mathematics and Economics.

Data collected from interviews further revealed that these bridging Mathematics modules created a foundation for students to apply certain formulas in other modules

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as well, which aligns with the literature by Poladian and Nicholas (2013), who found that students who transitioned through the preparatory programme felt well-prepared for their undergraduate Mathematics.

Research Question 2:

What attitudes do students have towards the bridging of mathematics modules?

The study established that students' attitude towards Mathematics influences the efforts they put into understanding and practising mathematical concepts and skills. Hwang and Son (2021) showed that students with positive attitudes towards Mathematics had higher Mathematics achievement than students with negative attitudes. Data collected from individual interviews revealed that some students were positive about this bridging Mathematics module; they were happy and positive about the bridging programme, as confirmed by the literature (Hwang & Son, 2021). Students view learning this module as a good opportunity to test their understanding of what is to come in the first year. Data collected from interviews further revealed that students are still hoping to get degrees of their choice, and they need to go through this bridging programme so that they can start with the degrees of their dreams.

Through the interview data collected, it was established that a small group of students had already given up on this module; they had a negative attitude towards bridging mathematics modules. They came to university with no mathematics in their mind; they anticipated pursuing a degree that did not include mathematics. Literature by Ndifor and Ngeche (2017) revealed a significant relationship between student attitudes and performance in Mathematics. It was clear that positive attitudes correlate with good performance and vice versa.

Furthermore, data collected from interviews revealed that most students dislike this bridging Mathematics module. They believe that this module is not related to their current studies, which aligns with the findings of researchers (Hwang & Son, 2021). Hwang and Son (2021) showed that students with positive attitudes towards Mathematics had higher Mathematics achievement than students with negative attitudes. The majority of the participants were positive about bridging Mathematics

modules. Participants further mentioned that their positivity about this module enabled them to score 100% on some tests, while those who were negative scored less than 20% on certain tests.

Classroom observation confirmed what the individual interview and focus group discovered. It was observed that some students were positive, while very few were negative. Some students participated in writing a class task, whereas a few did not. In some instances, it could be seen that students are actively participating in class, and they are happy even though there were a few who did not cooperate.

Research Question 3:

What are the factors that influence students' academic performance in bridging mathematics modules?

Data collected through interviews and focus groups established that factors such as the quality of teaching and workload influenced students' academic performance, which is confirmed by Kizito, Munyakazi & Basuayi (2016), who also found the same thing. Factors such as time management were confirmed by Gupta & Chitkara (2018). Other factors like overcrowding, as confirmed by (Crisianita & Mandasari, 2022), university environment, as confirmed by (Yin, Shi, Yi Tam & Lu, 2020) and group work, as confirmed by (Crisianita & Mandasari, 2022), were also found to be contributing factors towards students' academic performance.

Students' non-attendance and overcrowding were confirmed by the lecturers' interviews and observations, as confirmed by (Guleker & Keci, 2014), who mentioned that students who attend achieve better than students who do not attend classes. However, focus group data also indicated that tutors' help is another contributing factor to academic performance, which aligns with McKay (2016), who found that attending tutorials had a positive effect on students' academic performance. However, a poor or weak tutor can negatively affect learning. This aligns with Vygotsky's theory, which emphasises the importance of social interaction. During the tutorial, students interact with each other, and the lecturer is there as a coach. Interviews also identified group

work as a contributing factor, which aligns with the findings of Akpan, Igwe, Mpamah, and Okoro (2020), as well as Vygotsky's sociocultural theory (1978).

This study identified several factors that contribute to students' academic performance. Focus group data collected revealed that factors such as tutors, group work, overcrowding, class attendance, timetable clashes, time management, workload, and university environment contributed to students' academic performance. Class attendance, timetable clashes, and overcrowding were confirmed by data collected through observations and interviews with lecturers.

Research Question 4:

Challenges that students encountered when learning the bridging mathematics modules

This study identified some challenges that students and lecturers face in bridging Mathematics modules. Data from the lecturer revealed that students often arrive late, typically 20-30 minutes after the class has begun, and they stand at the back, making noise and disturbing the class. Even if the class is full, there will not be enough chairs in the venue.

It was revealed through interviews and collected data that most students initially struggled to understand the lecturer. In other words, they failed to adjust at the beginning, which is supported by Gordon and Nicholas (2010), who reported that learning new notations and mathematical concepts was daunting and that they had trouble adjusting to independent study and learning in the 'university way' (Gordon & Nicholas, 2010).

Classroom observation and lecturer interview data revealed another challenge of students' failure to communicate in English (Language barrier), supported by literature (Hugo & Lenyai, 2013), who reported that language barrier contributes to student achievement. Most students were tempted to use their mother tongue when interacting with other students and even with the lecturer.

Overcrowding was also revealed through classroom observations and interview data collected, which aligns with the literature (Crisianita & Mandasari, 2022). Students' and lecturers' interview data further revealed that writing tests over the weekend and delaying feedback on assessments are also challenges that students and lecturers' encounter. Classroom observations revealed that students' classroom environment (Vygotsky Theory), where students are overcrowded, affects teaching and learning, hence academic success.

Research Question 5:

What strategies can be used to improve students' academic performance in bridging Mathematics modules?

Data from individual and focus group interviews revealed a lack of information about this bridging programme in high school. This data further revealed that former students and lecturers must share the message with schools before learners pass Grade 12. Students must only bridge the modules they failed in Grade 12, not those they passed.

Data from the lecturer interviews revealed that the Foundation Mathematics department and former students must attend different schools to share the message about this bridging programme. However, HoD data revealed that the department is happy with the fact that at least students got registered at the university instead of staying at home.

Data from individual interviews revealed that teachers must be used to pass information about this bridging programme to learners at high school before they come to university. Individual interview data again revealed that the syllabus must be changed to be 50% pure Mathematics and 50% Mathematics Literacy, as most students have already completed Mathematics Literacy in high school.

Focus group interview data indicated that the university or department should introduce the top achiever award and make this module compulsory, so that everyone

can avoid laughing at each other. Additionally, this module should be attended in the morning, not in the afternoon.

6.2.2 Summary of the Empirical Findings

Mathematics is a crucial subject in everyday life. Most professions require Mathematics, and because of that, all students are studying mathematics; some are studying pure Mathematics, and some are studying mathematics literacy. Most students fail to meet the minimum university entrance requirements for Mathematics, and they end up enrolling in bridging Mathematics programs or modules. Students must understand the importance of this module before they register. One of the roles is to help students meet university's minimum entry requirements if they pass.

Therefore, Central Queensland University (CQU) helps students make the transition from secondary to university by offering a bridging programme (CQUniACCESS) to get them ready for university admission (regardless of their previous skills and educational achievements) (Dekkers, Adams & Elliott, 2011). The results of this qualitative research revealed that bridging Mathematics modules play a significant role in laying a foundation for first-year mathematics and other subjects, such as Chemistry and Physics. Results revealed that this module helped students to bridge the gap between high school and university.

The literature further revealed that students who entered engineering degree programmes by bridging Technology with Mathematics way outperformed their fellow students in both mathematical and non-mathematical module assessments. The performance of students who entered university through a bridging programme is generally good compared to those who did not; they passed all courses in their first year (Curtis et al., 2017).

It was found that students' attitude towards bridging Mathematics modules influences their academic performance. The findings also revealed that most students and lecturers showed a good attitude towards teaching and learning this bridging Mathematics module, even though very few were negative about this bridging programme. The findings further revealed that a few students had a negative attitude

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towards bridging Mathematics modules. They regarded this module as irrelevant to their degree programme. They could not see the relevance of this module to real-life situations, but most of them had a positive attitude.

The literature revealed that students' attitudes towards bridging Mathematics modules influence academic performance. Student achievements and attitudes towards Mathematics are directly related (Odogwu & Benedicta, 2015). Furthermore, the literature pointed out that students' attitude towards Mathematics influences the attempts they put into understanding and practising mathematical concepts and skills, as supported by Hwang and Son (2021).

Moreover, Ajisuksmo and Saputri (2017) argued that there is a correlation between students' attitudes towards Mathematics and their mathematical achievement. Komarraju and Nadler (2013) revealed that students' self-perceptions affect their performance. According to Kele (2018), students' knowledge and attitudes about their Mathematics learning were influenced both positively and negatively by elements related to their classroom experiences, teachers' and peers' attitudes, and their subject-matter expertise. Literature suggests that a student's ability to succeed in a fundamental business topic depends on their attitude, type of secondary education (government or non-government), and mathematical aptitude (Stenberg, Varua, & Yong, 2010).

In other words, the attitude towards these bridging Mathematics modules significantly influences students' success or failure. However, according to Enu, Agyman and Nkum (2015), poor teaching and learning resources and the lecturer's style of instruction are some of the factors that affect students' performance. They also made the case that both teachers' and students' self-motivation has an impact on Mathematics performance.

The study revealed that time management, language barriers, tutors, workload, overcrowding, class attendance, group work, timetable clashes, unstable venue and the university environment contributed to students' academic performance. Mathematics must be taught for understanding, not just to cram, pass, and forget. Teaching methods must be designed in a way that enables students to understand the

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lesson and acquire more knowledge and skills; otherwise, students may develop a negative attitude towards Mathematics.

Some literature has identified important factors that contribute to students' attitudes toward learning Mathematics. Some researchers have identified factors such as students themselves, the school, teachers' beliefs and attitudes, and their teaching methods (Attard, 2012; Mata, Monteiro & Peixoto, 2012). Lecturer teaching methods were also mentioned by Mensah, Okyere and Kuranchie (2013). According to Komarraju and Nadler (2013), students' beliefs about themselves have been consistently found to play a significant and positive role in influencing their academic performance. Lecturers must also be positive about this module for students to adopt a positive attitude. However, the literature has shown a positive and significant correlation between students' academic performance and their teachers' attitudes (Ekperi, Onwuka, & Nyejirime, 2019).

Students learn better when they interact with others, as noted by Ganyaupfu (2013), who found that students develop a deeper understanding of the main concepts more effectively when they engage in problem-solving activities during class. McKay (2016) argued that tutorials had a positive effect on the academic performance of students who attended them. There are students who do not attend classes at all; obviously, they will not succeed, as pointed out by Guleker and Keci (2014), who mentioned that students who do not attend classes cannot perform better than students who do attend classes.

Additionally, Kizito, Munyakazi and Basuayi (2016) at the University of the Western Cape reported that several factors, including prior academic knowledge, workload, teaching quality, teaching methods, students' approaches to learning (APL), assessment, teaching resources, and student support/satisfaction, were found to have some influence on first-year Mathematics student performance (Mat 105).

In addition, Yin, Shi, Yi Tam and Lu (2020) found that the setting of the Mathematics classroom significantly affects mathematics results. The lecturer must select the most effective teaching strategy based on the current class. In contrast to Islamic Azad University, where Kazemi and Ghoraishi (2012) demonstrated that the Problem-Based

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Learning (PBL) teaching approach is more effective than traditional methods in teaching Mathematics, Ganyaupfu (2013) found that the teacher-student interactive method was the most effective teaching method, followed by the student-centred method. This demonstrates that instructional strategies have a significant impact on students' academic performance.

This study revealed that overcrowding sometimes occurs, especially at the beginning and when students are about to take a test. Vygotsky's Theory collaboratively promotes teaching and learning; that is, lecturers have students work in groups to solve problems, which is sometimes impossible due to overcrowding. Another challenge revealed by the findings was that the venue was too small to accommodate a large number of students. Bridging Mathematics modules present challenges when topics must be covered within a very short timeframe. This is noted by Gordon and Nicholas (2010), who shared the difficulties they encountered in teaching a group of students with diverse mathematical backgrounds in such a short period of time. They also found that nearly all teachers expressed opinions suggesting that the unique setting of bridging Mathematics modules presented unique challenges for developing appropriate teaching approaches.

Mulwa (2015) noted another difficulty, which demonstrated that students struggle with the use of mathematical words and related concepts. Mulwa (2015) also developed a method for introducing these notations to students. Not only do students encounter challenges, but teachers also face challenges as they teach Mathematics. Literature highlights the challenges that teachers encounter in teaching Mathematics online, and it was found that older teachers found it difficult to develop content and provide feedback using e-learning systems (Bontogon, 2022). The language barrier was another challenge students encountered. Literature has pointed out that lecturers encouraged students to communicate in English; however, not all of them managed to do so, and this is supported by the literature (Hugo & Lenyai, 2013). Again, the findings revealed that the syllabus of the bridging Mathematics module needs to be changed. It must include 50% pure mathematics and 50% Mathematics Literacy to accommodate every student.

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Despite the challenges, such as overcrowding, students arriving late to class, and venue hunting problems, faced by students and lecturers, as revealed by the findings of this study, teaching and learning continued, and students eventually received the foundation they hoped for.

Students revealed that most high school learners do not like bridging programmes, and as such, the university must ensure that information about this bridging module is shared during career guidance, which the university holds annually. Former students must also be sent to different high schools to pass the message about the bridging programme.

6.3 CONCLUSIONS

The researcher set out to explore factors that influence students' academic performance in bridging Mathematics modules. The study established that different factors influence students' academic performance in bridging Mathematics modules.

Firstly, students should understand that bridging Mathematics modules are laying a strong foundation (DHET, 2012), equipping and preparing them for the next academic level (Robinson, Galligan, Hussain, Abdullah, Frederiks & Wandel, 2019). Furthermore, students should also know that this bridging module helps them in other modules as well.

Secondly, students and lecturers should have a positive attitude so that they can teach and learn effectively and perform well (Odogwu & Benedicta, 2015). Students should also know that students with positive attitudes towards mathematics achieved higher mathematics scores than students with negative attitudes.

Thirdly, this study identified factors such as the quality of teaching and workload, as mentioned by Kizito, Munyakazi and Basuayi (2016), time management, as pointed out by Gupta and Chitkara (2018), overcrowding, and the university environment, as mentioned by Yin, Shi, Yi Tam and Lu (2020). Furthermore, group work emphasized by (Vygotsky's Theory, 1978) was also found to be another factor that influences students' academic performance.

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Fourthly, challenges like overcrowding, students' non-attendance pointed out by (Guleker & Keci, 2014), unstable venues, and timetable clashes influence students' academic performance.

This study concludes that students must know the roles played by this module. This will then motivate them to work hard without any compromise. Students must also know and understand what this module will offer them in their future studies, as well as in their current studies. Students and lecturers should realise that several factors contribute to their academic performance. Some contribute positively, while others contribute negatively. To achieve this, both students and lecturers should have a positive attitude towards this module. Students and lecturers showed good attitudes towards teaching and learning in this bridging Mathematics module. Despite the challenges faced by students and lecturers, teaching and learning continued. They managed to do that because they showed good attitudes towards teaching and learning this Mathematics bridging module, and the lecturer used his lecturing experience to manage the big class. The results of the study are summarised in Table 6.1 below.

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Table 6.1: Summary of the Results of the Study

Research Questions	Results
1. What role does bridging mathematics play in the students' academic performance in bridging mathematics modules?	• Closes the gap • Laying strong mathematical foundations • Helps in advanced mathematics • Helps in other modules as well
2. What attitudes do students have towards the bridging of mathematics modules?	• Most students show a positive attitude and are characterized by enhanced motivation, increased engagement, increased self-confidence, and improved academic outcomes. • A small number of students show a negative attitude, characterized by being unmotivated, disrespectful, undisciplined, and counterproductive to learning.
3. What are the factors that influence students' academic performance in bridging mathematics modules?	• Time management • Tutors • Language barrier • Student workload • Timetable clashes • Teaching methods • University environment
4. What are the challenges that students and lecturers encountered in this bridging mathematics module?	• Overcrowding, • Lack of individual attention • Unstable venue • Timetable clashes,

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5. Which strategies can be used to improve students' academic performance in the bridging mathematics module or programme?	• Sharing of information with learners about the bridging programme before they come to university • Changing syllabus (50% pure mathematics and 50% mathematics literacy) • Relevance of syllabus • Bridging the subject, you have failed only

6.4 RECOMMENDATIONS

The research is significant in identifying the factors that influence students' academic performance in bridging Mathematics modules. This study has generated several recommendations for the University and the Department of Computational Science and Applied Mathematics that may be implemented.

- It is recommended to the university that the foundation department ensure there is a stable venue that can accommodate all bridging Mathematics students for this module.

- The university or department may avoid overcrowding by registering students depending on the venue's capacity. This module must be divided into two or three groups to avoid overcrowding. The other group must be taught by a full-time lecturer so that he can control and monitor the other groups that the part-time lecturer may teach.

- Some students are in the foundation program due to possibly failing Mathematics in Grade 12, while they have passed Grade 12 Physical Science and Life Sciences. It is recommended that students register only for the module they failed in Grade 12, rather than all of them; however, this should be optional for students.

- Students must not be allowed to register for modules before they pass their prerequisites. Students must not register for first-year modules until they have passed all the modules, they are currently registered for in the foundation programme.

  Most students are in favour of face-to-face classes; therefore, it is suggested that all online classes be replaced with face-to-face classes.

- Most lecturers for the bridging mathematics module work on a contract or part-time basis. It is therefore suggested that these lectures be absorbed so that they can give maximum performance.

- This module is much better because if students fail in the first semester, they repeat this module during the second semester. It is recommended to the university that if students still fail again in the second semester, they must not be allowed to register for this module anymore to avoid clashes. They can be allowed to write special examinations to avoid timetable clashes, as was mentioned many times by students. When students asked about their failure to attend classes, they said it was because of timetable clashes, and most of them were not doing their first year; they were in their second year and above. Timetable clashes affect even students who are in their first year of study.

- It is further recommended to the University that the syllabus of these bridging mathematics modules must change to accommodate students who did Mathematics Literacy in Grade 12. In other words, it is recommended that module contents must be 50% pure Mathematics and 50% Mathematics Literacy, as mentioned by students.

6.5 The study recommends that former students and university career guidance may be used to pass on information about bridging Mathematics modules, as a lack of information about this bridging programme brings less interest to students.

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6.6 LIMITATIONS OF THE STUDY

The study explores factors that influence the students' academic performance in bridging Mathematics modules at university. The study used a qualitative method with a sampling of 10 participants (6 students, 2 lecturers, and 2 HoDs) and 2 focus groups made up of 15 former students of those two bridging Mathematics modules. The study could have interviewed former lecturers of these bridging Mathematics modules and even lecturers who are teaching first-year modules, so that their views could be accommodated.

6.7 AREAS OF FUTURE RESEARCH

The following are the suggestions for future study: This study has looked at the contributing factors to the academic performance of bridging mathematics module students, and this has opened doors for future studies on:

- Similar study but using a quantitative or mixed method
- Investigative study on challenges faced by lecturers and students when teaching first-year students enrolled in a bridging mathematics program.
- Tracing the graduation rate of bridging mathematics students.
- Comparative study of bridging mathematics students and students who directly entered the mainstream.

6.8 CONTRIBUTION OF THE STUDY TO THE BODY OF KNOWLEDGE

The study is significant because it will contribute to new knowledge by adding perspectives from students, lecturers, and heads of Departments to explore factors that influence students' academic performance in bridging Mathematics modules in a rural university. Very little research has been done about bridging Mathematics modules influencing students' academic performance. This study aims to explore the influence of bridging Mathematics modules on students' academic performance at the bridging level.

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The study addressed the following:

- Bridging Mathematics modules students' academic performance as a gap in teaching and learning, as most researchers have overlooked it. Most researchers focused on the influence of bridging modules on students' first-year modules.

- The roles that bridging Mathematics modules played in the students' academic performance. By realizing the importance of the bridging programme, universities will begin to invest more in the bridging programme. Some of the universities might begin to introduce a pre-degree programme, which will be completed by every student before they go to the main degree programme.

- Traced factors that contributed to such academic performance. Universities must register students according to their capacity to avoid overcrowding.

- Investigated attitudes of students and lecturers of these Mathematics bridging modules. This study contributes to the body of knowledge by showing that attitudes and performance are correlated; those students who were negative performed poorly, but positive students achieved better on their tests.

- Revealed different challenges faced by students and lecturers of these Mathematics bridging modules. By fixing challenges encountered in bridging Mathematics modules, students will improve their academic performance.

- Strategies that the universities must use to improve students' academic performance in the bridging Mathematics programme. Most of the universities do not have strategies that are in place for recruiting students to register for the bridging programme if they are not qualified to do a main degree. This study is contributing by awakening the universities to come up with recruiting strategies and not focusing on the main programme only.

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APPENDICES

APPENDIX A: INTERVIEW SCHEDULE FOR HODs

HoDs' views on the influence of bridging mathematics modules on students' academic performance

1. BIOGRAPHICAL INFORMATION

1.1 Gender: ……..

1.2 Age: ……..

1.3 Highest academic qualification: ……..

1.4 Experience (number of years) as HoD: ……

2. CONTENT-BASED QUESTIONS

2.1 What do you think is the role that bridging Mathematics modules play in the academic performance of students?

2.2 What attitudes do students have towards the bridging Mathematics module?

2.3 What are the factors, in your own opinion, that influence the academic performance of students?

2.4 What are the challenges that you encounter when managing lecturers and students of bridging Mathematics modules?

2.5 Which strategies can be used to improve students' academic performance in the bridging Mathematics modules?

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APPENDIX B: INTERVIEW SCHEDULE FOR LECTURERS

Lecturers' views on the influence of mathematics bridging modules on students' academic performance

1. BIOGRAPHICAL INFORMATION

1.1 Gender: ……..

1.2 Age: ……..

1.3 Highest academic qualification: ……..

1.4 Experience (number of years) as module lecturer: ……..……..

2. CONTENT-BASED QUESTIONS

2.1 What do you think is the role that Mathematics bridging modules play in the academic performance of students?

2.2 What attitudes do students have towards the bridging programme?

2.3 What are the factors, in your opinion, that influence the academic performance of students?

2.4 What are the challenges that you encounter when teaching bridging Mathematics modules?

2.5 Which strategies can be used to improve students' academic performance in the bridging Mathematics modules?

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APPENDIX C: INTERVIEW SCHEDULE FOR STUDENTS

Students' views on the influence of mathematics bridging modules on students' academic performance

1. BIOGRAPHICAL INFORMATION

1.1 Gender: ……..

1.2 Age: ……..

1.3 Academic year: ……..

1.4 Degree: ……..

2. CONTENT-BASED QUESTIONS

2.1 What do you think is the role that Mathematics bridging modules play in the academic performance of students?

2.2 What attitudes do students have towards the mathematics bridging module?

2.3 What are the factors, in your opinion, that influence the academic performance of students?

2.4 What are the challenges that you encounter when learning this bridging Mathematics module?

2.5 Which strategies can be used to improve students' academic performance in the bridging Mathematics modules?

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APPENDIX D: INTERVIEW SCHEDULE FOR FOCUS GROUPS

Students' views on the influence of mathematics bridging modules on students' academic performance

1. BIOGRAPHICAL INFORMATION

1.1 Gender: ……..

1.2 Age: ……..

1.3 Academic year: ……..

1.4 Degree: ……..

2. CONTENT-BASED QUESTIONS

2.1 What do you think is the role that Mathematics bridging modules play in the academic performance of students?

2.2 What attitudes do students have towards the mathematics bridging module?

2.3 What are the factors, in your opinion, that influence the academic performance of students?

2.4 What are the challenges that you encounter when learning this bridging Mathematics module?

2.5 Which strategies can be used to improve students' academic performance in the bridging Mathematics modules?

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APPENDIX E: CLASSROOM OBSERVATION

Lecturer and students' interaction during the mathematics bridging class

Indicators of Mathematics Bridging Competence	Comments
Motivation of students and lecturers during a lesson	
How do Lecturers motivate students' active participation?	
Challenges encountered during the teaching and learning of the mathematics bridging module	
The use of the zone of proximal development (ZPD) in the classroom	
The use of Scaffolding in the mathematics classroom	

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APPENDIX F: BRIDGING MATHEMATICS MODULES TEACHING TIMETABLE

Modules	Monday	Tuesday	Wednesday	Thursday	Friday
A	11h00-12h00		12h00-13h00		
B	14h46-15h46	14h56-15h46	14h00-14h50		

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APPENDIX G: CLASSROOM OBSERVATION SCHEDULE

Lecturer	Number of registered students	Number of students	Topic of the lesson	Date	Time
A	249	146	Integration	09 September 2024	10h00-11h00
A	249	189	Matrices	23 October 2024	12h00-13h00
B	453	130	Percentages	03 September 2024	14h56-15h56
B	453	180	Simple interest	16 October 2024	14h00-15h00

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APPENDIX H: LECTURERS' CONSENT FORM FOR THE INTERVIEW ON THE FACTORS THAT INFLUENCE STUDENTS' ACADEMIC PERFORMANCE OF BRIDGING MATHEMATICS MODULES

Statement of Agreement to Participate in the Research Study:

1. I hereby confirm that I have been informed by the researcher, Avhatakali Manthada, about the nature, conduct, benefits, and risks of this study -Research Ethics Clearance Number: FHSSE/24/CSEM/21/2308
2. I have also received, read, and understood the above-written information (Participant Letter of Information) regarding the study.
3. I understand that significant new findings developed during this research, which may relate to my participation, will be made available to me.
4. I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials, and diagnosis, will be anonymously processed into a study report.
5. Given the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
6. I may, at any stage, without prejudice, withdraw my consent and participation in the study.
7. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

Full Name of Participant	Signature:	Date:	Time:
……..	…….	…….	…….

I, Avhatakali Manthada, herewith confirm that the above participant has been fully informed about the nature, conduct, and risks of the above study.

Signature:…… Date:……

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APPENDIX I: STUDENTS' CONSENT FORM FOR THE INTERVIEW ON THE FACTORS THAT INFLUENCE STUDENTS' ACADEMIC PERFORMANCE OF BRIDGING MATHEMATICS MODULES

Statement of Agreement to Participate in the Research Study:

1. I hereby confirm that I have been informed by the researcher, Avhatakali Manthada, about the nature, conduct, benefits and risks of this study -Research Ethics Clearance Number: FHSSE/24/CSEM/21/2308
2. I have also received, read and understood the above-written information (Participant Letter of Information) regarding the study.
3. I understand that significant new findings developed during this research, which may relate to my participation will be made available to me.
4. I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis, will be anonymously processed into a study report.
5. Given the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
6. I may, at any stage, without prejudice, withdraw my consent and participation in the study.
7. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

Full Name of Participant	Signature:	Date:	Time:
……..	……	…….	…….

I, Avhatakali Manthada, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Signature:…… Date:……

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APPENDIX J: ETHICAL CLEARANCE CERTIFICATE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr A Manthada

STUDENT NO:
940961

PROJECT TITLE: **Students' academic performance of bridging Mathematics module at a rural university in Limpopo province.**

ETHICAL CLEARANCE NO: **FHSSE/24/CSEM/21/2308**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr RM Makhwathana	UNIVEN, Early Childhood Development	Supervisor
Dr DA Sinthumule	UNIVEN, Early Childhood Development	Co-Supervisor
Mr A Manthada	UNIVEN, Early Childhood Development	Investigator-Students

Type: Doctoral Research
Risk: *Minimal risk to humans, animals or environment (Category 2)*
Approval Period: **August 2024 – August 2025**

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project.
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project,
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately,
  - New institutional rules, national legislation or international conventions A it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: August 2024

Name of the RESSC Chairperson of the Committee: Prof M. Mwale-Manjoro

Signature.....

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APPENDIX K: EDITOR'S LETTER

kufazano@gmail.com
+27631434276
22 February 2025

To whom it may concern,

RE: CONFIRMATION OF LANGUAGE EDITING

This serves to confirm that I have copy-edited a PhD thesis written by Avhatakali Manthada (Student Number 9409617) titled **STUDENTS' ACADEMIC PERFORMANCE OF BRIDGING MATHEMATICS MODULES AT A RURAL UNIVERSITY.**

The scope of my editing comprised:

- Spelling
- Tense
- Vocabulary
- Punctuation
- Word usage
- Language and sentence structure

If you need any further details, kindly contact me on the details provided above.

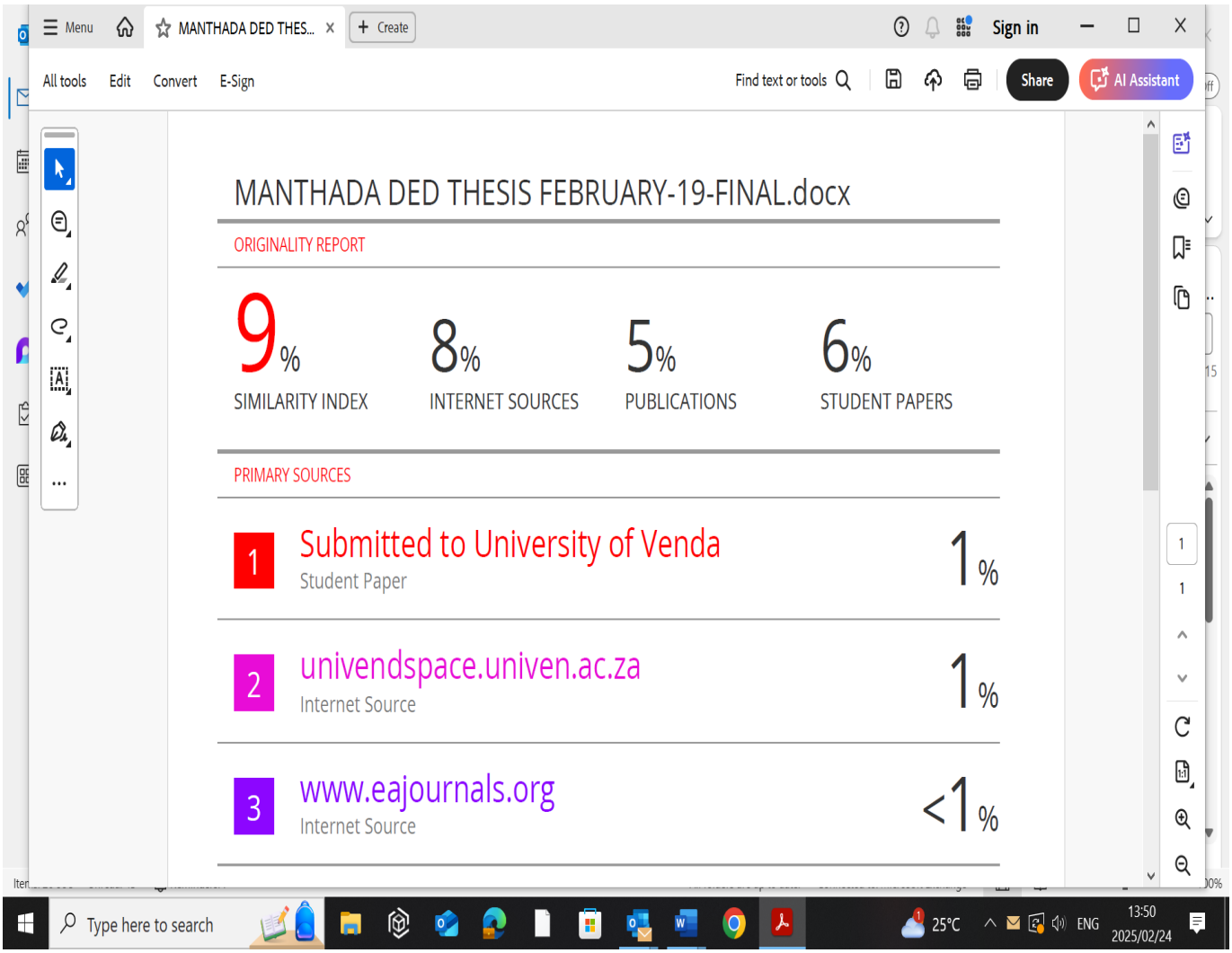
Yours faithfully



Kufakunesu Zano.

Dr Kufakunesu Zano, PhD (English). A member of the South African Translators' Institute, Ref 1000686

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