

**CHALLENGES OF TEACHING AND LEARNING MATHEMATICS AT
THE COPPERBELT UNIVERSITY**

BY

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degree of Master of Education in Mathematics Education

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FOREWORD

*“Whatever you do, work at it with all your heart, as working for the
Lord, not for men”*

Colossians 3v23

DECLARATION

I, DAVID MWILA CHABULEMBWA, do hereby declare that this work is my own, and that all the work of other persons used in this thesis has been duly acknowledged and that this work has not been previously presented in this, or any other university for similar purposes.

Date:.....Signature.....

CERTIFICATE OF APPROVAL

This dissertation of David Mwila CHABULEMBWA is approved as fulfilling the requirements for the award of the Degree of Master of Education in Mathematics Education of the University of Zambia.

Name

Signature

External Examiner

Internal Examiner

Internal Examiner

DEDICATION

This work is dedicated to the following people: My wife Dorcas Chabulembwa, my son Mwila and my two daughters Mutale and Chushi. You have made me a blessed husband and father.

To my parents: Mr J.D. Chabulembwa and Mrs F.K. Chabulembwa, for making the earliest and most durable impression upon my heart. Your teaching may not have been of a very high intellectual character and yet at a tender age you inculcated in me love of truth, hard work, integrity and honesty.

To my brothers and sisters: Edith, Charles (MHSRIP), Alice, Martha, Chilufya, Mutale, Kelvin, Martin and Chilobwa. No one could have more wonderful brothers and sisters.

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ABBREVIATIONS

ADMA	Additional Mathematics
CA	Continuous Assessment
CAS	Computer Algebra Systems
CBU	The Copperbelt University
DDEOL	Directorate of Distance Education & Open Learning
ECZ	Examination Council of Zambia
HOD	Head of Department
MOE	Ministry of Education
MESVTEE	Ministry of Education, Science, Vocational Training & Early Education
NCTM	National Council of Teachers of Mathematics
NRDC	Natural Resources Development College
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SACMEQ	Southern & Eastern African Consortium for Monitoring Education Equality
SB	School of Business
SBE	School of Built Environment
SE	School of Engineering
SMMS	School of Mining and Mineral Sciences
SMNS	School of Mathematics and Natural Sciences
SNR	School of Natural Resources
SOT	School of Technology
SPSS	Statistical Package for Social Sciences
TEVET	Technical Education, Vocational & Entrepreneurship Training
TEVETA	Technical Vocational & Entrepreneurship Authority
TIMSS	Trends in International Mathematics and Science
UNZA	The University of Zambia
ZIT	Zambia Institute of Technology

ABSTRACT

The purpose of this study was to investigate the challenges of teaching and learning mathematics at the Copperbelt University (CBU), the second largest public university in Zambia. The challenges of teaching and learning mathematics are myriad. The framework addressing the challenges could have many domains but this study looked at five domains which included effective teaching and learning styles for mathematics, mathematical knowledge for teaching, mathematics foundation and transition, attitude and a conducive learning climate. Questionnaires, interviews and focus group discussions were used in the data collection process in this study. The study found that among other challenges, students did not have a positive attitude towards mathematics, had a poor foundation in mathematics and that high school mathematics did not prepare students adequately for the rigours of university mathematics. Living off campus and adjusting to different teaching practices came with its own challenges. The lack of relevant reference books, latest mathematics software and exposure to the latest mathematics journals did not help the situation.

The study concludes by making recommendations that both lecturers and students should have access to mathematics resources and that there is need to consider teaching methods that create opportunities for students to actively participate in the learning process. There is also a need to expand infrastructure as CBU has now developed from a college that was designed to offer certificates and diplomas only into a fully fledged internationally recognised university catering for a large number of students.

CHAPTER ONE

BACKGROUND TO THE STUDY

1.0 INTRODUCTION

Mathematics has long been referred to as the mother and queen of all subjects and yet its study has been shrouded in mystery because many people do not understand it (Aiyedun, 2006). It is described as the science of quantity and space, it contains sets of concepts, facts and operations, which every layman, scientist and student needs to know (Umeaduagu, 2001). As Aiyedun (2006) has rightly said, “seek ye first the knowledge of mathematics and its understanding and all the other subjects will be added onto it”.

The importance of mathematics is acknowledged as it is offered at all levels of the educational system, however, its teaching and learning and hence performance of the students in the subject remains dismal and unsatisfactory. Nkoya (2009) observes that poor results have been noted across all levels of the educational system in Zambia. The Policy document in Education, titled *Educating Our Future* (MOE, 1996) also acknowledges that the performance in the key areas of mathematics and science is far from satisfactory. At secondary school level this is confirmed by the results of grade 12 school leavers (School certificate examinations) where on average less than two thirds of the candidates obtain a full pass each year (ECZ, 2003; MOE, 1996). The researches done at secondary school level seem to suggest a number of factors contributing to this

state of affairs among them lack of resources, facilities, attitudes of students towards mathematics self-efficacy and so on(MOE, 1996).

At primary school level a similar picture exists. A study conducted by Southern African Consortium for Monitoring Educational Quality (SACMEQ) which aimed at testing mathematics and reading achievements in fifteen countries in Eastern and Southern Africa showed that Zambian pupils were ranked the worst in mathematics and reading skills in the region. Zambia was ranked as the worst in its performance alongside Malawi, Namibia, Lesotho and Uganda with difficulties in Mathematics (SACMEQ, 2010)

Although poor results in mathematics have been noticed at all levels of the educational system in Zambia, the challenges faced by lecturers and learners of mathematics in higher education still remains unexplored. Few, if any studies have been conducted in Zambia that have attempted to investigate the challenges that are faced in the teaching and learning of mathematics in tertiary institutions. The National Policy on Education of 1996 acknowledges that in higher level of education in Zambia, the quality of teaching, research and development that is undertaken by the higher institutions is critically important for economic growth, national prosperity and social cohesiveness.

The Copperbelt University (CBU) initially started off as Zambia Institute of Technology (ZIT), a college that was designed to offer certificates and diplomas to a smaller population of students. The Institution now offers degree programmes in several disciplines. With such a transformation, challenges are likely to occur. This study, will

therefore, look at the challenges of teaching and learning of mathematics at tertiary level in particular at the Copperbelt University (CBU), Zambia. The Copperbelt University offers fertile ground for this research as all programmes at the institution require learners to study mathematics.

1.1 STATEMENT OF THE PROBLEM

Mathematics is one of the key subjects examined at all levels of education in Zambia. The subject is very important for all careers of business, science and technology. Over the years, poor performance has been seen at all levels (Nkoya, 2009). At the Copperbelt University, mathematics occupies a central place in the curriculum. Currently, any student who enrolls in any school of the university does one form of mathematics or another. Although mathematics occupies a central place in the curriculum and mastering it is seen as a gateway to graduating from the university, no study, to the knowledge of the researcher, has looked at the challenges of teaching and learning mathematics at this institution.

This study will look at the challenges the Copperbelt University is facing in the teaching and learning of mathematics.

1.2 PURPOSE OF THE STUDY

The purpose of this study is to investigate the challenges of teaching and learning mathematics at CBU.

1.3 RESEARCH OBJECTIVES

The research objectives were:

1. To determine the teaching and learning conditions of mathematics at CBU.
2. To establish the challenges faced by CBU lecturers when teaching mathematics
3. To identify the challenges faced by CBU students when learning mathematics.

1.4 RESEARCH QUESTIONS

The research questions that guided the study were:

1. What conditions exist at CBU regarding the teaching and learning of mathematics?
2. What challenges do CBU lecturers face when teaching mathematics?
3. What challenges do CBU students face when learning mathematics?

1.5 SIGNIFICANCE OF THE STUDY

It is hoped that the results from this study will not only be useful to the lecturers, the learners and the head of department in the school of mathematics and natural sciences at CBU but also to the lecturers and learners of mathematics in other tertiary institutions.

It is also hoped that the central administration at CBU would learn about the challenges and may take steps to alleviate them. This could be done in conjunction with the Government through the Ministry of Education, Science, Vocational Training and Early

Education (MESVTEE) and other cooperating partners. Findings from this study would also be useful to those who wish to go and study at CBU as the English adage says ‘forewarned is forearmed’. Finally, it is hoped that the findings from this study will add to the body of knowledge in mathematics education research.

1.6 THEORETICAL AND CONCEPTUAL FRAMEWORK

Education in most countries of the world faces a number of challenges (Inana, 2010). Power (2014) refers to challenges as obstacles that threaten success. In this study, challenges refer to obstacles that threaten success in mathematics teaching and learning, particularly at CBU. The challenges are particularly aggravated when it is mathematics involved. The challenges of teaching and learning mathematics are myriad. The framework addressing the challenges of teaching and learning mathematics could have many domains, but this study will look at five domains which are considered as key to help explain these challenges. These domains include effective teaching and learning styles for mathematics, mathematical knowledge for teaching, mathematics foundation and transition, attitude and a conducive learning climate. The domains are now discussed in detail.

1.6.1 Effective teaching and learning styles for mathematics

Most traditional mathematics instruction and curricula are based on the transmission or absorption view of teaching and learning. In this view, students passively “absorb” mathematical structures invented by others and recorded in texts or known by authoritative adults. Teaching consists of transmitting sets of established facts, skills and

concepts to students (Clements and Battista, 1990). It is cardinal for a lecturer to acknowledge that each student does not learn mathematics in the same way. This means that if a lecturer chooses just one style of teaching, the students will not be maximising their learning potential. Many people have struggled to find out the best way students learn mathematics. Brooks and Brooks (1993) posit that many people learn better when they do something themselves rather than when someone does something for them. This has led many educators to believe that the best way to learn is by having students construct their own knowledge instead of having someone construct it for them.

This belief is explained by the constructivist learning theory. This theory states that learning is an active process of creating meaning from different experiences. Learners construct their own understanding through their experiences and the character of their experiences is influenced profoundly by their cognitive lens (Mathews, 2000). Constructivism views each learner as a unique individual with unique needs and background. The learner is also seen as complex and multidimensional. The theory not only acknowledges the uniqueness and complexity of the learner, but actually encourages, utilises and rewards it as an integral part of the learning process (Wertsch, 1997). Thus there are huge differences among the mathematical knowledge and skill levels of students at any particular level or in any particular mathematics course. In addition, there are considerable differences in their ability to learn mathematics. Constructivism then, is a theory that is particularly applicable in mathematics. Brooks and Brooks (1993) argue that since all sensory input is organised by the person receiving the stimuli, it cannot always be directly transferred from the teacher to the student. This

means that a teacher cannot “pour” information into a student’s brain and always expect them to process it and apply it correctly later. For example, when an individual is taught something in a lecture type of class and contrasts this against a time when the same individual had to teach other people, it is probably true that the individual learnt better when preparing to teach others. This is because the individual constructed the knowledge.

Constructivist instruction gives preeminent value to the development of students’ personal mathematical ideas and encourages students to use their own methods for solving problems. Through interaction with mathematical tasks and other students, the student’s own intuitive mathematical thinking gradually becomes more powerful. Since mathematics is often labelled as a “doing subject”, the necessity of tutorials cannot be ignored for it is in such settings that students interaction is at its highest and students construct individual methods for solving problems.

1.6.2 Mathematical knowledge for teaching

The problem of knowledge for teaching mathematics is of growing concern to practitioners and researchers in ongoing efforts to improve mathematics education (Ferrini – Mundy, Floden & Mccrory, 2001). To be a lecturer of mathematics at CBU, one needs to hold a minimum qualification of MSc in mathematics or statistics. In today’s accountability-oriented policy, there is need for the improvement of students’ performance in mathematics and for the validation of the lecturer’s mathematical credentials necessary to demonstrate that they are qualified lecturers. Ferrini-Mundy et al

(2001) defines mathematical knowledge for teaching as the mathematics which is used in teaching and valuable for teachers to know.

At a tertiary institution, the number of mathematics courses done at undergraduate level, the class of the degree obtained and the number of mathematics courses done at masters level would be taken as a measure of mathematical knowledge. Of critical importance is what Shulman (1986) refers to as Pedagogical Content Knowledge (PCK) which involves understanding where students are likely to have difficulties and determining how to address these difficulties by drawing on a stock of the most powerful analogies, illustrations, examples, explanations and demonstrations. Shulman (1986) continues that making use of this stock to address particular student learning obstacles may well make additional mathematical demands of the teacher, because the teacher must see where a particular analogy, for example accurately represents a mathematical idea and where analogy breaks down. The teacher must also be able to modify an explanation if, despite the power it may have for some students, it does not seem to make sense to other students. Shulman has the secondary school mathematics teacher on his mind as he discusses this important matter, but the principles can equally be applied to a lecturer of mathematics at a tertiary institution. The lecturer should demonstrate an understanding and in depth knowledge of content and maintain an ability to convey this content to students.

1.6.3 Attitude

Attitudes are defined as positive or negative emotional dispositions (Aiken, 2000). According to this point of view, attitude towards mathematics is just a positive or negative disposition towards mathematics. Accepting this definition, it is quite clear that a positive attitude means positive emotional disposition towards mathematics and a negative attitude means negative emotional disposition towards mathematics.

From this point of view, an individual's attitude towards mathematics is defined in a more articulated way by the emotions that the individual associates with mathematics, by the beliefs the individual has regarding mathematics and by how the individual behaves in relation to mathematics. Similarly, a negative attitude is characterized by a negative emotional disposition towards mathematics. Conventional wisdom and research suggest that students with negative attitudes towards mathematics face challenges as they learn mathematics because of anxiety (Tapia, 2004). An individual needs to be self confident in mathematics in order to lessen the challenges faced by learners as they study mathematics. Self confidence refers to self-beliefs about abilities to do and learn mathematics in some context, not necessarily generally. Hence a learner may be confident within one area of mathematics, but perhaps not another (Tapia, 2004).

Aiken (2000) believes that in order to lessen challenges in the learning of mathematics, an individual needs not only to have positive attitudes towards mathematics but also be intrinsically motivated to study mathematics.

1.6.4 Transition and mathematics foundation

The transition from secondary school to university is crucial in the life of a student in a tertiary institution. Some fail to see how secondary school mathematics is connected to university mathematics. Holton (1997) is of the view that there is often perceived to be a discontinuity between mathematics education in secondary schools and mathematics education in universities. He argues that there is not the same attention paid to learning theories in the delivery of university mathematics as there is in the teaching of the subject at lower levels and that university teaching methods tend to be more conservative. Hence there is need for the transition from mathematics studied at high school to mathematics studied at a tertiary institution to be smooth and where a connection is seen between the two sets of mathematics. If this connection is not seen or there is an apparent discontinuity between the two sets of mathematics, problems then arise (Artigue, 1999).

Okello (2010), reports that students who do not have a strong foundation in mathematics find college algebra difficult. She is of the view that there are students who enter the university with poor grades in mathematics from high school and therefore, irrespective of the effort lecturers put in their lessons' content to make college algebra easy, these students still do not perform well. Hence a strong foundation in mathematics is desirable.

On the social side, students have to come to grips with the seemingly apparent "freedom" that they find at the university, particularly in their first year of study. First year students suddenly discover that there is no monitor in class to write down the names of noise

makers. There is no roll call to ascertain who is absent or present and that they can choose to miss class at will without any apparent repercussions.

1.6.5 Conducive learning climate

University students learn better in a climate where they are involved in the learning process (Lieb, 1991). They want to know the relevance of what they are learning to what they want to achieve. They must see a reason for learning. Like all learners, they want to be shown respect. Lecturers can demonstrate this respect to their students by taking interest in the progress and opinions of the learners. There are times when students wait for a long time to have feedback on assignments and tests that they have written. The lecturer should provide proper, regular, constructive and specific feedback. It is important for the lecturer to encourage the students to use resources such as the library, journals, internet and other departmental resources. To create this conducive learning environment, the lecturer and the learner need to have a connection, a personal relationship.

Other factors that contribute to a learning environment that is conducive include the size of the classes, infrastructure, physical environment of the classroom, mathematics reference books and budgetary allocations to CBU and in particular to the School of Mathematics and Natural Sciences as well as the staffing levels of lecturers of mathematics.

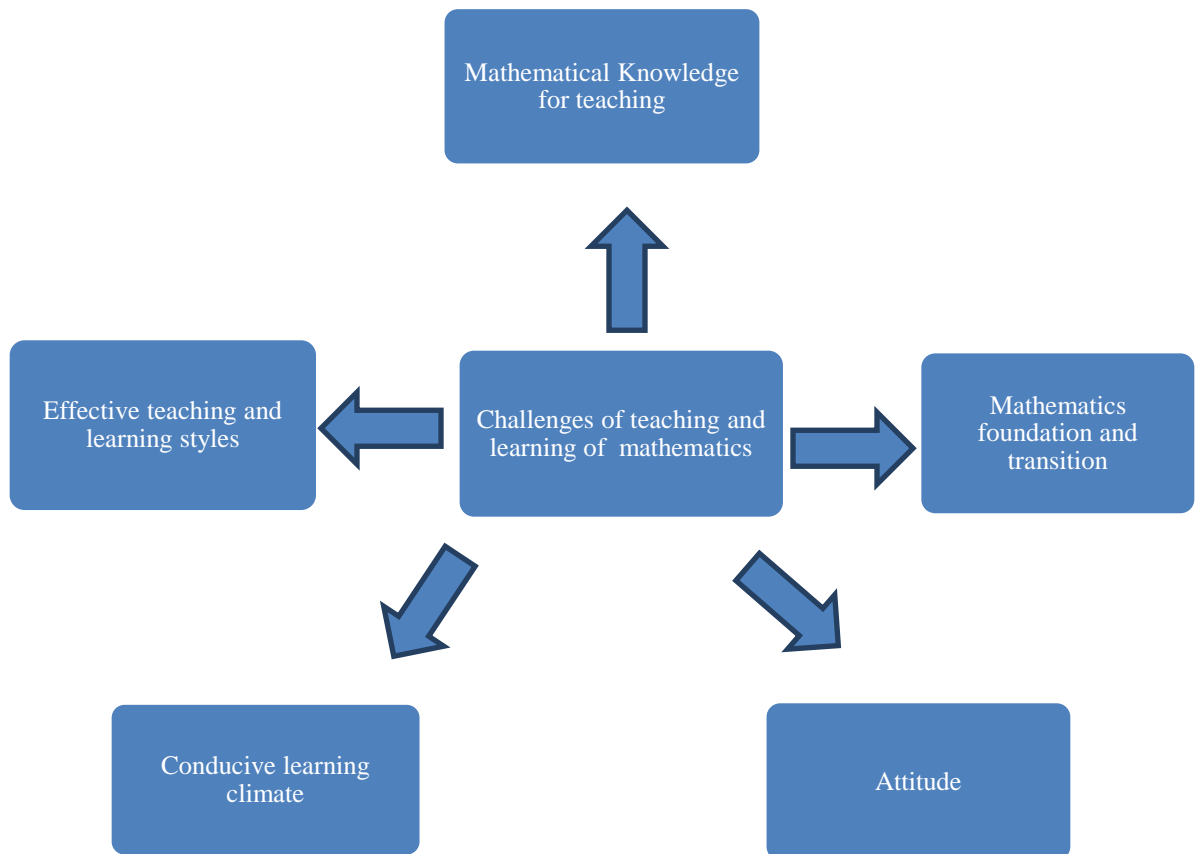
The curriculum is also considered to be an integral part in the study of challenges when teaching and learning mathematics at a tertiary institution. It should be coherent,

connected and relevant. Schmidt (2005) found that in the United States, most of the curriculum cover an enormous number of topics and lack a core set of ideas linking concepts in the curriculum.

1.6.6 Summary of the conceptual and theoretical framework

The domains that have been discussed in this chapter can be shown in the conceptual model that follows:

Figure 1.1: Conceptual model of challenges of teaching and learning mathematics



Source: Formulated by the author

A conducive learning climate for learners and an effective teaching and learning styles for mathematics are the genesis of the teaching and learning process. When these conditions are present in a learning environment, the attitude towards mathematics of most of the learners will begin to change. Even those that have a poor foundation in mathematics or have difficulties in finding the connection between secondary school mathematics and university mathematics are encouraged when a conducive learning climate and effective teaching and learning styles are present. When these conditions are in place, it is up to the lecturers to use their mathematical knowledge and their Pedagogical Content Knowledge skills to facilitate the acquisition of mathematical knowledge by the learners.

1.7 DEFINITIONS OF TERMS

The terms to be used in this study will have the following meanings:

Tertiary Institution: An institution designed to provide post secondary education and/or training leading to an award of a certificate, diploma or degree (Grubb, 1996).

Learning: Process of active discovery (Perry, 1999).

Lecturer: A person in charge of teaching in a subject area at a tertiary institution.

Student: A learner at a tertiary institution or secondary school. Learner and student are used interchangeably.

Challenges: Obstacles that threaten success.

1.8 SUMMARY OF CHAPTER DIVISIONS

This study is organised into six chapters as follows:

CHAPTER ONE

This chapter gives an introduction and background to the study. It highlights the importance of mathematics and how the performance of students in mathematics remains dismal and unsatisfactory at all levels of the educational system in Zambia. The problem statement, purpose of the study, significance of the study and the conceptual framework are explained. The chapter further states the research objectives and research questions. It ends with a brief definition of key terms that are used in this study.

CHAPTER TWO

This chapter provides the reader with an insight into the findings of previous research dealing with challenges of teaching and learning mathematics in tertiary institutions. It introduces some of the common factors recognised by the literature as general challenges faced by tertiary institutions. This chapter ends with an overview of challenges specifically dealing with mathematics teaching and learning in tertiary institutions in Zambia as well as tertiary institutions outside Zambia.

CHAPTER THREE

Chapter three looks at the research design and methodology undertaken by the author in conducting this study. It describes the methods and instruments used to collect data.

Ethical aspects of the study are highlighted and the limitations of this study are brought to the attention of the reader.

CHAPTER FOUR

The findings obtained from the research instruments are presented in this chapter. In many instances, figures and tables produced by the statistical package SPSS and Excel are used to present the findings.

CHAPTER FIVE

In this chapter, the author discusses the findings obtained in this study. Some of the findings are compared and contrasted with findings from previous research. This allows the reader to see the similarities and differences between the findings of this study and those of previous research.

CHAPTER SIX

This chapter begins by reminding the reader of the research questions and then gives a summary of the main findings. It makes recommendations and ends with suggestions on a possible area for future research.

1.9 CONCLUSION

The author undertook this study to determine the conditions existing at CBU regarding the teaching and learning of mathematics, the challenges faced by lecturers as they teach

mathematics and the challenges students face as they learn mathematics at CBU. The theoretical and conceptual framework indicated that a conducive learning climate and effective teaching and learning styles for mathematics are cardinal in the teaching and learning process. In understanding these challenges, it is important to look at the findings of related researches. The next chapter will review the findings of other researchers who have done work in this field.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

The previous chapter gave an introduction and background to the study. This chapter looks at some of the research that has already been carried out in this domain. In this review of literature, the author hopes to give the reader an understanding of the context of this study as well as providing an insight into the findings of previous researchers. Initially, the author looks at the general challenges faced by tertiary institutions before looking at the challenges faced in the teaching and learning of mathematics in these tertiary institutions.

2.1 LEARNING

The process of learning has been a source of amazement, fascination and study for centuries. Researchers have continually attempted to describe both animal and human learning in a wide variety of interactions and contexts. Numerous theories have emerged, many describing in minute detail both the learner and the manner in which learning can be enhanced (Post, 1988).

Burns (1995) conceives of learning as a relatively permanent change in behaviour with behaviour including both observable activity and internal processes such as thinking,

attitudes and emotions. There are many different theories of how people learn. There are theories that look at a learner as someone who is passive in the learning process and only receives instructions without being actively involved. Other theories of how people learn submit that the learner must be actively involved both mentally and physically if any learning has to take place. Some theories have depicted the role of the teacher as the prime expositor of knowledge, as the person primarily responsible for the students' learning. Others view the role of the teacher primarily as a guide or facilitator of learning, one who effectively organises the conditions under which learning can take place and then exposes the learners to those conditions (Post, 1998). The implication of the later view is that the learner has an active role to play in the learning process. The teacher is just there to facilitate the learning process. It goes without saying then that, for effective learning to take place in mathematics, the learner has to participate actively both mentally and physically. Mathematics learning is not an activity where the learner is just a spectator.

Inana and Agbedeyi (2010) are of the view that learning mathematics is not only learning rules, statements, definitions to demonstrate theorems and using them in the resolution of problems, but practically using it in solving challenging problems, trying different strategies and shorter and simpler ways of coming to an exact conclusion. The lesson to be drawn from Inana and Agbedeyi's view is that learners cannot solve challenging problems by using different strategies if they are passive in the learning process. They can only do this if they are involved actively both mentally and physically in the learning

process. The learning of mathematics at the tertiary level is very involving and needs the learners' participation and studying (Inana and Agbedeyi, 2010).

2.2 TEACHING

At the centre of effective teaching lie two critical components, that is, content and pedagogy and the relationship between the two. Trends in International Mathematics and Science Study (TIMSS) defines effective teaching as a complex endeavour requiring knowledge about the subject matter of mathematics, the ways students learn and effective pedagogy in mathematics (Beaton et al, 1996). The implication of this definition is that for one to teach mathematics effectively, one needs to know about the subject matter to be taught. The content to be covered in high school mathematics is different from the content to be covered in undergraduate mathematics. Knowledge of content is of critical importance for teachers.

As Shulman (1986) noted, this knowledge would include knowledge of concepts, theories, ideas, organisational frameworks, knowledge of evidence and proof as well as established practices and approaches toward developing such knowledge. Amplifying on Shulman's statement, it means that a lecturer of mathematics in a tertiary institution needs to have a deeper knowledge of differentiation and integration and their applications. A lecturer who does not have a deeper knowledge of the content is of no use to the students. Pfund and Duit (2000) and the National Research Council (2000), submit that the cost of not having a comprehensive base of content knowledge can be prohibitive, for example, students can receive incorrect information and develop

misconceptions about the content area. On the other hand, there are benefits for the students if the lecturer has a deeper knowledge of the content. Ma (1999) observes that a successful mathematics lecturer needs a deeper understanding of mathematics content to create mathematically rich task structures and to adapt to meet the needs of individual students. In this regard, it must be noted that professional development focussed on increasing lecturer knowledge of mathematics may increase student performance, after all, research suggests that greater lecturer content knowledge is a contributing factor to increased student learning (Ball, Hill and Bass, 2005).

The National Council of Teachers of Mathematics (NCTM, 2000) is of the view that effective mathematics teaching requires an understanding of what students know and need to learn and then challenging and supporting them to learn it well. One implication of this definition is that a lecturer needs to have a deeper knowledge about the process and practices or methods of teaching and learning. This knowledge will include among other things, over all educational purposes, values and aims. The lecturer needs to know and understand how students learn, general classroom management skills, lesson planning and student assessment. An untrained teacher would not easily be in a position to write an effective lesson plan and implement it, let alone possess knowledge about techniques or methods used in the classroom, the nature of the target audience and strategies for evaluating student understanding. Shulman (1986) calls this Pedagogical Knowledge (PK). Koehler and Mishra (2007) submit that a teacher with deep pedagogical knowledge understands how students construct knowledge and acquire skills and how they develop habits of mind and positive dispositions towards learning. They

further submit that pedagogical knowledge requires an understanding of cognitive, social and development theories of learning and how they apply to students in the classroom.

The second implication of the view held by the National Council of Teachers of Mathematics (NCTM, 2000) is that in order for effective teaching to take place, teachers need to have the knowledge of how to interpret the content knowledge and then transmitting it to the learners, if need be, in multiple ways. When learners do not understand one method used by the teacher, the teacher should be in a position to use another method to transmit the subject matter to the learner. Having a deeper knowledge of differentiation and integration is of no use if the lecturer cannot transmit this knowledge to students in multiple ways. Possessing this knowledge covers the core business of teaching and learning. It is this knowledge that helps the lecturer to become aware of common misconception and common mistakes in mathematics and bringing them to the attention of the students. Shulman (1986) calls this knowledge Pedagogical Content Knowledge (PCK) and notes that the transmission of the subject matter occurs as the lecturer interprets the subject matter, finds multiple ways to represent it and adapts and tailors the instructional material to alternative conceptions and students' prior knowledge.

When asked to solve the equation: $\sqrt{x+1}=2$, some students may proceed in the following erroneous manner:

Squaring both sides $(\sqrt{x+1})^2 = (2)^2$

$$(x+1)^2 = 4$$

$$x^2 + 2x + 1 = 4$$

$$x^2 + 2x - 3 = 0$$

$$x = 1 \text{ or } x = -3$$

A lecturer who has a deeper knowledge of PCK should alert students about this common mistake made by students, ask them why the solution is flawed and how they can avoid making this mistake. For effective teaching to take place, lecturers need to be aware of topics that are problematic for students. (Shulman, 1986; Wilson, Shulman and Richert, 1987). Ball (1997) goes a step further and notes that teachers need ways to see into the subject matter through the eyes, hearts and minds of the learners. In other words, the lecturer needs to assume the seat of the student and find the simplest way of transmitting the subject matter. Wilson et al (1987) submits that the teacher's task is to transform the subject matter in ways that make it accessible to students.

2.3 GENERAL CHALLENGES IN TERTIARY INSTITUTIONS

Higher education is of central importance to the economic and social development of a country (MESVTEE, 2011). The activities of institutions of higher education and the recipients of higher education advance and preserve a society's intellectual, scientific, cultural and artistic endeavours. The Government recognises its responsibility to safeguard and uphold the traditional role of higher education. Universities in Zambia operate under legislation which makes them responsible to parliament through

MESVTEE. The legislation confers on them academic freedom and managerial autonomy. The public universities have over the years set tuition fees in collaboration with the Ministry. Where the fees have been set too high, the Ministry has intervened so as to allow more access by Zambians. It is however increasingly being accepted that in order to improve operations of public universities, economic fees that reflect the real cost of providing higher education to students should be charged. In order to maintain and improve standards, the Government is reviewing the student financing system. Since 2004, students have been on a loan scheme (from bursary) but no tracer system has been implemented to follow up the graduates to pay back the loan as per statutory instrument on the loan scheme (MESVTEE, 2011).

On the other hand, Vision 2030 (2006) for Zambia is of the view that technical and vocational training is an important component of the education and skills development sector that contribute significantly to economic development. However, in the past twenty years, this subsector has faced a lot of challenges, including lack of investment, lack of comprehensive and integrated curricula and poor state of vocational education. Zambia's Technical Education Vocational and Entrepreneurship Training (TEVET) program is designed to address this but the impact has not yet been substantial. Combined with inadequate supply of middle level management skills to effectively administer the education system, such shortcomings in educational support have led to failure by the system to adequately provide skills to over 20 000 youths who exit from Zambia's school system every year. As for the two public universities, UNZA and CBU, Vision 2030 acknowledges that there are challenges to be addressed. The challenges include

rehabilitating existing infrastructure and constructing new facilities to support the development of human capital. Staff development and retention of qualified staff will also be a focus in order to improve quality of university education (Vision 2030, 2006).

2.4 CHALLENGES IN MATHEMATICS TEACHING AND LEARNING

Challenges in mathematics teaching and learning are observed at secondary school level as well as at higher education level. At the secondary level, the Zambia National Policy on Education of 1996 acknowledges that the performance in the key areas of mathematics and science is far from satisfactory (MOE, 1996). This is confirmed by the results that students obtain at the end of twelve years in school when students sit for a public examination set and marked by the Examination Council of Zambia (ECZ). This is the Zambia School certificate examination roughly equivalent to 'O' level in the British system. On average, less than two thirds of the candidates obtain a full pass in school certificate each year. The over all, unsatisfactory performance in school certificate is attributable in large measure to poor performance in mathematics and science (MOE, 1996). There are many students who fail to gain entry into a tertiary institution immediately after leaving high school because of the poor grade they obtained in mathematics after twelve years in school. A good pass in mathematics is a requirement for entry into a tertiary institution.

This unsatisfactory performance in school certificate does not reflect well upon the country since one of the major tasks of MESVTEE is to concentrate on efforts to improve achievement in science and mathematics. The National Policy on Education of 1996

attributes this poor performance to challenges at the school level. The document states that the challenges “may be in the facilities, the resources or the teaching. It may be in the balance of the curriculum. It may be in the expectations that pupils set for themselves since these are known to have a major impact on student performance” (MOE, 1996). It is evident from the consistent use of the word ‘may’ in the above report, that MESVTEE did not initiate a study to substantiate its claim on the challenges stated in its National Policy document on education.

Furthermore, the requirements for mathematics and science teachers at secondary school level are enormous and require urgent intervention (MESVTEE, 2011). To this effect, the Ministry embarked on the Fast Track Training initiative especially for teachers of science and mathematics to address this challenge. In addition to upgrading teachers using the Fast Track initiative, a selected number of colleges of education will be converted to universities to increase the output of teachers with degree qualifications. During the National Implementation Framework (NIF III) period, three institutions have been earmarked for conversion to universities. The Copperbelt College of Education has been earmarked for transformation into a university of education (Mukuba University of Education) specialised to train teachers of mathematics and science. In addition, Mulakupikwa University, which is under construction will offer training in science and mathematics once operational (MESVTEE, 2011).

Nkrumah College of Education will be converted to Nkrumah University of Education to focus on training of teachers of social sciences for secondary school level and shall

transfer training of mathematics and natural sciences to Mukuba University of Education. It is anticipated that this measure will enable Nkrumah University of Education to substantially increase capacity for training of teachers of social sciences at secondary school level in the country. Chalimbana University will offer degree programmes for primary and early childhood education training. It will also focus on the upgrading of serving primary school teachers through in-service programmes (MESVTEE, 2011).

Challenges in mathematics teaching and learning have also been noted by many other researchers. D'Souza and Wood (1998) observed that the learning of mathematics is often viewed as an isolated, individualistic matter where one sits alone with pen and paper and struggles to understand the materials and concepts at hand. This process can often be quite lonely and frustrating. Some tertiary students believe that only a few talented individuals can successfully compete in the mathematics realm. Tertiary students' experiences during their first year of study appear to be crucial to their personal adjustment and academic performance. First year at university for many students entails a considerable time of transition and change, particularly for those entering tertiary education directly after the end of their high school education.

Adjustment problems during the early stages of undergraduate study are one reason for students dropping out or deferring studies. The transition from school to university involves adjusting to different learning environments and assessment systems, different perspectives on discipline-based knowledge and different teaching practices (Pargetter et al, 1998). In Nigeria, due to the increasing demand for mathematical knowledge in nearly

all spheres of life, there is a need for a new method of teaching mathematical sciences at the tertiary level. This method has to be based on a well-rooted mathematical training and a teaching approach aimed at solving problems (Umeoduagu, 2001).

The attitude a learner has towards mathematics is of critical importance because it determines the learner's behaviour towards mathematics and the effort the learner will put into the learning of mathematics. Thurstone (1928) refers to attitude as a concept that denotes the sum total of a person's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specific topic. Thus a learner's attitude towards mathematics refers to all that a learner feels and thinks about mathematics. It is indeed a subjective and personal affair. Attitudes are thus learned and acquired in much the same manner that other internal learned activity is acquired.

Researchers such as Okello (2010) and Ekol (2010) in their studies have attributed challenges faced by students as they learn mathematics to the wrong attitudes they hold about mathematics. Okello in her study which set out to establish the challenges students at a college in Uganda had in solving mathematical problems, particularly algebra cited 'wrong attitude' held by the students as one of the challenges faced by the students and their lecturers. She states in her study that "some students have an attitude that mathematics is not for them or they are not born to be good at mathematics".

Ekol (2010) of Kyambogo University in Uganda agrees with Okello on the attitudes towards mathematics held by students in National Teachers Colleges (NTCs) in Uganda.

A survey conducted in Government aided NTCs by mathematics faculty of Kyambogo University in April 2008 found out that a major challenge in mathematics teaching and learning is the attitude of students towards the subject. According to the mathematics faculty members, students “think and believe that mathematics is for a select few”. The survey also found out that this attitude is sometimes enforced by the non-supportive attitude by faculty members. Discussions with the mathematics faculty in NTCs invariably echoed the negative attitude and poor mathematics background by students as being the major setback to their mathematics attainment. The survey concludes that the majority of faculty knew what the problem was but was seemingly ill-equipped if not unprepared to deal with the problem. Another challenge the lecturers face in Uganda is that of lack of motivation amongst the learners. Ekol (2010), reports that in Uganda, 59% of the total enrolment in tertiary institutions is in the university and 41% in Non-University Institutions (NUTI). Mathematics is taught in all these institutions either as a core subject or as a support subject to professional qualifications. Admission of students to NUTI is done after the university admissions are complete. Ekol (2010) posits that this has implications on the motivation of some students that join NUTI as some of them consider themselves as having not made it at all by joining NUTI. Ekol is of the view that such students need a lot of motivation and encouragement to pick up in mathematics and this poses a challenge for the lecturers.

Mulendema’s (2007) findings in his study contradict the findings of Okello and Ekol. The study carried out in selected Government high schools in the Copperbelt province of Zambia examined the perceptions and attitudes the high school students had towards

mathematics. The study was conducted with Grades 10, 11 and 12 learners. Results of this study showed that “about 90% of the learners that took part in the study have positive attitudes towards mathematics and that the majority of the learners have a positive perception about mathematics”.

The John Templeton Foundation Report (2009) revealed that while African countries differ from one another in many features, they are broadly similar in the issues that hinder mathematical development. The report states that in most African countries, mathematical development is limited by low numbers of secondary school teachers and mathematicians at the masters and PhD levels. The report revealed that by 2007, Djibouti and Cape Verde each had only one doctorate holder in mathematics. Libya, Somalia and Angola had two doctorate holders in mathematics each. With few professors to train the next generation of leaders in the field, countries cannot meet the growing demand for mathematicians with advanced up-to-date training. According to this report, university mathematics departments in Africa were seriously under-resourced and understaffed. The report further highlights large classes, lack of access to text books and poor infrastructure in the universities as major challenges faced by learners and lecturers across the continent of Africa.

Tuan (2011) observes that mathematics is one of the core subjects in any engineering field, including engineering technology and science fields. It is also known as the backbone of success in these fields. A student who masters the subject of mathematics is perceived to be bright and is assured of graduating from the university. However,

students entering higher education, particularly in the field of engineering were found to have insufficient basic mathematics skills and knowledge. This scenario is not only becoming an issue in Malaysia (Ahmad, 2010) but it is also becoming a worldwide phenomenon in adding up burden to mathematics educators. Okello (2010) in her study in Uganda found the same situation. An analysis of the mathematics entry grades of students after high school showed that most of the students do not pass well in mathematics at school prior to being admitted into college where they must undertake college algebra irrespective of whatever specialised courses they intend to study. In her study, Okello found that only 33% of the students who were admitted at the beginning of 2007 to study mathematics at the college passed well at school. The reasons for admitting people with insufficient basic mathematics skills are varied. In some countries politicians have had an influence in the proliferation of tertiary institutions where the larger the number of tertiary institutions the more favourable they appear in the eyes of the electorate (Okello, 2010). In other countries, it is a deliberate policy by the Government or the university itself to entice more students in the natural sciences by lowering the entry point. Whatever the reason may be, this becomes a huge challenge for mathematics educators at the university. One of the biggest challenges in teaching mathematics skills based at the university level is the under preparedness of students enrolling in the mathematics related fields (Varsavsky, 2010). What will happen next are very predictable low levels of success and engagement with university level mathematics. The increasingly weaker mathematics background of university students and its consequences have been reported around the world (Varsavsky, 2010). Bell (2009) concluded that every year in the United States, nearly 60% of first year college students discover that, despite being fully eligible

to attend college, they are not academically ready for college mathematics. This gap between college eligibility and readiness to study college mathematics has attracted much attention in the last decade, yet it persists unabated. The National Centre for Policy and Higher Education report (2009) revealed that earning a high school diploma does not mean that graduates are ready for college.

Taylor (1999), reports that the changing nature of Australian Universities has resulted in a student intake with a broad range of abilities, attitudes, personal and educational experiences. The study revealed that uneven preparedness was a problem for many tertiary institutions with mathematics in particular cited as a barrier for success of many students. In separate studies conducted along similar lines by the University of Adelaide and the University of Southern Queensland, academicians were still concerned by the mathematical proficiencies of first year students.

Apart from under preparedness and lack of strong basic mathematics skills and knowledge, another reason for the high rate of the decline in mathematics performance is that they consider mathematics as a difficult and tedious subject (Effandi et al, 2010). Furthermore, a common method of delivering information to all students, irrespective of their individual strengths and weaknesses and programme of study, is normally applied in the university. Whereas, researches on students' learning style have shown that every student has a different preference style (Felder, 1988). Tuan (2011) further observes that at the University of Kuala Lumpur Malaysia, mathematics is not a specialisation offered as a major course. However, mathematics is one of the compulsory subjects for

graduation and it is used as a tool for the engineering technology courses. Since this subject is not a major specialisation, the time allocated for this subject is very limited. Therefore, students have very little time to study mathematics because they have to concentrate on the core technical subjects. Traditional methods of teaching mathematics were found to be ineffective for all topics due to the poor performance in certain topics of mathematics such as integral calculus. Tuan (2010) concludes by stating that an innovation in teaching and learning of mathematics should be considered to bridge the gap of knowledge in mathematics to ensure the quality of future engineers and scientists in the 21st century. He proposes a transformation in teaching and learning mathematics at the university level using Computer Algebra Systems (CAS). This system is a catalyst in improving students understanding of difficult abstract mathematical concepts and it is able to perform any complex calculations (Robinson and Burns, 2009). Though this system is a catalyst in improving students' understanding of difficult abstract mathematical concepts, its implementation in Zambia in her current economic form would face many challenges, chief amongst this is the cost associated with the system. The two computer algebra full systems Mathematica and Maple are very powerful means, having a wide range of functions and services but needing modern personal computers as a basis. They both run under linux and Microsoft windows. Unfortunately, the licences for them are very expensive and it is also assumed that there is adequate technical equipment in the lecture rooms (Luderer, 2006).

In recent years, mathematics has increasingly been put under the spotlight as its potential in a vast array of sectors in business, science and technology is gaining increased

recognition in society. Much of the recent studies show that tertiary institutions in many countries around the world are facing various challenges in the teaching and learning of mathematics (Rylands and Coady, 2009). There is not much research that has been done in the area of mathematics in tertiary institutions in Zambia, particularly at CBU that the author is aware of. This study will therefore look at the challenges that lecturers and students face in the teaching and learning of mathematics at CBU.

2.5 CONCLUSION

The major aim of this chapter was to review relevant literature dealing with the challenges of teaching and learning mathematics in tertiary institutions. This review of literature indicates that some of the challenges include rehabilitating existing infrastructure, adjustment problems during the early stages of undergraduate study and the attitude that students have towards mathematics. The next chapter outlines the methodologies that were used in this study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 INTRODUCTION

The preceding chapter looked at some of the research that has already been carried out concerning the challenges of teaching and learning mathematics in tertiary institutions.

This chapter reviews the methods used to collect and analyse the information required for the study. It discusses the research design, target population, data collection methods and techniques, sample size, sampling design and data analysis techniques. The chapter ends with an overview of the ethical aspects and the limitations of the study.

3.1 RESEARCH DESIGN

A Research Design helps the researcher to plan and implement the study in a way that helps the researcher to obtain intended results, thus increasing the chances of obtaining information that could be associated with the real situation (Burns & Grove, 2001). This study focussed on the challenges of teaching and learning mathematics at CBU.

This research used the descriptive research design. Collis and Hussey (2003) describe descriptive research as research which describes phenomena as they exist, that it is used to identify and obtain information on the characteristics of a particular problem or issue. Hence the challenges faced by lecturers as they teach mathematics and the challenges

faced by the learners as they study mathematics are described. Botes (1995) describes contextual research as findings valid within the time space and value context in which the study is being done. The study thus also attempted to capture the context in which mathematics teaching and learning took place at CBU in order to obtain a holistic picture of the challenges faced by lecturers and learners of mathematics.

The research approach was qualitative, descriptive and contextual. Burns & Grove (2001) describe a qualitative approach as a systematic subjective approach used to describe life experiences and situations to give them meaning. Parahoo (1997) states that qualitative research focuses on the experiences of people as well as stressing the uniqueness of the individual. The researcher focussed on the experiences from the participants' perspective, that is, the lecturers and the students. The rationale for using a qualitative approach in this research was to determine and establish the challenges faced by lecturers as they teach mathematics and the challenges faced by students as they learn mathematics. Through this approach, it was possible for the researcher to deeply engage and interact with both the lecturers and the learners of mathematics. A qualitative approach was appropriate in capturing the perceptions of both the lecturers and the students.

3.2 RESEARCH SITE

The Copperbelt University (CBU) was established as a public university by an act of Parliament Number 19 on 1st November 1987. Before then, it was one of the three constituent institutions of the then UNZA federal system which comprised of several campuses namely: Lusaka campus, Ndola campus and Solwezi campus (which never

took off). In 1987, the Government reconstituted UNZA Ndola campus (which was in Kitwe) into CBU, while UNZA, Lusaka campus became UNZA (CBU web page, accessed 9.08.11).

The premises occupied by CBU today were formerly occupied by Zambia Institute of Technology (ZIT). In 1989, ZIT was incorporated into the university as School of Technology (SOT). CBU has undergone many changes since its inception. Currently, it has the following schools: School of Business (SB), School of Natural Resources (SNR), School of Mining and Mineral Sciences (SMMS), School of Built Environment (SBE), School of Engineering (SE), School of Mathematics and Natural Sciences (SMNS) and School of Graduate Studies. The Directorate of Distance Education and Open Learning (DDEOL) offers certificates, diplomas and degree programmes.

The Copperbelt University (CBU) Executive Council approved the establishment of the School of Mathematics and Natural Sciences (SMNS) in June 2008. The School has the following departments: Computer Science, Mathematics, Mathematics and Science Education, Physical Sciences and Biological Sciences. This school now coordinates the teaching of mathematics in all schools in CBU.

Before the establishment of this school, each school, that is, Business, SOT, SBE, SNR had its own lecturers who taught foundational courses of mathematics in their respective schools.

The School of Mathematics and Natural Sciences (SMNS) continues to contribute to the academic growth of CBU by providing coordinated teaching of foundational Mathematics and Science courses and by providing specialised education and training in these disciplines. In the words of the Dean of SMNS, he saw the role of the school as:

*“Advancement of mathematical and scientific knowledge and innovations
and the advancement of exemplary teaching and learning of mathematics
and science”*

During the interview, the Dean stated that SMNS taught all the mathematics courses in the university because lecturers in the school had an understanding of the theoretical basis of mathematics and built up graduates with a strong understanding of mathematics.

3.3 TARGET POPULATIONS

Polit and Hungler (1999) refer to the population as an aggregate or totality of all the objects, subjects or members that conform to a set of specifications. In this study, the target population consisted of all the mathematics lecturers at CBU. In addition to the mathematics lecturers, another target population for the study included all the learners of mathematics at CBU.

3.4 SAMPLE

A sample is a subset of a population selected to participate in the study, it is a fraction of the whole selected to participate in the research project (Polit & Hungler, 1999). In this study, all the lecturers of mathematics took part in the study.

A sample of 400 learners was selected out of the entire population of those who were studying mathematics.

To determine the sample size of the learners of mathematics, the following formula was used:

$$n = \frac{0.25xNzZ^2}{[d^2x(N-1)] + [0.25xZ^2]}$$

Where n = sample size

N = population

d = 0.05 ± 5% precision level

Z = 1.96 at 0.95 confidence level

Using the above formula

$$n = 327.72$$

A sample of 400 was selected instead of the 328 to allow for attrition during the research.

3.5 SAMPLING DESIGN

Sampling refers to the process of selecting a portion of the population that conforms to a designated set of specifications to be studied (Polit & Beck, 2004). A purposive sampling method was used. Cresswell (2000) describes purposive sampling as the intentional seeking or selecting of individuals or situations likely to yield a greater understanding of the phenomenon of interest. The participants must be willing to share

this knowledge. The criterion for choosing the individuals or situations is whether they are information rich (Patton, 1990). Lecturers and learners of mathematics were found to be the best source of rich and valuable information regarding the challenges they face as they teach mathematics and the challenges they face as they learn mathematics respectively. The lecturers and learners were selected based on their particular knowledge of the challenges and for the purpose of sharing these challenges with the researcher. All the lecturers of mathematics were requested to participate in the study and four hundred (400) learners of mathematics took part in the study. Quantitative research requires standardisation of procedures and random selection of participants to remove the potential influence of external variables and ensure generalisability of results (Sargeant, 2012). In contrast, subject selection in qualitative research is purposeful, participants are selected who can best inform the research questions and enhance the understanding of the phenomenon under study. Hence four hundred (400) participants were selected on the basis that they would generate rich information which would enhance understanding the challenges faced by students as they learn mathematics at CBU. Two hundred (200) students were selected from the first years since they form the majority of the learners of mathematics, 100 students from second year, 70 students from third year and 30 students from fourth year. The inclusion criteria in the study was that the participant had to be a lecturer of mathematics or a learner of mathematics.

3.6 TRIANGULATION

In order to determine the experiences, perceptions and views of the lecturers and learners, triangulation was a strategy that was used in the collection of data. Robson (2002)

describes triangulation as a means of using different methods to collect data on the same topic thereby allowing findings to be compared and then collaborated or questioned accordingly. Neuman (1994) defines triangulation as the use of two or more methods of data collection techniques in order to examine the same variable. Triangulation implies that measurements from highly diverse methods result in greater validity. In this study, triangulation was followed in which qualitative data gathered in the form of questionnaires completed by both lecturers and learners, was collaborated with interviews with the Dean of the School of Mathematics Natural Sciences, the lecturers and focus group discussions with the learners. This triangulation of methods was adopted to embrace the validity of the findings and to overcome any biases that might stem from a single method only.

3.7 DATA COLLECTION METHODS AND INSTRUMENTS

Different data collection methods and instruments were used:

3.7.1 Questionnaire

One of the instruments used in this study to gather data was the questionnaire. Questionnaires are a good and efficient way of collecting information quickly and relatively cheaply. They provide many advantages to researchers some of which are: efficient use of time, anonymity, the possibility of a high return rate and standardisation (Munn and Drever, 1996).

Two forms of questionnaires were developed. One was given to the learners of mathematics and the other one was given to the lecturers. The questionnaire given to the lecturers was administered by the researcher but the one given to the learners was administered on behalf of the researcher by various lecturers at different times as they taught their classes. Both types of questionnaires contained open-ended, close-ended and rating type of questions and statements.

The lecturers' questionnaire consisted of general information such as gender, highest qualification and the number of years of teaching mathematics at the university level. There were questions requiring a response on a 4-point Likert scale. Questions were also asked concerning the teaching method a lecturer used most often, the activity a mathematics lecturer usually engaged in while teaching and the challenges the lecturer faced while teaching mathematics at CBU.

The students' questionnaire consisted of general information such as gender, year of study and 'O' level result in mathematics. There were questions requiring a response on a 4-point Likert scale. Questions were also asked concerning accommodation, activities their lecturers usually engaged in while teaching mathematics and the challenges they faced as they learnt mathematics.

3.7.2 Interviews

Interviews were conducted to gather information from mathematics lecturers, the Dean of School of Mathematics and Natural Sciences (SMNS) and an officer from the library.

The interviews were conducted after the questionnaires had been administered so that the researcher could probe further some of the issues that had been raised in the questionnaires. Semi structured interviews were preferred over structured interviews because they provided a setting and atmosphere where the interviewer and interviewee could discuss the topic in detail. The interviewer therefore could make use of cues and prompts to help and direct the interviewee into the research topic area thus being able to gather more in depth and detailed data set (Creswell, 2003).

The purpose of the interview was to give a chance to lecturers to elaborate on some of their responses in the questionnaire. The interviews also allowed the researcher to seek further clarification and further explanation on the availability of mathematics resources, consultations with the students, recommended teaching loads, sizes of classes that they taught among other things. The interview with the Dean of SMNS was conducted for the purpose of collecting information on the role of SMNS at CBU, budgetary allocations to the school, staffing levels in the school and availability of mathematics teaching resources in the school. The purpose of the interview with the official from the library was to establish the number of mathematics journals that the main CBU library had subscribed to.

3.7.3 Focus Group Discussion

Another method used to gather information from the students on the challenges they faced as they learnt mathematics was by using a focus group discussion. A focus group is a method whereby a group of six to eight people are brought together to discuss a given

event or phenomenon in which they have a shared experience (Creswell, 2003). The researcher decided to use a focus group discussion because it is a technique that can be used where individual interviews are too time consuming and too difficult to arrange. It is an economical method of collecting a lot of verbal data. Among its strengths are providing rich and in-depth data and allows the researcher to produce concentrated data on a precise topic (Scheurich, 1997).

The group consisted of eight (8) learners of mathematics, drawn from first year through to fourth year. The eight (8) participants were selected following a strategy called purposeful sampling. Purposeful sampling in contrast to probabilistic sampling is selecting information rich cases for study in depth (Patton, 1990). The group had four (4) males and four (4) females. Some of the learners were accommodated on campus and others lived off campus. The researcher introduced himself to the participants to establish rapport and informed them about the purpose of the study. The participants sat in a circle for better communication. During the discussion, data collected was recorded on audiotape and field notes were taken by the researcher.

The researcher conducted the focus group discussion with the participants using an interview guide with semi-structured questions. The researcher facilitated the interaction and let the questions guide the discussion by allowing a flexible allocation of time to participants. Hence the researcher was able to explore new directions relevant to the study and allowed a more fluid interaction between the participants as they were given the opportunity to elaborate on each others' answers. A dynamic interaction among the

participants was encouraged for the purpose of stimulating their thoughts and all participants, including the researcher had an opportunity to ask questions.

3.8 DATA ANALYSIS TECHNIQUES

To analyse the data gathered from the questionnaires and the interviews, the responses were read several times by the researcher. Responses during the focus group discussion were recorded and then transcribed verbatim. Significant statements pertaining to the challenges faced by lecturers and learners were extracted. The themes that emerged were coded then used to provide a full description of the challenges. Coding involves assigning numbers or other symbols to responses so that the responses can be grouped into a limited number of classes or categories (Cooper & Schindler, 2003). The coding made use of key research concepts and ideas emerging from the questionnaire such as “living off campus hinders me from discussing mathematics with my course mates” or “there is a lack of mathematics reference books in the library”. Quantitative data was analysed using statistical packages such as SPSS and Microsoft Excel. The results were presented using descriptive statistics in the form of percentages, bar graphs and frequency counts.

3.9 ETHICAL ASPECTS

Ethical considerations are of the utmost importance when one is conducting research involving human participants (Goddard & Melville, 2001). It is incumbent upon researchers to design a study in which the principles of integrity, a respect for persons and justice are exemplified. In view of these ethical considerations, permission was requested and obtained in writing from the Registrar of CBU to conduct the study.

Permission was obtained from the lecturers and students to participate in the study. The assurance was given that the information gathered was for academic purposes and therefore will be treated with anonymity and confidentiality. The aims and objectives of the study were explained verbally to the lecturers and the learners by the researcher prior to their participation. No remuneration was offered for taking part in this study and the participants were informed that they were free to withdraw from the study if they so wished at any stage of the research without incurring any penalty.

3.10 LIMITATIONS OF THE STUDY

This study was limited to mathematics lecturers, learners of mathematics and conducted at CBU only. The questionnaires for the learners were distributed by their lecturers. This might have led to learners being more conservative with any negative comments which they may have wished to make. However, the fact that the questionnaires were confidential and did not require the learners' name may have alleviated this issue. The focus group discussions were difficult to organise as finding a time and venue that suited all participants invited was a challenge. The study was carried out when both lecturers and learners were busy. The total number of mathematics lecturers at CBU is thirteen. Eleven took part in the study. However the absence of two lecturers had no significant effect on the study. There were no problems encountered with the learners of mathematics as almost 90% filled in and returned the questionnaires. Almost an equal percentage of lecturers filled in and returned the questionnaires.

3.11 CONCLUSION

This chapter outlined the methodologies used in this study. It outlined the research design and discussed data collection methods and instruments. The purpose of a research design is to maximise valid answers to a research question. This was achieved by using a qualitative, descriptive approach that was contextual. Data was collected by means of questionnaires and interviews. The chapter ended with an overview of ethical aspects and the limitations of the study. The next chapter presents the findings of the study.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.0 INTRODUCTION

The preceding chapter presented the research design and methodologies used in this study. This chapter concentrates on the research findings arising from the analysis of data collected. Findings arising from questionnaires given to the lecturers and students are presented together with findings arising from personal interviews with lecturers and findings arising from focus group interviews with students. Some findings from personal interviews with lecturers and most of the findings from focus group interviews are given in italics. The findings are presented in the following order: conditions existing at CBU regarding the teaching and learning of mathematics, challenges faced by CBU lecturers when teaching mathematics and challenges faced by CBU students when learning mathematics.

4.1 THE TEACHING AND LEARNING OF MATHEMATICS AT CBU

This section deals with the conditions existing at CBU regarding the teaching and learning of mathematics. It begins with the qualifications of lecturers teaching mathematics before looking at the availability of lecturers for consultations. The section further looks at the use of the library by students, completion of the syllabus by lecturers and ends with an overview of how courses are assessed at CBU.

4.1.1 Qualifications of mathematics lecturers

Table 4.1 shows the qualifications of the lecturers who were teaching mathematics at CBU.

Table 4.1: Qualifications of the lecturers teaching mathematics

Highest Qualification	MSc	MSc Ed/MEd	PhD	Total
Number of lecturers	8	2	3	13

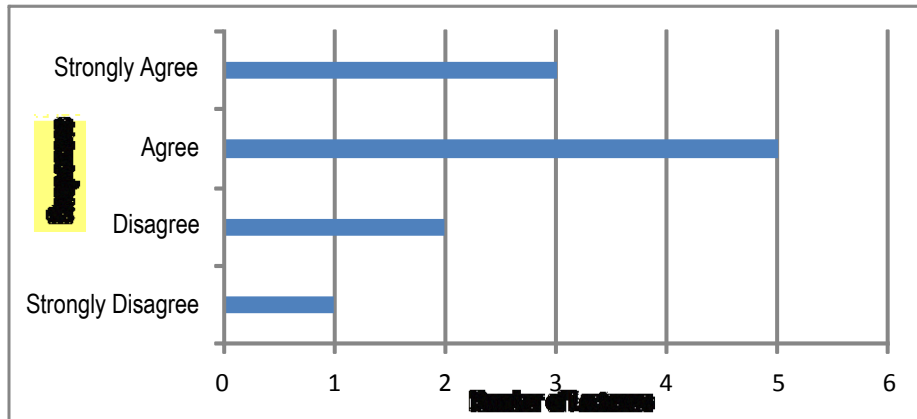
Source: Field Survey (2012)

The mathematics department had thirteen (13) lecturers. Eight (8) of these had MSc in mathematics, two (2) had MEd and three (3) were PhD holders. Of the three (3) PhD holders, two (2) are professors in mathematics. There was a considerable range in the lecturers' ages and teaching experience at the university level. Of the eleven (11) lecturers that took part in the study, five (5) had taught at the university level for more than fifteen (15) years and five (5) had taught for less than five (5) years. It was also noted that only two (2) of the thirteen (13) lecturers were female.

4.1.2 Lecturers' perception of their teaching loads

Lecturers were asked if their teaching load was within the recommended bracket. Their responses are shown in Figure 4.1.

Figure 4.1: Lecturers' perception of their teaching loads



Source: Field Survey (2012)

The figure shows that eight (8) lecturers (representing 73%) in the department taught within the recommended bracket and three (3) lecturers taught outside the recommended bracket. The three (3) lecturers who taught outside the recommended bracket indicated that they were normally tired at the end of the day and would appreciate a reduction in the number of hours that they taught per week. During the interview, the Dean of SMNS and the lecturers stated that the recommended teaching load in the university was twelve (12) hours per week. The three (3) lecturers believed that because of the many hours that they had to teach, they could hardly find time to do research and to publish. The Dean of SMNS believed that there was no optimal number of lecturers needed for the department to operate at full strength. The Head of Department submitted that there was a shortage of lecturers in Real Analysis and Algebra. Asked if shortage of lecturers could affect research and publications undertaken by lecturers, the Dean stated that carrying out research and publications was a matter of individual attitude towards these activities and does not necessarily depend upon the number of hours a lecturer teaches.

4.1.3 Mathematics tutorial

Students were asked how often tutorials were conducted at CBU. Their responses are shown in Table 4.2.

Table 4.2: Students' responses on frequency of tutorials in mathematics.

Year of study	Never (%)	Sometimes (%)	Often (%)	Always (%)
1	2(1.0)	36(18.4)	45(23.0)	113(57.6)
2	52(57.8)	28(31.1)	2(2.2)	8(8.9)
3	35(94.6)	2(5.4)	0(0.0)	0(0.0)
4	15(62.5)	6(25.0)	2(8.3)	1(4.2)

Source: Field Survey 2012

Tutorials were conducted frequently and consistently for 1st year students. Table 4.2 shows that 113(57.6%) of the first year students agreed that tutorials were conducted always. During the focus group interviews, the first year students stated that tutorials were conducted once or twice a week depending on the group one was in. The tutorial times were clearly specified by the lecturers and the students were aware of these times. Though tutorials were conducted, they were in most cases held in very large groups. As one first year student said during the focus group interview:

“During our tutorials, we are more than eighty students in the class.”

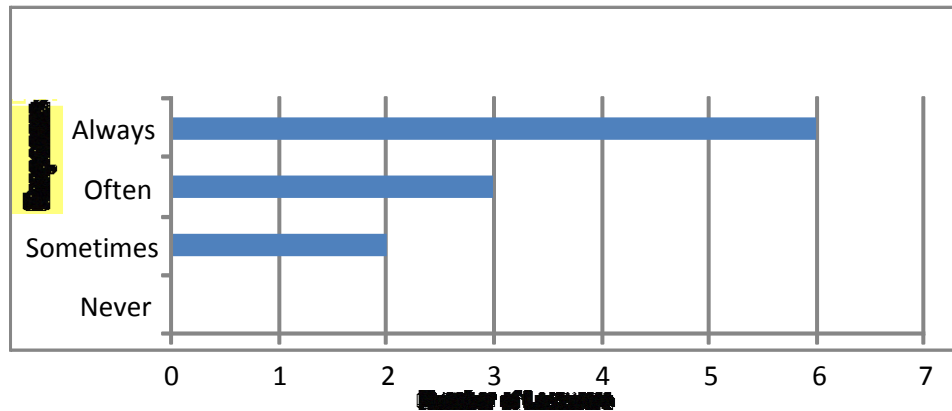
It was a different case with the third and fourth year students. 35(94.6%) of the third year students stated that tutorials were never conducted while 15(62.5%) of the fourth year students stated that tutorials were never conducted. The HOD for mathematics, during the interview stated that funds permitting, tutors were hired for first year students but the

budget allocation to the department does not permit to hire tutors for second, third and fourth year students. However, the School of Business had included in its budget funds to hire tutors for first and second year students' tutorials.

4.1.4 Completing the syllabus at the end of each academic year

Lecturers were asked if they managed to complete the syllabus at the end of each academic year. Their responses are shown in Figure 4.2

Figure 4.2: Number of lecturers who complete the syllabus



The majority of the lecturers managed to complete the syllabus at the end of each academic year. Six(55%) lecturers always managed to complete the syllabus. Only two (2) lecturers failed to complete the syllabus. However during the interview, one lecturer stated that:

“I sometimes find it difficult to finish the syllabus at the end of each academic year because I teach many hours during the day. When I get tired, my pace slows down. Hence I do not cover as much as I would want to”

4.1.5 Availability of lecturers for Consultations

Lecturers were asked how often they were available for consultations. The first section outlines the responses by the lecturers and the second section outlines the responses by the learners over the same.

i. Lecturers' responses on their availability

During the interview, all the lecturers stated that they were available for consultations with the learners and that they spent varying amounts of time with learners. Two said that they were available every day from Monday to Friday in the afternoons, one said three times a week in the afternoon, three lecturers said they were available two times a week. Two other lecturers said that they were available for consultations any time that they were free.

During the interview, the lecturers said that they generally spent fifteen minutes on average on each student, but two lecturers said that they spent as much time as it took for the student "to understand". Five lecturers stated that they informed their students the specific times that they were available for consultations and the students were aware of these times. However, two lecturers indicated that:

“Students have a tendency of coming for consultations when they are informed that they will be writing a test”

ii. Learners' responses on availability of their lecturers for consultations

Learners were also asked how often their lecturers were available for consultations. All the eight learners that participated in the focus group interview indicated that lecturers were usually available for consultations and that they were aware of the consultation times. This confirmed what the lecturers had said during the interview. However, one student during the focus group interview observed that:

“Our lecturer is not usually found in his office during the times that he told us to see him, but when I find him in the office, he explains until I understand”

4.1.6 Library opening hours

The main library opens from 09:00 hours to 22:00 hours during week days, 09:00 hours to 12:00 hours on Saturdays and 14:00 hours to 16:00 hours on Sundays. Students were allowed to borrow books for two weeks from the main collection and for three hours from short loan section. Although all the eight students that participated in the focus group interview agreed that they had access to the library, one student observed that:

“Although I am free to use the library, I don't because most of the books that I am told to use are not there. Worse still there is not enough sitting space in the library and I live in a boarding house very far away from campus”

Learners observed that they mostly used the library when they were not attending lectures or tutorials while those who were accommodated on campus also used the library in the evenings.

4.1.7 Assessment of coursework

The Dean of SMNS, during an interview stated that assessment of all learners' work in each course consisted of coursework and a written examination. The continuous assessment (CA) had a weighting of 40% and the final examination in the course had a weighting of 60% in each course. Only students who had passed the continuous assessment were allowed to sit for the final examination. A pass mark in CA was 50%. The CA consisted of tests, assignments, projects, practical work and any other work that was assigned in each course. CA consisted of at least two assessments in each term. The pass mark in each course was a score of 50% or better.

During the focus group interview, 50% of the students stated that there were mathematics lecturers who allowed some students to sit for final examination even when their CA was below 50%. Two lecturers, including the HOD confirmed in an interview that they sometimes used their discretion to allow students to sit for the final examinations if their CA was close to 50%. Though the university regulations state that CA should consist of at least two assessments in each term, students in the focus group interview indicated that first year students wrote one test in a term and had feedback after four or six weeks except one group which wrote two or more tests in a term and got feedback from their lecturer after a few days. They said that on some rare occasions, some first year students

received feedback from their lecturers the following term. On the other hand, one lecturer felt that the numbers of students in first year classes were too large and posed a challenge when grading the test papers:

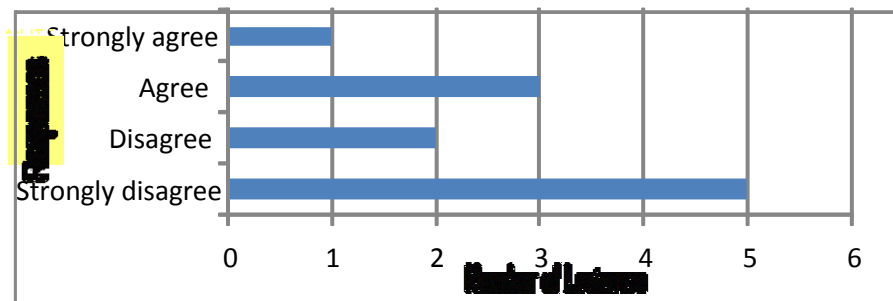
“The classes are too large, hence there are times when I just give one test in a term”

Students in third and fourth year stated that they wrote more than one test in mathematics in a term and usually had feedback after two weeks or less. One lecturer stated that he had less than twenty learners in the course that he taught; hence he took a short time to grade the papers.

4.1.8 Lecturers’ perception on the availability of mathematics resources

Lecturers were asked if mathematics resources such as reference books were available in the main library. Their responses on the availability of mathematics reference books are shown in Figure 4.3.

Figure 4.3: Perceptions on availability of mathematics resources



Source: Field Survey (2012)

Mathematics resources such as reference books were not available in the main library. This was evidenced by the fact that 7(64%) mathematics lecturers indicated that reference books were not available in the main library. Some lecturers were of the view that the books that were available were old, outdated and not enough and hence this posed a challenge when lecturers prepared their material for teaching. According to the Dean, the challenges lecturers faced were not just a lack of mathematics laboratories but also:

“Lack of accessibility to latest text books, latest mathematics software packages and exposure to the latest journals”

However, one lecturer stated that the lack of mathematics reference books in the library did not affect his teaching because he purchased his own books and other resources. Three lecturers cited an inadequacy in the number of rooms where they taught as a challenge they faced when teaching mathematics. They said that some of the class rooms they taught in were:

“Small, have small boards that are difficult to clean and are poorly ventilated”

In an interview, an official of the library explained that due to financial constraints, CBU did not subscribe to as many mathematics on-line journals as it would wish.

4.1.9 Students' perception on the availability of mathematics resources

Students were asked about the availability of relevant mathematics books in the main library. The responses to the statement “There are relevant mathematics books in the library” are shown in Table 4.3.

Table 4.3: Availability of mathematics resources

Year of study	Strongly Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
1	80(42.9)	52(27.2)	43(21.5)	16(8.4)
2	33(36.3)	28(30.8)	26(28.6)	4(4.4)
3	12(32.4)	21(56.8)	3(8.1)	1(2.7)
4	4(16.7)	12(50.0)	6(25.0)	2(8.3)

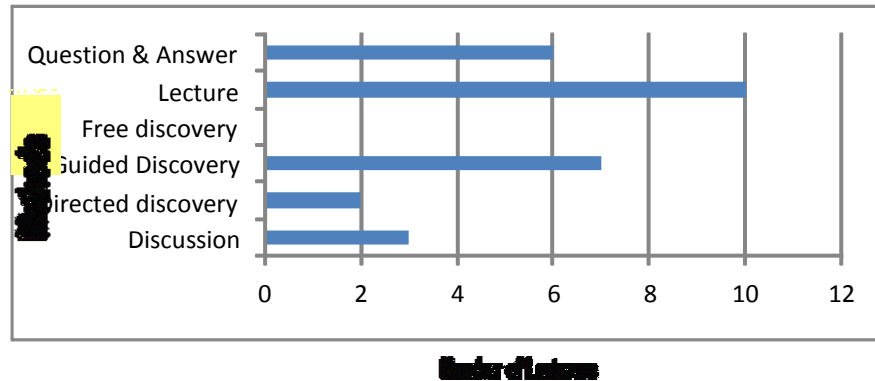
Source: Field Survey 2012

Some students disagreed with the statement that mathematics resources are available in the library. A total of 132(70.1%) and 33(89.2%) of first and third year students respectively indicated that mathematics reference books were not available in the main library and they stated that this affected their learning. During the focus group interviews, some students indicated that the lack of reference books made them depend entirely on the class notes. They also noted that many books that were available on the internet did not show all the content unless one had a password or was willing to subscribe at a cost.

4.1.10 Teaching methods used by lecturers

Lecturers were asked to state the methods of teaching they usually used when teaching mathematics. They were at liberty to write more than one method if they so wished. Figure 4.4 shows their responses.

Figure 4.4: Teaching methods used by lecturers



Source: Field Survey (2012)

The most common method of teaching used was the lecture method, for 10(91%) lecturers usually used this method followed by the guided discovery method. It was worth noting that none of the lecturers that participated in the study used the free discovery method.

4.1.10.1 Methods of teaching preferred by lecturers

Six methods of teaching were presented to the lecturers namely: question and answer, lecture, free discovery, guided discovery, directed discovery and discussion. Lecturers were asked to indicate the methods they usually used when teaching, the methods they least enjoyed when teaching and the methods they enjoyed most when teaching. Box 1 shows their responses.

Box 1: Methods of teaching preferred

Box 4.1: Methods of teaching preferred

- Lecture method is the teaching method usually used by lecturers (10)
- Lecture method is the teaching method lecturers least enjoy (5)
- Guided discovery is the teaching method lecturers enjoy most (7)

Source: Field Survey (2012)

Box 1 shows that 10(91%) lecturers usually used the lecture method and 7(64%) enjoyed most the guided discovery method when teaching. The lecture method emerged to be the method that the highest number of lecturers least enjoyed when teaching.

Although the majority of the lecturers used the lecture methods, it was a teaching method most of the lecturers least enjoyed than any other teaching method. They used it and yet at the same time, they did not enjoy it. One lecturer observed that:

“In the lecture method, my feeling is that due to lack of active participation by the students, it is difficult to find out how well they have understood what has been taught”

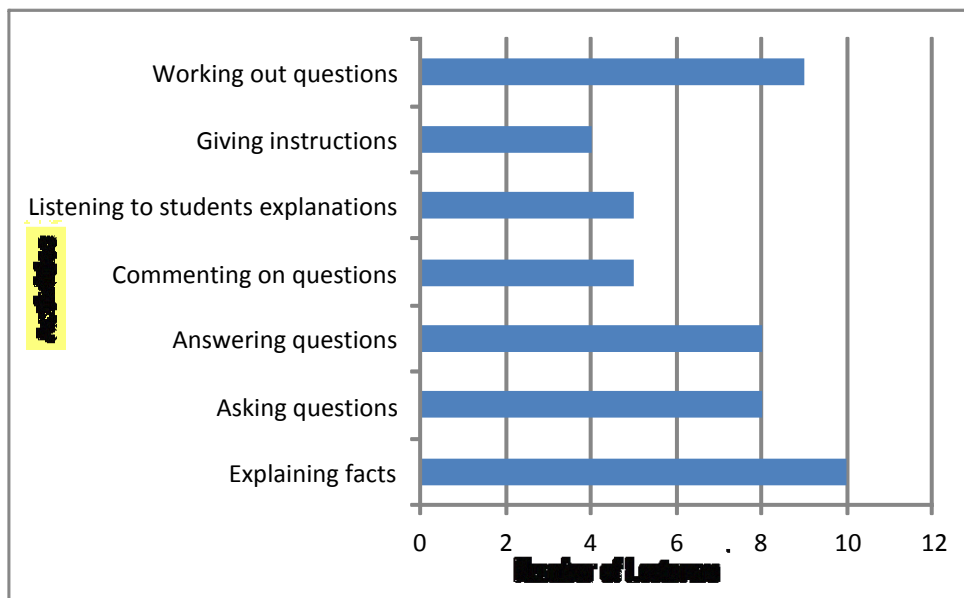
And another lecturer observed that:

“It is one-sided mostly”

4.1.10.2 Lecturers' activities while teaching

Some of the activities that lecturers engaged in while teaching were presented to them such as: working out questions on the board, giving instructions, listening to students' explanations, commenting on students' questions, answering questions from students, asking students questions and explaining facts. They were asked to indicate the activities that they usually engaged in. Figure 4.5 shows their responses.

Figure 4.5: Lecturers' activities while teaching



Source: Field Survey (2012)

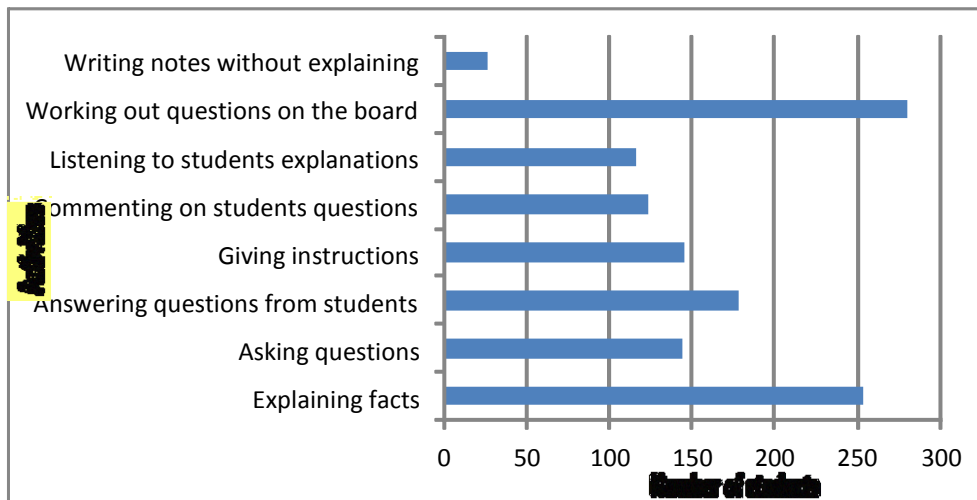
During mathematics classes, there seemed to be little interaction between the lecturers and the students. 9(82%) lecturers spent most of their time working out questions on the board while 10(91%) spent most of their time explaining facts as shown in figure 4.5. Only 5(46%) lecturers indicated that they usually engaged in listening to students'

explanations and commenting on questions posed by students. This painted a picture of students being passive in the learning process. They listened to the lecturer explaining facts while at the same time hastily copied notes as the lecturer worked out questions on the board.

4.1.10.3 Teaching Practices as observed by students

Activities that lecturers perform while teaching mathematics may include the following: writing notes without explaining, working out questions on the board, listening to students' explanations, commenting on students' questions, giving instructions, answering questions from students, asking students questions and explaining facts to students. Learners were asked to indicate the activities that their lecturers usually performed while teaching. Their responses are shown in Figure 4.6.

Figure 4.6: Lecturers' activities while teaching as observed by learners



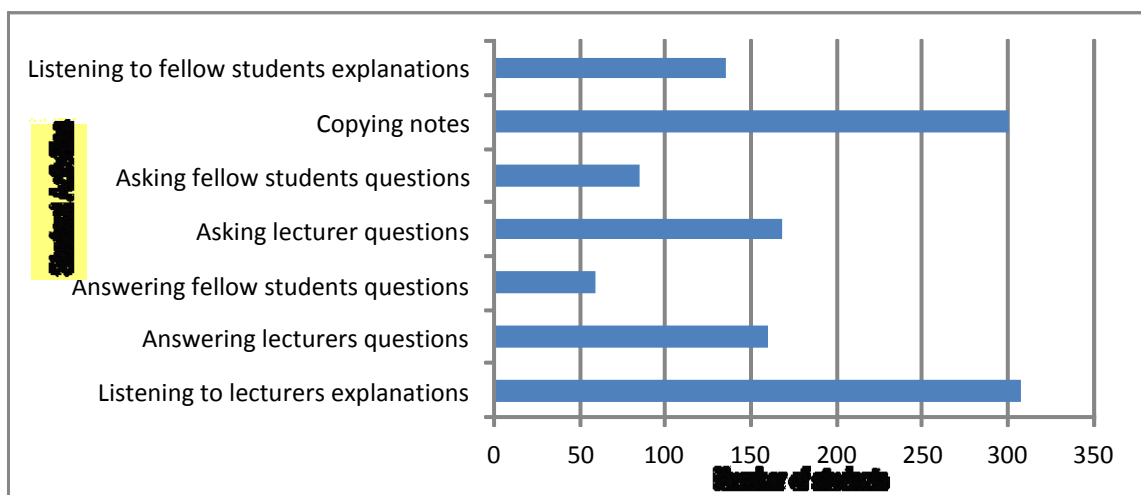
Source: Field Survey 2012

The majority of the students 280(80%) indicated that the main activities lecturers performed while teaching mathematics were working out questions or examples on the board while 253(72.3%) indicated that the main activity lecturers performed while teaching mathematics was explaining facts. A notable response by 26(7.4%) of the students was that one of the activities lecturers performed while teaching mathematics was writing notes on the board without explaining.

4.1.11 Students' activities while learning mathematics

Activities that students may engage in while learning mathematics may include the following: listening to fellow students' explanations, copying notes, asking fellow students questions, asking the lecturer questions, answering fellow students' questions, answering the lecturer's questions and listening to the lecturer's explanations. Students were asked to indicate the activities that they usually engaged in while learning mathematics. Their responses are shown in Figure 4.7.

Figure 4.7: Students' activities while learning



Source: Field Survey 2012

Listening to the lecturers explaining facts and copying notes were the main activities students usually engaged in during mathematics classes. When students were asked about the activities they usually engaged in during mathematics classes, 310(88%) responded that they usually listened to the explanations of their lecturers and 300(85%) indicated that they copied notes. During the lecture, there was a high level of interaction between the students themselves as 135(38.6%) of the students engaged in listening to fellow students' explanations.

4.1.12 Budgetary Allocation to the School

Information concerning the funds allocated to different schools in the university was not established but the School of Mathematics and Natural Sciences indicated that the budgetary allocation to it was not enough to purchase reference books for the departmental library and other resources required by the department. The main library lacked these resources as well. According to the Dean of the school due to the meagre allocation, the school could not obtain latest materials and resources for teaching. He stated that,

“The school cannot afford the latest software and exposure to the latest journals”

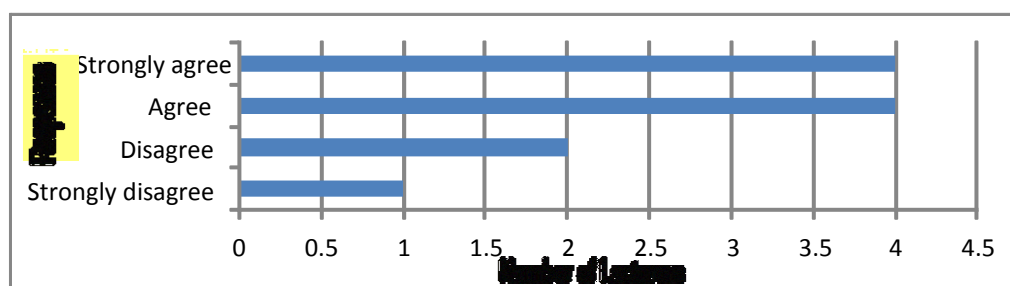
4.2 CHALLENGES FACED BY CBU MATHEMATICS LECTURERS WHEN TEACHING

This section presents an outline of the challenges lecturers face when teaching mathematics at CBU. The number of mathematics lecturers that took part in the study was 11 (N=11). The section begins by looking at the lecturers' perceptions of the students' study patterns in mathematics and the availability of mathematics resources. It then looks at the lecturers' perception of the students' attitude, foundation in mathematics and the preparedness to study university mathematics.

4.2.1 Students' Practices in Mathematics

Lecturers were asked if they thought that students did not practice solving mathematics problems on their own during their study time. Figure 4.8 shows their responses.

Figure 4.8: Students do not practice solving problems on their own



Source Field Survey (2012)

Lecturers of mathematics at CBU thought that students did not practice solving problems on their own. This was evidenced by the fact that 8(73%) lecturers as shown in figure 4.8

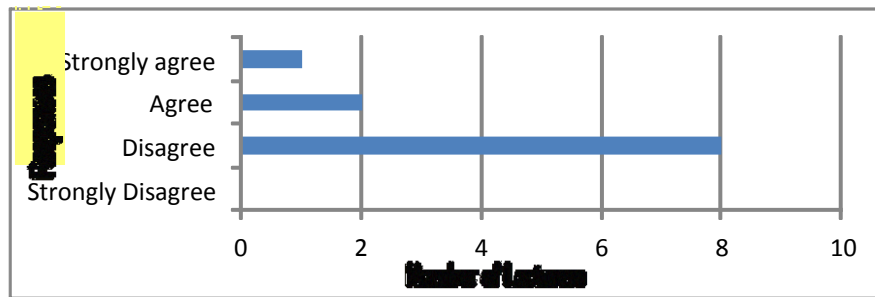
indicated that students did not practice solving mathematics problems on their own. As one lecturer stated

“Some students are lazy, they do not practice solving mathematics problems on their own after the lecture but instead wait for the lecturer to do everything for them, this puts a strain on the lecturer”

4.2.2 Attitude of students towards Mathematics

Lecturers were asked about their perception on the attitude of their students towards mathematics. Their perceptions of the statement “Students have a positive attitude towards mathematics” are shown in Figure 4.9.

Figure 4.9: Lecturers’ perception on whether students have a positive attitude or not



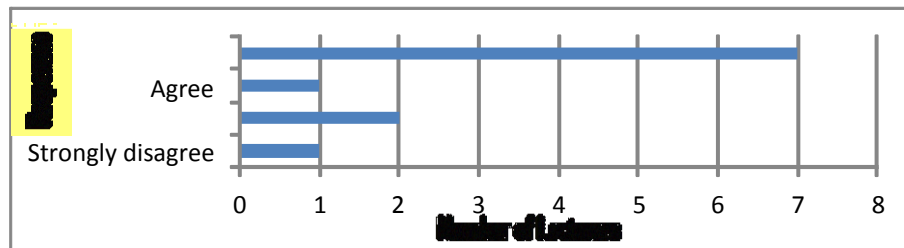
Source: Field Survey (2012)

Lecturers of mathematics at CBU indicated that one of the biggest challenges they faced as they taught mathematics was the lack of a positive attitude towards mathematics. The majority of the lecturers disagreed with the statement that “students have a positive attitude towards mathematics” for 8(73%) of the lecturers indicated that students did not have a positive attitude towards mathematics.

4.2.3 Foundation in Mathematics of students from secondary school

The lecturers' perception of the statement "Students have a poor foundation in mathematics from secondary school" are summarised in figure 4.10. The majority of the lecturers agreed with this statement as shown in Figure 4.10.

Figure 4.10: Lecturers' perception on whether students have a poor foundation or not



Source: Field Survey (2012)

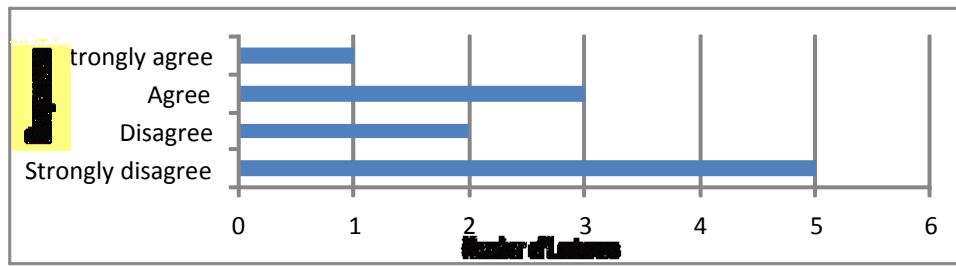
Eight (73%) mathematics lecturers indicated that students at CBU had a poor foundation in mathematics from secondary school. As one lecturer put it:

“It is difficult to introduce a higher concept as students have a weak background in mathematics from secondary school”

4.2.4 Preparedness to study university Mathematics

Lecturers were asked to indicate whether secondary school mathematics prepared the students adequately or not for the rigours of mathematics that students encounter at the university. The lecturers' perception of the statement: "Secondary school mathematics prepared students adequately for university mathematics" are shown in Figure 4.11.

Figure 4.11: Secondary school mathematics prepared students adequately



Source: Field Survey (2012)

Six (64%) lecturers at CBU disagreed with the statement that secondary school mathematics prepared students adequately for university mathematics.

4.3 CHALLENGES FACED BY CBU STUDENTS WHEN LEARNING MATHEMATICS

In this section, students were asked to present the challenges they faced when learning mathematics. The section begins by detailing the attitude students had towards mathematics, the class room environment and the effect of lack of accommodation on campus on their studies in mathematics. The section ends by looking at the activities lecturers and students engaged in while learning mathematics and an overview of challenges that were peculiar to first year students.

4.3.1 Attitude of students towards Mathematics

This section details the responses given by students to the three statements on attitude towards mathematics. The responses to all the three statements are shown in Table 4.4.

Table 4.4: Attitudes of students towards mathematics

Attitudes	Disagree	Disagree	Disagree	Disagree
	1 st Year(%)	2 nd Year(%)	3 rd Year(%)	4 th Year(%)
Mathematics is for a select few	166(84.7)	80(89.2)	33(91)	16(69.6)
I am not naturally good in mathematics	165(82.9)	84(92.3)	36(97.3)	21(87.5)
I am confident in a mathematics class	49(25.0)	16(17.6)	5(13.5)	3(12.5)

Source: Field Survey (2012)

Table 4.4 shows that 166(84.7%) of the first year students disagreed with the statement that “Mathematics is for a select few” while only 16(69.6%) of the fourth year students disagreed with this statement. 165(82.9%) of the first year students disagreed with the statement that “I am not naturally good in mathematics”.

The responses to the statement “I am confident in mathematics” indicated that 49(25%) of the first year students were not confident in mathematics. Table 4.4 shows that one out of four students of mathematics in the first year of study was not confident in mathematics whereas only 3(12.5%) of the fourth year students were not confident in mathematics.

4.3.2 Transition and mathematics foundation

This section begins by looking at the preparedness of first year mathematics students to study mathematics at the university and concludes by looking at the teaching and learning environment that is found at the university.

4.3.2.1 Preparedness to study university mathematics

Students were asked to indicate if the mathematics they learnt at secondary school prepared them adequately for the rigours of mathematics at university. The responses to the statement “Secondary school mathematics prepared me adequately for university mathematics” are shown in Table 4.5.

Table 4.5: Preparation of secondary school mathematics

Year of study	1 st Year	2 nd Year	3 rd Year	4 th Year	Total
Agree	117(59%)	63(69%)	23(62%)	16(67%)	219(63%)
Disagree	80(41%)	28(31%)	14(38%)	8(33%)	130(37%)

Source: Field Survey 2012

A total of 130(37%) students disagreed with the statement that secondary school mathematics prepared them adequately for university mathematics.

4.3.3 Teaching and learning environment at university

When students arrive at the university, they seem to find “freedom” to do many things that they were not allowed to do at secondary school. The responses to the statement “Freedom at university interferes with my studies in mathematics” are shown in Table 4.6.

Table 4.6: Freedom at university interferes with studies

Year of study	Never (%)	Sometimes (%)	Often (%)	Always (%)
1	73(37.1)	90(45.7)	16(8.1)	18(9.1)
2	43(47.3)	36(39.6)	5(5.5)	7(7.7)
3	13(36.1)	16(44.4)	6(16.7)	1(2.8)
4	9(37.5)	13(54.2)	2(8.3)	0(0.0)

Source: Field Survey 2012

When asked if this “freedom” interferes with their studies, 18(9.1%) of first year students indicated that this apparent freedom always interfered with their studies in mathematics. As Table 4.6 shows, students in the university were to varying degrees affected by this freedom for even 13(54.2%) of the fourth year students indicated that this apparent freedom sometimes interfered with their studies. During the focus group interview, one student observed that:

“Here at the university, there is no one to monitor and force me to attend classes, there is no one to force me to write a test when I feel I am not ready”

4.3.3.1 Learning in a large class

Students sometimes learn in large classes. They were asked if they feel intimidated learning in large classes. Their responses are shown in Table 4.7.

Table 4.7: Intimidated by learning in a large class

Year of study	Never (%)	Sometimes (%)	Often (%)	Always (%)
1	64(32.8)	80(41.1)	26(13.3)	25(12.8)
2	47(51.6)	32(35.2)	9(9.9)	3(3.3)
3	24(64.9)	9(24.3)	2(5.4)	2(5.4)
4	10(41.6)	9(37.5)	4(16.7)	1(4.2)

Source: Field Survey 2012

Table 4.7 shows that only 64(32.8%) of first year students indicated that they were never intimidated learning in a large class. This implied that a larger percentage of students 131(67.2%) indicated that they were intimidated learning in a large class with varying

degrees. Students who were not in their first year of study indicated that they were less intimidated learning in a large class.

4.3.3.2 Physical classroom environment

Students were asked if there was enough furniture for everyone in the classroom in which they learn mathematics. Students were also asked if they were able to hear their lecturer clearly when they are learning mathematics from any part of the class where they were seated. Table 4.8 shows the percentage of students according to their year of study who indicated that there was never enough furniture in the classroom and also the percentage of students who indicated that they never heard their lecturer clearly as they learned mathematics.

Table 4.8: Physical classroom environment

Statement	Never (%)	Never (%)	Never (%)	Never (%)
	1 st year (%)	2 nd year (%)	3 rd year	4 th year
There is enough furniture	21(10.6)	18(20.0)	7(18.9)	3(12.5)
I can hear clearly	32(16.3)	6(6.6)	1(3.9)	2(6.7)

Source: Field Survey 2012

Table 4.8 shows that there was never enough furniture for all students in the largest class they attended. 21(10.6%) of the first year students indicated that there was never enough furniture for all to sit on. The study also revealed that though the second and third year students may be smaller in number compared to the first year students, they too experienced a shortage of furniture for they were allocated smaller rooms which, because of their size, had fewer desks and chairs. In fact 18(20%) and 7(18.9%) of second and

third year students respectively indicated that there was never enough furniture for them. During the focus group interview, one first year student observed that:

“When I go late for a lecture and I find that there is no chair to sit on, I always go back to my room for I can’t manage to copy notes for two hours while standing”

When asked if they were able to hear their lecturer clearly from where they sat in the largest class they attended, 32(16.3%) of the first year students indicated that they were never able to hear clearly what their lecturers were saying when sitting at the back. During the focus group interview, first year students said that they were able to hear clearly their lecturer only when they were sitting near the front or in front of the lecture room. One of the lecturers during an interview observed that:

“I do not think all my students hear me clearly since there are no public speaking systems in the lecture rooms”

4.3.3.3 Availability of accommodation on campus

Students were asked if they were accommodated on campus. Table 4.9 shows the number of students who were accommodated on campus and those who were not. The respective percentages are given in brackets. The responses are shown according to the year of study so as to highlight which year of study was affected most by lack of accommodation.

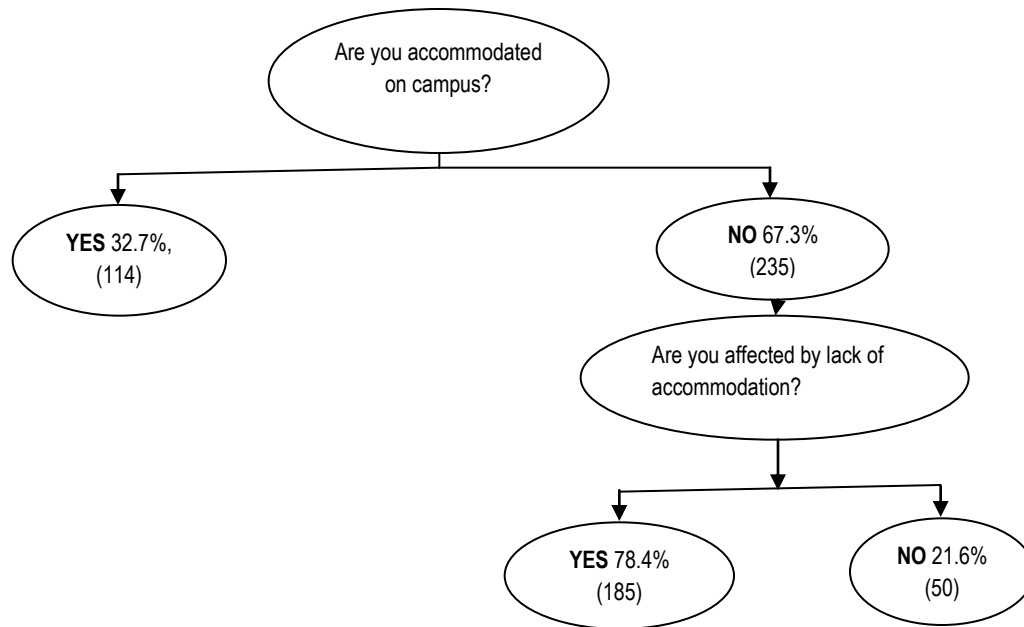
Table 4.9: Students accommodation on campus

Year of study	Year 1 (%)	Year 2 (%)	Year 3 (%)	Year 4 (%)	Total (%)
Accommodated YES	51 (25.8)	32 (35.2)	15 (41.7)	16 (66.7)	114 (32.7)
on campus NO	147 (74.2)	59 (64.8)	21 (58.3)	8 (33.3)	235 (67.3)

Source: Field Survey (2012)

The table shows that 235(67.3%) of mathematics students were not accommodated on campus and that there were more first year students 147(74.2%) than any other stream of learners who were not accommodated on campus. Students gained access to accommodation as they progressed further in their studies. Students who were not accommodated on campus were then asked if lack of accommodation on campus affected their studies in mathematics. Figure 4.12 shows both the number and the percentage of learners of mathematics who were accommodated on campus and those that were not accommodated on campus. It then shows the number and percentage of students who indicated that they were affected because they were not accommodated on campus.

Figure 4.12: Students affected by lack of accommodation



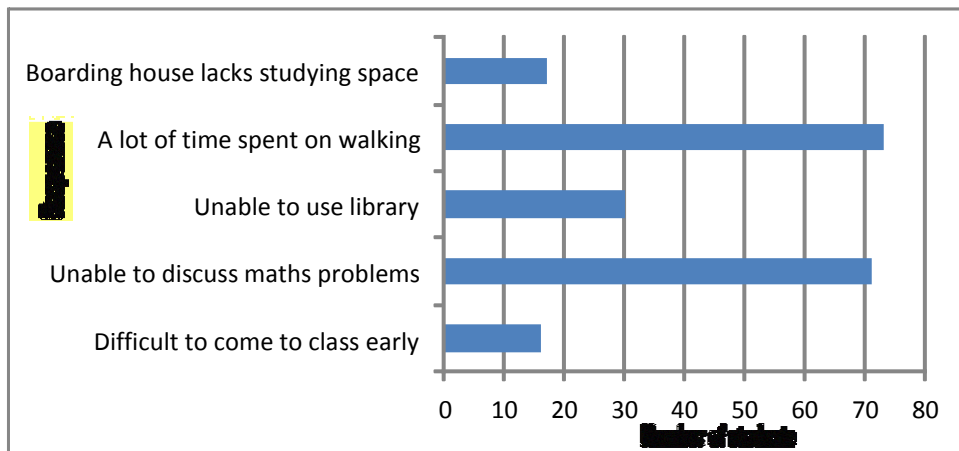
Source: Formulated by author

Of the 350 students that took part in the study, 235, that is 67.3% were not accommodated on campus. When these 235 students who were not accommodated on campus were asked if lack of accommodation affected their studies, 185 (representing 78.4%) responded that lack of accommodation affected them in many ways.

Students were asked to explain how lack of accommodation on campus affected their studies in mathematics. The most common five themes that emerged from their responses were: Boarding house lacks studying space, A lot of time is spent on travelling to and from campus, unable to discuss mathematics problems and assignments with their course mates and challenges encountered with public transport in the morning. This is a

challenge which students that live off campus face unlike those that live on campus. These themes are shown in Figure 4.13.

Figure 4.13: Lack of accommodation on campus and its effects



Source: Field Survey (2012)

To cut down on expenses, many learners that were not accommodated walked to campus. The majority of these students 73(31.1%) that were not accommodated indicated that they spent a lot of time and energy walking to campus and hence by the time they arrived on campus for their first lecture, they were tired and unable to concentrate on the proceedings of the lecture. At the end of the day, they walked back to the boarding house and arrived feeling tired again. During the focus group interview, one student remarked that:

“When I arrive on campus in the morning, I am already tired. In between lectures and during lunch time, students that are accommodated go back to their rooms to freshen up while I spend my time sitting on the bench near the School of Built Environment eating my cold packed lunch as I wait for my afternoon lecture”

A significant number of students 71(30.2%) who were not accommodated indicated that because they were not accommodated on campus, they were not able to consult or discuss mathematics problems with course mates in the evenings. They submitted that they were too busy during the day attending lectures to discuss with one another the problems they faced in mathematics, also it was reported that it was difficult to find course mates in the boarding house. Students indicated that they would like to use the library not only as a place for studying but also to make use of the fewer reference books that have been placed on short loan. Living in boarding houses was the reason why 30(12.8%) of the students indicated that they were not able to make full use of the library in the evenings as they feared to walk in the night. These students felt they were not making use of the library during the day because they were busy and during the night. The students that came to campus in the morning using public transport submitted that they faced a lot of challenges in the mornings with the system of transportation; hence they failed to be on time for the first lecture in the mornings. Other students 17(7.2%), submitted that the boarding houses where they lived lacked studying facilities. This made it difficult for students to study for a longer period when they walked back from campus because the rooms in the boarding houses were small and they lacked chairs and desks. As one student observed:

“My room in the boarding house has no chair or desk. I find myself falling asleep in a short period of time because I study while lying down on the bed”

4.3.4 Teaching and learning styles in Mathematics

This section begins by looking at the responses given by students on whether they practiced solving mathematics problems on their own and in groups. It looks at how free the students were able to participate in the learning process by asking questions and voicing their opinions. It concludes by looking at the activities that lecturers performed as they taught and the activities that learners usually engaged in during mathematics classes.

4.3.4.1 Students' Practices in Mathematics

Students were asked if they practiced solving mathematics problems on their own. They were also asked if they practiced solving mathematics problems in groups with other course mates. Table 4.10 shows the number and percentage of students who responded that they only practiced solving mathematics problems sometimes.

Table 4.10: Solving mathematics problems

Statement	Sometimes 1 st year (%)	Sometimes 2 nd year (%)	Sometimes 3 rd year (%)	Sometimes 4 th year (%)
I practice solving mathematics problems on my own	42(21.2)	19(20.9)	11(29.7)	4(16.7)
I practice solving mathematics problems in groups	119(60.1)	50(54.9)	27(73.0)	14(58.3)

Source: Field Survey 2012

Table 4.10 shows that 11(29.7%) third year students only practiced solving mathematics problems on their own sometimes. As for practicing solving mathematics problems in groups, 119(60.1%) first year students and 27(73.0%) third year students did this only sometimes.

4.3.4.2 Students' participation in class

Some of the ways in which students participated in learning were by asking questions freely in class, especially when they needed clarification and by voicing their opinions freely. Students were asked if they were allowed to ask questions and voice their opinions freely in class. Table 4.11 shows the percentage of students who responded that they were only allowed to ask questions and voice their opinions freely sometimes.

Table 4.11: Students' participation in class

Statement	Sometimes	Sometimes	Sometimes	Sometimes
	1 st year (%)	2 nd year (%)	3 rd year (%)	4 th year (%)
Allowed to ask questions in class freely	89(45.2)	18(19.8)	7(18.9)	6(25.0)
Allowed to voice opinions in class freely	86(43.9)	23(25.3)	6(16.7)	8(33.3)

Source: Field Survey 2012

One out of four, fourth year students indicated that they were only allowed to ask questions freely in class sometimes and almost half 89(45.2%) of the first year students indicated that they were only allowed to ask questions freely in class sometimes. During the focus group interview, some students observed that when they tried to ask questions during the lecture, they were told that:

“Go and ask your questions during tutorials, this is a lecture”

As for expressing their opinions in class freely, Table 4.11 shows that 86(43.9%) of the first year students indicated that they were only allowed to express their opinions in class freely sometimes.

4.3.4.3 Respect for the student

Students were asked if they thought that lecturers respected them as learners. The responses to the statement “Lecturer respects me as a learner” are shown in Table 4.12.

Table 4.12: Lecturer respects me as a learner

Year of study (%)	Strongly Disagree (%)	Disagree (%)	Strongly Agree (%)	Agree (%)
1	21(10.8)	26(13.4)	93(47.9)	54(27.8)
2	5(5.5)	2(2.2)	34(37.4)	50(54.9)
3	1(2.7)	0(0.0)	16(43.2)	20(54.1)
4	3(12.5)	0(0.0)	12(50.0)	9(37.5)

Source: Field Survey 2012

Like all learners, adult learners need to be respected, yet almost one out of four 47(24.2%) learners of mathematics in first year indicated that they were not respected by their lecturers.

4.3.5 Challenges encountered mainly by first year students

This section presents findings that were more prevalent among the first year mathematics students than any other category of students. In selected sections, students have been classified into two groups: first year students and non-first year students.

4.3.5.1 Learning in large classes

Second year students are sometimes exposed to large classes but it is mainly the first year classes that are large. Students were asked about their experiences of learning in a large class. In this study, a large class refers to a class that had more than one hundred and fifty (150) students managed by a single lecturer.

Learning in a large class has its own challenges particularly for someone who has been learning in a class of generally not more than forty (40) pupils since they started school. 180(90.4%) of first year mathematics students found learning in a large class a huge challenge and only 14(9%) of non-first year students cited learning in a large class as a challenge. During the focus group interview, one first year student observed that:

“In a large class, I feel shy to ask questions. I do not hear what the lecturer is saying neither do I see what the lecturer is writing when I am sitting at the back”

4.3.5.2 Pace of instruction

Students were asked about the pace of teaching by their lecturers. The study found that 181(90.7%) of first year students indicated that their mathematics lecturers were too fast when teaching and only 14(9.3%) of non-first year students indicated that their lecturers were too fast when teaching. As one first year student observed during the focus group interview:

“We are expected to listen and copy notes at the same time, but how can we do this when the lecturer is too fast? At secondary school, we were given time to listen first and

then time to copy”

4.3.5.3 Information overload

Information overload refers to a situation where the lecturer gives the students too much information in one lecture such that in most cases they end up just copying notes without understanding. Students were asked if they experienced information overload during their mathematics learning. The study found that 151(75.6%) of first year students indicated that they experienced information overload and only 1(2.2%) third year student indicated that they experienced information overload.

4.3.5.4 Teaching Additional Mathematics (ADMA) and Non-Additional Mathematics learners

Some students studied Additional Mathematics (ADMA) at secondary school while others did not. Students who had studied ADMA at secondary school had learnt the basics in topics such as calculus. On the other hand, course mates who had not studied ADMA at secondary school had no idea at all about such topics. Students were asked if they thought that their lecturer was not considerate with those that did not study ADMA at secondary school. All first year students indicated that their mathematics lecturers were not considerate with those who did not study additional mathematics at secondary school. During the focus group interview, a first year student observed that:

“I did not study additional mathematics at secondary school but when teaching some topics like differentiation and integration, our lecturer assumes that we all did these topics at secondary school and so he is very fast”

4.3.5.5 Lecturers' explanations

Students were asked what they thought about the way their lecturer explained the concepts and procedures of mathematics when teaching. Many students indicated that their lecturer did not explain well. In this study, “explain well” refers to a situation where if a student does not understand one method used by the lecturer to explain the subject matter, the lecturer should be in a position to use another method. The study found that 172(86%) first year students indicated that their lecturer did not explain well enough for them to understand. There was remarkable contrast with third year students in that all the third year students indicated that their mathematics lecturers explained well enough for them to understand.

4.4 CONCLUSION

This chapter presented the findings of the study. The first section looked at the conditions existing at CBU regarding the teaching and learning of mathematics. It was presented that SMNS coordinated the teaching of mathematics in all schools in the university since the lecturers in this school had an understanding of the theoretical basis of mathematics. The section that followed dealt with the challenges faced by lecturers as they taught mathematics and the chapter ended with challenges students faced as they learnt mathematics. The next chapter discusses the findings that have been presented in this chapter.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.0 INTRODUCTION

This chapter discusses the findings. In the discussion, the findings will be examined. The findings are discussed according to the objectives of the study. The objectives of the study were:

- To determine the teaching and learning conditions of mathematics at CBU
- To establish the challenges faced by CBU lecturers when teaching mathematics
- To identify the challenges faced by CBU students when learning mathematics

5.1 THE TEACHING AND LEARNING CONDITIONS OF MATHEMATICS

This section discusses the conditions existing at CBU regarding the teaching and learning of mathematics. It begins by looking at the qualifications of the lecturers who teach mathematics at CBU and the perceptions they hold about their teaching loads. It then looks at how tutorials in mathematics are conducted and ends by looking at how courses are conducted.

5.1.1 Qualifications of mathematics lecturers

A key component in fulfilling some of the roles of a higher institution of learning is having a core group of qualified staff at the institution. The lecturers of mathematics at

CBU as shown in Table 4.1 of Chapter 4 had the mathematics credentials necessary to demonstrate that they are qualified lecturers, both in terms of experience and academic qualifications. Five of them had taught for more than fifteen years at university level. These lecturers had the necessary mathematical knowledge for teaching because they had studied mathematics up to masters' level. Ferrini-Mundy et al (2001) describes mathematical knowledge for teaching as the mathematics which is used in teaching and valuable for teachers to know. Even though this may be the case, there was a shortage of staff in Real Analysis and Algebra.

5.1.2 Mathematics tutorials

Tutorial teaching is an educational experience that CBU offered to its first year learners consistently and at specific times. The tutorial times were clearly specified by the lecturers and the students were aware of these times. Even though tutorials were conducted consistently, they were sometimes conducted in groups of more than eighty students and this defeats the purpose of tutorials for there are elements which contribute to the effectiveness of tutorials. Some of the elements include students meeting individually or in small groups. When these elements are put in place, tutorials are an effective practice (Boylan, 2002) and tutored students achieve significantly higher grade average points, show greater passing rates and course completion rates (Hendriksen, 2005).

5.1.3 Lecturers' perception of their teaching load and completing the syllabus

The majority of the lecturers managed to complete the syllabus at the end of each academic year. However, there were some lecturers who failed to complete the syllabus because they taught longer hours than the recommended twelve hours per week. Teaching longer hours had also affected their ability to do research and publish as evidenced by one lecturer who said that he was too tired at the end of the day but the Dean of SMNS was of the opinion that carrying out research is a matter of individual attitude. Joyner (2012) concurs with lecturers that it is very difficult to do research during the academic year because of lack of time unless one uses the Christmas break and other breaks to do research. Teaching longer hours has also contributed to two lecturers failing to complete the syllabus at the end of the academic year because they reduce the pace of lecturing when they get tired after having many back to back lectures in a single day. This has implications: there is a lack of professional development on the part of the lecturer and the lecturer will inevitably continue teaching from textbooks rather than from research informed material or using foreign research. This could also be an indication that there is little time for consultations with students.

5.1.4 Consultations

Consultations between lecturers and learners in mathematics took place at CBU. Lecturers were available for consultations and many learners took advantage of this arrangement. Consultations between lecturers and learners in mathematics at a university are cardinal in the learning process. Learners have a diverse range of mathematical abilities. Some students can be inspired and motivated through consultations with their

lecturers. Consultations can also help lecturers to develop a strong rapport with learners and allow them to know learners on an individual basis. According to Belward (2009), the technique of consultation has proven to be very successful as learners no longer feel like another “face in crowd” and are more likely to attend lectures.

5.1.5 Accessibility to the library

A well stocked library is an important facility in any university. Dickenson (2006) posits that a library can be used as a quiet space for study, a place where students and lecturers may find traditional print resources, computers and other electronic resources. All registered learners had access to the main library. They were allowed to borrow books on presentation of their identity cards for two weeks and thereafter renewable once. The opening and closing times of the library for each day of the week were known by the learners. However, learners who lived off campus found it difficult to use the library in the night because of safety issues. At CBU the library was also a place which was used for studying but as some learners indicated, it was difficult to find a place where to sit because the library did not have sufficient seats.

5.1.6 Assessment in Mathematics Courses

Assessment is the heart of the learning process for it can offer a wider view of student needs and accomplishments. At CBU, assessment of all courses consisted of coursework and a written examination. Although it was stated that CA in each course consisted of at least two assessments in each term, some first year learners wrote only one test per term. Lecturers acknowledged this fact and attributed it to the large classes that they taught.

Giving one test in a term had implications. The first implication was that lecturers were in violation of senate rules which stated that assessment should consist of two tests in a term and the second implication was that this had a bearing on the purpose of assessment of coursework which was to provide feedback to learners on their progress and to encourage effort all year long. On some rare occasions, learners received feedback from their lecturers the following term.. Feedback to the learners served to identify problem areas and while to the lecturers it served to identify the degree to which instruction was successful and to identify needed changes in instruction (Yorke, 2003).

5.1.7 Availability of mathematics resources

Lecturers and learners were in agreement that CBU lacked the latest mathematics reference books and the latest mathematics journals. Lecturers indicated that there was a lack of mathematics resources at CBU. The lack of mathematics resources posed a challenge to the lecturers when they prepared their material for teaching. Lecturers also cited an inadequacy in the number of rooms where they were supposed to teach mathematics. The rooms that were available were poorly ventilated and had small boards which could not be cleaned easily. Learners acknowledged that the lack of such important resources in the library affected their studies in mathematics because they were not able to make use of such resources or borrow books from the library. Consequently, learners were forced to rely on their class notes. A useful summary of the literature attempting to show that library use contributes to academic success form the basis of research conducted at the University of Cape Town. This study found that learners who did well in their examinations tended to borrow more books from the library than those that did not

(de Jager, 2002). The statistical analysis showed that the circulation of library materials indeed correlated significantly with academic achievement leading to the deduction that undergraduate students who used their library a lot, also did well in their examinations (de Jager, 2002).

5.1.8 TEACHING METHODS

What happens in the classroom has an impact on the students' opportunity to learn. There is some evidence that different teaching styles can have different impacts on student achievement and that the choice of teaching approaches can make an important difference in a student's learning (Wentzel, 2002). The most common teaching method used at CBU is the lecture method. In this method, the main activity of the learners was copying notes and trying to keep pace with the lecturer's explanation. During an interview one lecturer observed that: *"In the lecture method, my feeling is that due to lack of active participation by the learners, it is difficult to find out how well they have understood what has been taught"*. It was evident that the majority of the lecturers of mathematics at CBU relied heavily on the traditional mathematics instruction in which students passively 'absorbed' information from them for the findings indicate that ten out of eleven lecturers (91%) usually used the lecture method. Although the lecture method could be an effective and efficient teaching method, it allowed for little or no learner verbal participation. This was consistent with what one of the lecturers had observed. Learning was an active process but the lecture method among other things tended to foster passivity. Consequently, it failed to provide the lecturer with an opportunity to estimate learners' progress before an examination. The study revealed that when teaching mathematics at CBU, the main

activities lecturers engaged in were explaining facts and working out examples on the board while students hastily copied notes from the board at the same time listening to the lecturer explaining facts. Although the majority of the lecturers used the lecture method, it was a teaching method most of the lecturers least enjoyed than any other. This indeed was a contradiction. One lecturer observed that the students were not active participants in the lecture method and another observed that the method was 'one-sided' mostly. This finding was consistent with the report of Rosenthal (1995) who found that advanced mathematics and other theoretical sciences taught purely using the lecture method promoted passivity and isolation in students. He reported that many potentially successful students became uninterested in mathematics and failed to learn it well or to enrol in subsequent courses in the traditional lecture approach to the teaching of mathematics.

Most mathematicians agreed that the best way to learn mathematics was by actively doing mathematics, by discussing it with others and by synthesizing major ideas (Rosenthal, 1995). Waterhouse (1990) identified two basic characteristics: an emphasis on learning by doing and an emphasis on student decision making. Kyriacou (1992) described it as the use of learning activities where pupils were given a marked degree of ownership and had a control over the learning activities used. When students participated in the learning activities, the knowledge they gained became the students' own product. In other words, students were allowed to construct their own understanding. This could not be the case in the lecture method.

5.1.9 Budgetary allocation to the School

The School of Mathematics and Natural Sciences (SMNS) received meagre funding from Central Administration. This situation presented challenges to lecturers as they taught mathematics. It entailed that the school could not afford to subscribe to online journals, purchase reference books, latest mathematics software packages and latest mathematics journals. Because of the meagre resources, the school failed to employ tutors for all the learners except for those studying in first year.

5.2 CHALLENGES FACED BY CBU LECTURERS WHEN TEACHING MATHEMATICS

This section presents the challenges faced by lecturers as they teach mathematics. The majority of the lecturers believed that students at CBU did not practice solving mathematics problems on their own or even in groups. It then looks at how budgetary constraints, lack of mathematics resources and lack of a positive attitude towards mathematics by the learners posed a challenge to the lecturers as they taught mathematics.

5.2.1 Students' Practices in Mathematics

Eight out of eleven lecturers of mathematics indicated that students at CBU did not practice solving mathematics problems and indeed 42(21.2%) and 11(29.7%) of first and third year learners respectively agreed that they only practiced solving mathematics on their own sometimes. As for solving mathematics problems in groups, 119(60.1%) of first year learners and 27(73%) of third year learners only do it sometimes. Some

lecturers indicated that because learners did not practice solving mathematics problems on their own or indeed even in groups, this put a strain on them because learners waited for the lecturers to do everything for them. It was of paramount importance to discuss and practice solving mathematics problems in small groups. Small groups provided a social support mechanism for the learning of mathematics. It provided a forum in which students asked questions, discussed ideas, made mistakes, learnt to listen to others' ideas, offered constructive criticism and summarised their discoveries in writing (NCTM, 1989).

Learners could persuade one another why using a certain method to solve a problem had more merits than the other. For example, when learners practiced solving mathematics problems in groups, they learnt to advance logical arguments on why integrating by substitution would be preferable to integrating by parts when solving certain mathematics problems. Discussing mathematics in groups could boost their confidence. Studies had shown not only positive effects of discussing mathematics in small groups in the following areas: academic achievement, self esteem or self confidence as a learner but also that group work kept learner interest and improved learner performance (Davidson, 1990).

5.2.2 Attitude of learners towards mathematics

Lecturers of mathematics at CBU believed that one of the biggest challenges they faced as they taught mathematics was the lack of a positive attitude towards mathematics by learners. Aiken (2000) reported that in order to lessen challenges in the learning of

mathematics, an individual needed not only to have a positive attitude towards mathematics but also be intrinsically motivated to study mathematics. Although 166(84.7%) first year learners disagreed with the statement: “I am not naturally good in mathematics”, we cannot ignore the 34(15.3%) who agreed that they were not naturally good in mathematics. Neither can we ignore the 49(25%) who indicated that they were not confident in mathematics. A learner needs to be self confident in mathematics in order to overcome the challenges faced by learners as they study mathematics (Tapia, 2004). Yet one out of four learners in first year as shown in Chapter four was not confident in mathematics.

Aiken (1970) found significant relationship between attitudes towards mathematics and achievement. Specifically, he showed that attitudes and achievement in mathematics were reciprocal. Students who had better attitudes towards mathematics demonstrated higher achievement and students who had higher achievement exhibited better attitudes. The implication of the results of Aiken’s study was that students who exhibited a negative attitude towards mathematics will have a lower achievement. Gal and Ginsburg (1994) found that negative attitudes and beliefs about statistics could impede the learning of statistics.

5.2.3 Mathematics foundation and preparedness to study mathematics

The majority of the mathematics lecturers indicated that learners at CBU had a poor foundation in mathematics from secondary school and that the mathematics offered at secondary school did not prepare them adequately for the mathematics offered at the

university. Eighty (41%) first year learners as presented in chapter four were in agreement with the lecturers that the mathematics they studied at secondary school did not prepare them adequately for the mathematics that they met at university. This finding concurs with Rylands and Coady (2009) who reported that in recent years, universities and colleges across the globe have found that their learners do not have sufficient ‘mathematical’ background to deal with their first year mathematics courses and because of this, universities and colleges have seen an increase in failure rates. A lecturer at CBU reported that it was a challenge to introduce a higher concept as learners had a weaker background in mathematics from secondary school. This finding was not peculiar to CBU, for the challenges of addressing under preparedness for university mathematics studies continue and had also been reported internationally (Ulovec, 2006).

5.3 CHALLENGES FACED BY CBU STUDENTS WHEN LEARNING MATHEMATICS

This section presents the challenges faced by CBU students when learning mathematics. It begins by looking at transition from secondary school and the learning environment found at the university. It discusses the preparedness of the learners to study mathematics at the university and the physical classroom environment. The section ends by discussing lack of accommodation on campus and learners’ participation in class.

5.3.1 Transition and freedom

Adjusting to a new life at CBU is not easy for a first year student. When learners arrived at the university, they seemed to find “freedom” to do many things that they were not

allowed to do at secondary school. During the focus group discussion, one learner observed that: *“Here at the university, there is no one to monitor or force me to attend classes, there is no one to force me to write a test when I feel I am not ready”*. This was a new phenomenon to first year students. As a result, university freshmen saw the initial semester as a period of transition in which they adjusted to new routines, to independence and to increased academic demands (Chase, 1968). Transitioning from secondary school to university came with a lot of challenges. Although 138(40%) learners indicated that this apparent “freedom” never interfered with their studies, we cannot ignore the majority of the learners 210(60%) who indicated that this “freedom” interfered with their studies. This finding was consistent with Boyer (1986) who reported that the transition was not a smooth one. Students move from a structured parent-disciplined life to a self-disciplined university life. Methods of teaching were different too. One student had observed that at secondary school they were given time to listen first and then time to copy notes. In fact they were chided if they attempted to write notes while the teacher was explaining.

5.3.2 Mathematics foundation and preparedness to study mathematics

Seven (64%) lecturers disagreed with the statement that “secondary school mathematics prepared learners adequately for university mathematics” and 130(37%) of the learners indicated that secondary school mathematics did not prepare them adequately for the rigours of university mathematics. The perception of 8(73%) lecturers was that learners at CBU had a poor foundation in mathematics from secondary school and that the mathematics offered at secondary school did not prepare them adequately for the mathematics offered at university. Teaching mathematics to a group that was under

prepared came with a lot of challenges for the lecturer. In mathematics, background knowledge matters because mathematics is cumulative. New material builds upon the previously covered material.

5.3.3 Physical classroom environment

Twenty one (11%) of first year learners indicated that there was never enough furniture for all to sit on and 32(16%) of first year learners indicated that they were never able to hear clearly what their lecturers were saying when sitting at the back. One of the lecturers who taught a first year class observed that: *“I do not think that all my students hear me clearly since there are no public speaking systems in the lecture rooms”*. The physical arrangement of the classroom could serve as a powerful setting for providing learners effective instruction and facilitate (or inhibit) positive teaching or learning interactions. All learners should have a clear view of the teacher and vice versa at all times and personal spaces that each learner can call his or her own (Rinehart, 1991). A well structured classroom tends to improve student academic and behavioural outcomes (MacAuley, 1990). At CBU some learners were not able to hear clearly what the lecturer was teaching when sitting at the back of the room for there was no public address system in their rooms. Neither were they able to see clearly what the lecturers wrote on the board when sitting at the back of the room. Boards were small and could not easily be cleaned. Both lecturers and learners indicated that some rooms were poorly ventilated and did not have enough seats for everyone. If a classroom is not properly organised to support the activities a lecturer has planned, it can limit what and how students learn. However, a

well arranged classroom environment is one way to effectively manage instructions for it establishes a climate conducive to learning.

5.3.4 Availability of accommodation on campus

Of the 350 learners that took part in the study, 235(67%) lived off campus. When the 235 learners were asked if lack of accommodation affected their studies, 185(78%) responded that living off campus indicated that they spent a lot of time and energy walking to and from campus and 71(30%) indicated that they were not able to discuss mathematics problems with course mates in the evenings. One learner remarked that: *“When I arrive on campus in the morning, I am already tired. In between lectures and during lunch time, learners that are accommodated go back to their rooms to freshen up while I spend my time sitting on the bench near the School Of Built Environment eating my cold packed lunch as I wait for my afternoon lecture”*. Living off campus was likely to have an effect on their academic performance for De Araujo and Murray (2000) reported that living on campus does have an immediate positive effect on academic performance. To determine why learners that live on campus perform better, De Araujo and Murray found no evidence to show that learners who live on campus used university resources differently than learners who live off campus. However, they found significant evidence that showed that students who lived on campus performed better because they spent more time studying along with roommates and learners in their same classes. This finding by De Araujo and Murray is consistent with Pascarella and Terenzini (2005) who reported that there is a large significant improvement with student retention rates, grades and four year graduation rates for those who live on campus.

5.3.5 Respect and learners' participation in class

Participation in class is an extremely crucial element for learning. There are benefits when learners are encouraged to ask questions and express their opinions freely in class. Learners are more motivated, learn better and become better critical thinkers (Wade, 1994). Participation can come in many different forms, including learners' questions and opinions that are expressed in class. Wade (1994) considered the "ideal class discussion" as one in which learners participate by way of asking questions, expressing their opinions and are interested, learning and listening to others' comments and suggestions. A conducive learning environment for learners of all ages is created when learners are respected by their lecturers and they feel free to ask questions and express their opinions in class (Lieb, 1991). Yet almost one out of four, that is, 47(24.2%) learners of mathematics in first year indicated that they were not respected as learners by their lecturers and almost half, that is, 89(45.2%) of first year learners indicated that they were only allowed to ask questions freely in class sometimes and were on some occasions told not to ask questions in class but to go and ask in the tutorial sessions. The classroom should be a safe place where honest attempts to ask questions and express opinions are supported and encouraged.

5.3.6 Challenges encountered mainly by first year students

This section deals with challenges encountered mainly by first year students. Notable is the observation that the situation improves as students progress beyond their first year. The classes become smaller and students become accustomed to the pace of instruction.

The challenge of information overload becomes manageable and they are able to understand better the explanations by their lecturers.

5.3.6.1 LARGE CLASSES

Second year students are sometimes exposed to large classes but it is mainly the first year classes that are large. In this study a large class refers to a class that had more than 150 students managed by a single lecturer. One Hundred Eighty (90.4%) of first year students cited learning in a large class as a huge challenge. During the focus group discussion, a first year student observed that: *“In a large class, I feel shy to ask questions. I do not hear what the lecturer is saying, neither do I see what the lecturer is writing when I am sitting at the back”*. Although large classes were popular as an efficient and cost effective way to teach large numbers of students, basic facts about teaching allude to the fact that to teach was to engage students in learning, thus teaching consisted of getting students involved in the active construction of knowledge. The aim of teaching was not only to transmit information but also to transform students from passive recipients of other peoples’ knowledge into active constructors of their own and others’ knowledge. The lecturer standing in front of more than one hundred and fifty students cannot transform learners effectively without their participation. Much research does recognise large class size as a deterrent to student engagement (Murdoch & Guy, 2000). It is difficult to motivate students in a large class and to actively engage students in learning.

The large class experience challenges the first year student for whom learning in a class with more than one hundred and fifty other students is a new experience. Many students

in large classes feel too intimidated to ask questions as shown in chapter four. One hundred and thirty one (67.2%) first year students felt intimidated learning in a large class. This finding was in agreement with McLeod (1998) who found that students felt intimidated learning in a large class. In large classes, some students felt anonymous and unknown. That is why it was easy, as one student had shared in the focus group interview to walk away unnoticed from a lecture.

5.3.6.2 PACE OF INSTRUCTION

The majority of first year learners of mathematics 181(90.7%) indicated that the pace of instruction by their lecturers was too fast and only 14(9.3%) of non-first year learners indicated that the pace of their lecturers was too fast. The response by first year students that their lecturers were too fast could be ascribed to the change in the method of instruction that the students had been accustomed to in secondary school. Students had been accustomed to being given time to listen first and then copy notes after the explanation. Upon entering university, students encountered a new method of learning where they were expected to listen and take note of the main points or write notes simultaneously.

5.3.6.3 INFORMATION OVERLOAD

The majority of mathematics learners in first year 151(75.6%) indicated that they received too much information in one lecture such that they experienced frustration, became discouraged and subsequently just copied notes without understanding them. Students became accustomed to the method of teaching at the university as they advanced

beyond first year for only 1(2.2%) third year student indicated that they received too much information in one lecture.

5.3.6.4 ADMA AND NON-ADMA LEARNERS

There was a diversity of the student population in the lecture room, particularly for first year learners. There were some who studied ADMA in secondary school and others who did not. The lecturer treated them all equally and taught them all at the same pace like they had the same background in mathematics. It was not surprising that a large number of first year students indicated that their lecturer was not considerate with those who had not studied ADMA. It could be helpful to vary teaching methods as the students did not have the same background in mathematics.

5.3.6.5 LECTURERS' EXPLANATIONS

The majority of learners of mathematics in first year, that is, 172(86%) indicated that their lecturers did not explain sufficiently well for them to understand when asked questions by learners. This response could be ascribed to the different teaching and learning methods that they were being exposed to in the university. As they progressed beyond their first year of study, they became accustomed with the manner in which lecturers explained the concepts.

5.4 CONCLUSION

This chapter presented a discussion of findings yielded by this study. The lecturers of mathematics have the necessary credentials for teaching mathematics even though there

was a shortage of staff in the area of Real Analysis and Algebra. Teaching and learning in large classes, particularly in first year continues to be a source of challenge for both lecturers and learners.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 INTRODUCTION

This study investigated the conditions that exist at CBU regarding the teaching and learning of mathematics, the challenges CBU lecturers face when teaching mathematics and the challenges CBU students face when learning mathematics. This chapter starts with a brief summary or synopsis of the study before presenting the conclusion and recommendations. It ends with suggestions on the possible area for future research.

6.1 SUMMARY

The study investigated the challenges of teaching and learning of mathematics at CBU. It looked at the conditions that existed at CBU regarding the teaching and learning of mathematics, the challenges that CBU lecturers faced when teaching mathematics and the challenges that CBU students faced when learning mathematics. The study was guided by a framework consisting of five domains which included effective teaching and learning styles for mathematics, mathematical knowledge for teaching, mathematics foundation and transition, attitude and a conducive learning climate. The research approach was qualitative, descriptive and contextual. This approach was appropriate in capturing the perceptions of both the lecturers and the learners. The target population consisted of all the mathematics lecturers and learners of mathematics and purposive sampling was used

to select a sample. Questionnaires, interviews and focus group discussions were used in the data collection process of the study. The data collected was analysed using SPSS and Microsoft Excel.

6.2 CONCLUSION

The conclusion is presented under the following headings: Conditions existing at CBU regarding the teaching and learning of mathematics, Challenges faced by lecturers when teaching mathematics and Challenges faced by students as they learn mathematics.

6.2.1 The teaching and learning of mathematics at CBU

The study has established that teaching and learning conditions at CBU were partially conducive. The Lecturers were appropriately qualified with satisfactory experience. The Institution had infrastructure for teaching and learning; a library, lecture rooms, tutorial rooms and accommodation for students. The University also had adequate administrative and academic systems in place. However, the staffing levels in all fields of mathematics especially in Algebra and Real Analysis were low and this tended to put a strain on the few lecturers. This was compounded by large numbers of students in lecture rooms and tutorials. Although tutorials were conducted consistently for first year learners, these were not effective due to large groups. Tutorials were rarely conducted for the other students in higher years.

Also due to this scenario some requirements in some courses were not fulfilled, not to mention delayed or poor feedback on tasks given to students. The lecture method was dominant at the institution largely due to these conditions. Also the infrastructure though

available was not suitable or appropriate for a university as most of the existing buildings were built for a different purpose. Further, the mathematics resources were inadequate and in some cases totally unavailable and this was also true for the library.

6.2.2 Challenges faced by CBU lecturers when teaching mathematics

The study established that students did not practice solving mathematics problems on their own neither did they practice solving mathematics problems in groups. This tended to put a strain on the lecturers because learners waited for lecturers to do everything for them. Lack of a positive attitude by the learners towards mathematics and a lack of confidence in mathematics coupled with the belief that mathematics was for a select few did not help matters. Further, the students had a poor foundation in mathematics from secondary school and the mathematics learnt in secondary school did not prepare them adequately for the mathematics that they encountered at the university.

6.2.3 Challenges faced by CBU students when learning mathematics

The study established that transitioning from secondary school to university came with a lot of challenges. When students arrived at the university, they seemed to find “freedom” to do many things that they were not allowed to do at secondary school. Students moved from a structured parent-disciplined life to a self-disciplined university life. Methods of teaching were different too. Lecture rooms were poorly ventilated and some learners were not able to hear clearly what their lecturer was teaching when sitting at the back, neither were they able to see clearly what their lecturers wrote on the board when sitting at the back. Students living off campus could not discuss mathematics problems with

their course mates in the evenings. In class, students were not allowed to ask questions freely and first year students were intimidated learning in a large class and could not cope with the pace of instruction by their lecturers.

6.3 RECOMMENDATIONS

The following are the suggested recommendations:

6.3.1 Mathematics Resources

This study recommends that both lecturers and students have access to the latest mathematics reference books, journals and mathematics software. These resources must be acquired to meet the expectations of the lecturers and learners. Although CBU is a member of many on-line publications, it has not paid subscription fees for some of them, hence difficulties are encountered in accessing these sites.. It is recommended that CBU updates its membership so that lecturers and students have links to electronic journals that are scholarly without cost. CBU needs to stock the library with the latest mathematics resources. Research shows that well stocked libraries are a catalyst for better performance.

6.3.2 Infrastructure Development

CBU was initially constructed as a college to offer certificates and diplomas. It has now developed into a fully fledged, internationally recognised university catering for a large number of students. It is therefore necessary to build modern lecture rooms equipped with

sufficient furniture and audio-visual equipment. Students are not able to hear clearly the lecturer in some of the large classes where lectures are conducted.

There is need to build more hostels for students on campus as undeveloped land is still available around the campus. This will enable students to consult and attend group discussions with course mates in the evenings and during weekends. Consequently, this will save the students the energy and time they spend walking to and from campus each day. It is clear that the library is no longer able to provide studying space for all its users. The study recommends that another library is built if the existing one cannot be expanded.

6.3.3 Teaching Methods

Students spend most of their time during mathematics lectures listening to the lecturer explaining mathematical facts and copying notes from the board. It is agony for many students to match the pace of the lecturers, hence they end up just copying notes without understanding them. The lecturers could be using the lecture method because of the large classes that are involved. Clearly, the majority of the lecturers are not fond of the lecture method yet they use it. Current trends are toward learner centred teaching methods. The study therefore recommends that lecturers consider switching from one-way lecturing to strategies that create opportunities for students to actively participate in the lecture.

6.4 AREA FOR FUTURE RESEARCH

This study investigated the challenges of teaching and learning mathematics at CBU. It would be worthwhile to replicate this research at other tertiary institutions in Zambia.

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8.	I only learn mathematics because I need it to get my degree	1	2	3	4
9.	Mathematics is relevant to my future career	1	2	3	4
10.	I am happier in a mathematics class than in any other class	1	2	3	4
11.	I am confident in maths	1	2	3	4
12.	The lecturer respects me as a learner	1	2	3	4
13.	Maths at high school prepared me adequately for maths at university	1	2	3	4
14.	There are relevant maths reference books in the library	1	2	3	4

SECTION B.

Read each question carefully and then decide how often what you have selected happens.

Please use the following symbols: 1 = Never (N); 2 = Sometimes (S); 3 = Often (O); 4 = Always (A)

		N	S	O	A
1.	In the largest class you attend, is there enough furniture for every one?	1	2	3	4
2.	Do you feel intimidated learning in a large class?	1	2	3	4
3.	In the largest class, can you hear clearly the lecturer from where you are?	1	2	3	4
4.	Are you allowed to ask questions in class?	1	2	3	4
5.	Are you allowed to voice your opinions in class freely?	1	2	3	4
6.	Are tutorials in maths conducted?	1	2	3	4
7.	Do you practice solving maths problems (not assignments) on your own?	1	2	3	4

8.	Do you practise solving maths problems in groups?	1	2	3	4
9.	Does the 'freedom' found at the university interfere with your studies?	1	2	3	4

SECTION C

Please respond to all questions by drawing a neat circle around an appropriate number or by writing your answer in the space provided.

1. Are you accommodated on campus? Yes 1 No 2

If your answer to question 1 is YES, go to question 4

2. Does lack of accommodation on campus affect your studies in maths?

Yes 1 No 2 If your answer is No, go to question 4

3. Explain how lack of accommodation affects your studies in maths.

4. During maths lectures, what activities do your lecturers **usually** engage in? You can circle more than one.

Explaining facts 1 Asking questions 2

Answering questions from students 3 Giving instructions 4

Commenting on students' questions 5 Listening to students explanations 6

Working out questions on the board 7

Others (specify) _____

5. What activities do you as students **usually** engage in during maths lectures? You can circle more than one.

Listening to lecturer's explanations 1 Answering lecturer's questions 2

Answering fellow students' questions 3 Asking lecturer questions 4

Asking fellow students questions 5 Copying notes 6

Listening to fellow students' explanations 7

Others (specify) _____

6. List challenges you face at CBU as you learn maths.

Thank you for your participation. End of questionnaire.

Dear Respondent,

The purpose of this questionnaire is to gather information concerning the challenges faced by lecturers as they teach mathematics at CBU. The information gathered will be for academic purposes and therefore will be treated with anonymity and confidentiality. You **do not** need to write your name on the questionnaire.

LECTURER'S QUESTIONNAIRE

SECTION A

Please respond to all statements by drawing a neat circle around an appropriate number.

1. Your gender Male Female
2. Your highest qualification in mathematics
BA/BS BA Ed/BSc Ed MSc MSc Ed/MEd PhD
3. Years of experience in teaching mathematics at the university level
0 – 5 6 – 10 11 – 15 Above 15

SECTION B

Read each statement below carefully and then decide how strongly you agree or disagree with each statement. Circle around an appropriate number.

*Please use the following codes: 1 = Strongly Disagree (SD); 2 = Disagree (D); 3 = Agree (A)
4 = Strongly Agree (SA)*

		SD	D	A	SA
4.	My teaching load is within the recommended bracket	1	2	3	4
5.	Students do not practice solving mathematics on their own	1	2	3	4
6.	Mathematics resources (reference books) are available	1	2	3	4
7.	Students have a positive attitude towards mathematics	1	2	3	4
8.	Students have a negative attitude towards mathematics	1	2	3	4
9.	Students have a poor foundation in mathematics from secondary school level	1	2	3	4
10.	Secondary school mathematics prepares the students adequately for university mathematics	1	2	3	4

Read each statement or question carefully and then decide how often what you have selected happens. Please use the following codes: 1 = Never (N); 2 = Sometimes (S); 3 = Often (O); 4 = Always (A).

		N	S	O	A
12.	Tutorials in mathematics are given	1	2	3	4
13.	I do manage to complete the syllabus at the end of each academic year	1	2	3	4
14.	Lecture rooms for mathematics are available	1	2	3	4
15.	Furniture for all students in mathematics lecture rooms is available	1	2	3	4

SECTION C

Please respond to all questions by drawing a neat circle around an appropriate number or by writing your answer in the space provided.

1. Which method(s) of teaching do you **usually** use in your teaching of mathematics?

Discussion Directed discovery Guided discovery
 Free discovery Lecture Question and answer

Other (specify) _____

2. Which method(s) of mathematics teaching in question 1 do you enjoy **most** in your mathematics teaching?

(Respond by writing numbers if your answer above is between 1 and 6)

3. Which method(s) of maths teaching in question 1 do you **least** enjoy in your mathematics teaching?

4. In your opinion, can the challenges faced by students in mathematics be affected by the teaching method which you use?

Yes No

Explain _____

5. During mathematics lectures, what activities do you **usually** engage in?

- | | | | | | |
|-------------------------------------|--------------------------|---|-----------------------------------|--------------------------|---|
| Explaining facts (talking) | <input type="checkbox"/> | 1 | Asking questions | <input type="checkbox"/> | 2 |
| Answering questions from students | <input type="checkbox"/> | 3 | Commenting on students' questions | <input type="checkbox"/> | 4 |
| Listening to students' explanations | <input type="checkbox"/> | 5 | Giving instructions | <input type="checkbox"/> | 6 |
| Working out questions on the board | <input type="checkbox"/> | 7 | | | |

Other (specify) _____

6. List challenges you face as you teach mathematics at CBU.

Thank you for your participation. End of questionnaire.

INTRODUCTION

The purpose of this interview is to gather information concerning the challenges faced by students as they learn mathematics at CBU. The information gathered will be for academic purposes and therefore will be treated with anonymity and confidentiality. Your participation is greatly appreciated.

INTERVIEW GUIDE FOR THE STUDENTS

1. Do you have access to the library?
 - a. What are the opening and closing times of the library?
 - b. How long are you allowed to borrow books?
2. Are there relevant mathematics reference books in the library? If so, are they adequate?
3. Are tutorials conducted? If the answer is Yes,
 - a. Where are they conducted? are the premises adequate?
 - b. How many times per week?
 - c. Are the tutorial times specified?
4. Are lecturers available for consultations? If the answer is Yes, are consultation times given to you?
5. How many lectures of mathematics do you have per week? how long is each lecture?
6. How many mathematics tests do you write per term? how long does it take to have feedback from your lecturer?
7. How many assignments are you given per term? how long does it take to have feedback from your lecturer?
8. How is the continuous assignment administered? are you allowed to sit for end of year examinations irrespective of the mark you get as CA?
9. Does the 'freedom' found at the university interfere with your studies, that is
 - a. Does the apparent lack of a class monitor interfere with your studies? If the answer is Yes, explain.
 - b. Does the apparent lack of a class register to monitor class attendance interfere with your studies? If the answer is Yes, explain.

10. a. Do you practice solving mathematics problems on your own? If the answer is NO, why?
b. Do you practice solving mathematics problems in groups? If the answer is NO, why?
11. Are public convenience rooms available near the lecture rooms?
12. Does your lecturer respect you as a learner? Does he/she listen to your opinion in class?
13. Do you think mathematics at secondary school prepared you for mathematics at the university?
14. In the largest class you attend, is there enough furniture for everyone?

INTRODUCTION

The purpose of this interview is to gather information concerning the challenges faced by lecturers as they teach mathematics at CBU. The information gathered will be for academic purposes and therefore will be treated with anonymity and confidentiality. Your participation is greatly appreciated.

INTERVIEW GUIDE FOR THE LECTURERS

1. Are there adequate, relevant mathematics reference books in the library? If your answer is No, how does this affect your teaching of mathematics?
2.
 - a. Are you available for consultations with the students? If the answer is Yes, how many times per week?
 - b. How long on average do you spend with each student?
 - c. Do you have specific times when you meet the students? If the answer is Yes, do the students know these specific times?
3. Do students make appointments to see you? If the answer is Yes, how long on average do you spend with each student?
4. What is the recommended teaching load in the university? Is your load within this bracket?
If your load is not within the recommended bracket, does this affect your efforts to carry out research and publications?
5. In the largest class that you teach, are the students able to hear you clearly from all parts of the lecture room?

INTRODUCTION

The purpose of this interview is to gather information concerning the challenges faced by the lecturers as they teach maths and the challenges faced by the students as they learn mathematics at CBU. The information gathered will be for academic purposes and therefore will be treated with anonymity and confidentiality. Your participation is greatly appreciated.

INTERVIEW QUESTIONS FOR THE DEAN OF THE SCHOOL OF MATHEMATICS AND NATURAL SCIENCES (SMNS).

1. What is the role of SMNS at CBU?
2. How many mathematics lecturers are currently available at CBU?
3. How many mathematics lecturers are needed for the school to operate at full strength?
4. If there is a shortage of mathematics lecturers at CBU, how does this affect the teaching of mathematics in relation to the following:
 - a. research
 - b. publications
 - c. others (specify)
5. Does SMNS teach all the mathematics courses in the university?
If Yes, what are the advantages and disadvantages of doing so?
If No, what are the advantages and disadvantages of doing so?
6. Is the budget allocation to SMNS adequate?
If No, explain how it affects the teaching of mathematics.
7. Do lecturers in SMNS get opportunities to attend professional conferences?
If Yes, how often?
If No, why?
8. What is the situation of mathematics teaching resources in the school?
10. What challenges, if any, do lecturers face as they teach mathematics at CBU?
11. What challenges, if any, do students face as they learn mathematics at CBU?
12. How many professors of mathematics do you have in SMNS?

Thank you for your participation. End of interview.

