MEd in Open and Distance Learning

TITLE: Exploring the Prevalence of Developmental Dyscalculia amongst distance education students at the Namibian University of Science and Technology.

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Open Rubric

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LIST OF ACRONYMS

ADHD	Attention Deficit Hyperactivity Disorder
CAI	Computer Aided Instruction
CAL	Computer Assisted Learning
COLL	Centre for Open and Lifelong Learning
ICT	Information Communication and Technology
MLD	Mathematics Learning Difficulty
NUST	Namibia University of Science and Technology
ODL	Open and Distance Learning
SLD	Specific Learning Difficulty
UK	United Kingdom
USA	United States of America

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Abstract

This qualitative study sought to investigate the misconceptions related to the low Mathematics pass rate of the distance education learners at the Namibia University of Science and Technology (NUST). The researcher suspects that the low pass rate might be due to Dyscalculia, a Mathematics Learning Disability. Therefore, this study examines the symptoms of Dyscalculia in adults, identifies other learning difficulties that are associated with Mathematics and suggests appropriate learning support strategies. The population of this study was 131 distance education students, aged 25 years and above, enrolled for basic mathematics. The purposive sampling method was used, and the data collection methods were interviews and an open-ended online questionnaire. Data were analysed using thematic analysis technique. The findings revealed that some of the symptoms of Dyscalculia in adults include the lack of mastering basic mathematics skills, have difficulty in understanding mathematical vocabulary and have difficulty in the retrieval of arithmetic facts, amongst others. The findings illustrate that Dyscalculia may be an attributing factor towards the low pass rate in Mathematics and that a holistic learning support approach should be used; this entails early identification and screening for specific learning disabilities.

KEY TERMS

Dyscalculia, Open and Distance Learning, Mathematics Learning Difficulties and Disabilities, Adult Learners, Learning Support,

CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Mathematics is one of the most important subjects in the Namibian curricula. While some people believe that mathematics is “fun” others regard it as “a no-go area”. In my more than fifteen years’ experience of dealing with Mathematics at schools, Vocational Education institutions and higher education institutions as an academic administrator, I have observed that mathematics is a word that sparks fear and anxiety in many students, especially those in higher education. I believe that this ‘anxiety’ has a negative impact on the performance of higher education students in general, and adult learners in open and distance learning institutions in particular; such as Namibia University of Science and Technology. I believe that these ‘mathematics anxiety’ attacks can also lead to detrimental consequences on students’ lifelong learning endeavours as well as future career prospects. For example, many Namibian educational learning institutions experience low pass rates in mathematics. According to Gamundani and Jegede (2015:59) Namibia currently has a mathematics failure rate of 39%, mainly due to children not being good at maths (Booysen 2019:1). This is unacceptable as it has negative effects on the admission of students into higher education and the progression of students that are enrolled for mathematics at higher learning institutions (Gamundani and Jegede 2015:59). One of the biggest challenges is that educators do not know the exact cause of the low pass rates within the mathematics-related subjects, like Basic Mathematics, because not much research has been done to fully understand issues related to various maths difficulties. Most often, speculations are that students do not study, or they just cannot do maths. However, literature indicates that lack of motivation, poor teaching, maths phobia and maths anxiety are some of the reasons students may not do well in maths. One of the most talked about topics among these is anxiety. According to Sokolowski and Ansari (2017:n.d.), people with maths anxiety “believe that they are bad at maths and because of this, they do not like maths. These feelings lead them to avoid situations in which they must do maths”. These authors go on to point out that adults with maths anxiety are less likely to show interest, enter, and succeed in careers relating to science, technology, engineering and mathematics (STEM).

Furthermore, Alamu and Taiwo (2014:113-114) point out that the aspect of anxiety and fear that is associated with maths, is the most serious limitation to education and affects the individual's ability to manipulate numbers and solve mathematical problems associated with everyday life and academic situations." It affects many individuals through feelings of tension, apprehension or fear thereby affecting the individual's ability to manipulate numbers and solve mathematical problems associated with everyday life and academic situations (Aremu and Taiwo 2014:113-114). Another view is that mathematics anxiety is caused by the "inability (or unwillingness) to complete difficult assignment, negative prepositions of parents, and even the maths teacher" (Smith, 2004:7). In addition to the observations by Smith (2004) and, Aremu and Taiwo (2014), Mokotjo, (2017) points out that mathematics anxiety is often linked with a learning disability referred to as dyscalculia. Dyscalculia is described as a disability that affects an individual's ability to understand maths and numbers in general. In accordance with the literature, there are two types of dyscalculia, namely; developmental and acquired. While acquired dyscalculia is said to be a disability acquired mostly in adulthood as a result of brain injury or stroke, developmental Dyscalculia is said to occur developmentally; which means that babies are born with it. Kaurfmann, Mazzoco, Dowker et al. (2013) categorise developmental Dyscalculia into primary and secondary. Primary development dyscalculia is "characterised by severe deficit in numerical or arithmetic functioning, caused by different underlying factors'; while secondary dyscalculia "denotes individuals, whose impaired numerical capacity can be explained entirely by non-numerical impairments, such as attention or working-memory process (Kaurfmann et al., 2013).

This study will explore dyscalculia as "a learning disability that affects the acquisition of basic arithmetic skills, not explainable by poor schooling, deprivation or low intelligence" (Dresler, Bugden, Gouet, Lallier, Oliveira, Pinheiro-Chagas,Pires,Wang, Zugarramurdi and Weissheimer, 2018:3). Since fear and anxiety are linked to maths learning difficulties, these two elements will also be investigated. Furthemore, the research will also explore students' attitute towards maths because Navarro et al. (2018); Dowker et al. (2016), Cuskelly and Faragher (2019) and Mokotjo (2017) show the link between dyscalculia and negative attitute towards maths. According to Kaufmann and von Aster (2012: 767), many children with dyscalculia aquire a

negative attitude to counting and arithmatic, which in turn, often develops into “a specific maths anxiety or even a generalised school phobia”, which can persist into adulthood if left untreated.

Dresler et al. (2018) and Lewis & Lynn (2018), agree that students who suffer from dyscalculia, experience challenges in processing quantity, number sense, magnitude representation, and Arabic numerals. According to Mokotjo (2017:1-2), dyscalculia is a learning disability that affects between 2% to 10% of the population worldwide. However, a limited body of research could be located that investigates the characteristics and impact of dyscalculia, especially within the African context.

The researcher suspects that dyscalculia or other mathematics learning difficulties such as anxiety might be attributing factors when it comes to the low pass rate in mathematics, especially within the Namibian higher education sector. This phenomena warrant research to understand their prevalence because mathematics is an important subject within our national curriculum. It is considered a key role player when it comes to the various sciences that are offered as part of any curriculum (Aremu & Taiwo, 2014:113). Mathematics has a direct impact on the socio-economic status, self-esteem, and identity of an individual (Mokotjo 2017:35-36), therefore not being numerically competent can decrease the prospects of employment in many economic sectors. Mathematics is inextricably linked to the development of any nation (Aremu and Taiwo 2014:113). As Aremu and Taiwo (2014) emphasised that “without mathematics there is no science, without science there is no modern technology, and without modern technology, there is no modern society” (Aremu and Taiwo 2014:113).

In Namibia, increasing attention is being given to mathematics as a discipline because mathematics forms part of the STEM fields. Furthermore, the importance of mathematics can be directly associated with the country’s Sustainable Development Goal 4.6 which states that all youth and a substantial proportion of adults should achieve literacy and numeracy skills by the year 2030. According to Open Data Africa (2019), Namibia’s indicator for Goal 4.6 is “Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex”.

Considering the importance of numeracy competency in the national economy, the researcher believes that more research in mathematics and mathematics-related subjects should be conducted to understand some of the problems that might prevent Namibia from meeting the Sustainable Development Goals (SDGs). The researcher proposes that Goal 4 (Quality Education) of the Sustainable Development Goals will have an impact on Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) and considers that high mathematics failure rate might be a contributing factor that will affect the employment prospects and economic development of Namibia. Data gathered by the Namibia Statistics Agency state that 47.4% of the Namibian population aged fifteen and above is absorbed in employment (Namibia Statistics Agency, 2018:57). The Namibia Statistics Agency (2018:57) is of the opinion that the employment absorption rate increases with higher levels of education and show that our average unemployment rate is currently 33.4% (Namibia Statistics Agency, 2018:78).

The challenge of a national mathematics failure rate of below 50% (Booysen 2019:1), has been an increasing concern for Namibia. However, limited research has been done in the context of Namibia in order to understand the problem and explore the strategies to improve the problems associated with mathematics for students with dyscalculia.

1.2 BACKGROUND

This study situates adult education, distance learning and maths learning difficulties and disabilities within the realm of the Vision 2030. The researcher, being a learning coordinator at an Open and Distance Learning University in Namibia, is of the belief that the ever-increasing demand which is exerted on the higher education sector to increase enrolments in STEM subjects, is putting more strain on Open and Distance learning (ODL) institutions in Namibia. The Vision 2030 strategy contains Namibia's dream of becoming an industrialised nation by the year 2030, as made possible by its own human resources, and making the country remain competitive in the international arena. This document was adopted in 2004 by the Namibian government and the nation as a whole and contains eight themes, of which

Knowledge, Information and Technology form part of the sixth theme. With this vision in mind, increasing pressure is being exerted on the Namibian higher education sector to incorporate STEM fields as part of the curricula.

However, two of the biggest challenges faced by educators and students in higher education institutions are low pass rates in mathematics-related subjects. Despite the importance and significance that is attached to mathematics as a discipline, the students' performance within this subject remains consistently poor (Aremu and Taiwo 2014:113; Gamundani and Jegede 2015:59; Booysen 2019:1) and has resulted in the low admission rate of students into university (Aremu and Taiwo 2014:113, Gamundani and Jegede 2015:59).

Despite the Namibian government putting up support mechanisms to improve the pass rates of students in mathematics, these interventions mostly catered for the teacher as opposed to addressing the challenges faced by students themselves (Gamundani and Jegede 2015:59). In addition, such interventions that target teachers only, are less likely to impact distance education students because they are separated from their teachers. Therefore, it is always important that mathematics learning support be focused on the student if we were to successfully address the challenge of high failure rate in mathematics at Namibian institutions of learning (Gamundani and Jegede 2015:59), especially in distance education settings.

In order to contextualise the extent of the problem (the low pass rate in mathematics), it is vital to have an overview of the Namibia University of Science and Technology and the important role that the distance education students play at the university. The Namibia University of Science and Technology (NUST) is one of Namibia's popular dual-mode universities. NUST has six faculties, namely: Management Sciences, Human Sciences, Engineering, Health and Applied Sciences, Computing and Informatics, as well as Natural Resources and Spatial Sciences. The total number of students that are enrolled at NUST for the 2019 academic year is 11235, of which 5702 are male and 5533 are female (NUST, 2019).The Namibia University of Science and Technology's Centre for Open and Lifelong Learning (NUST-COLL) has ten (10) regional centres which offer learning support to the regional distance education students of the university. These regional

centres are located in the following towns, namely Otjiwarongo, Tsumeb, Ongwediva, Outapi, Opuwo, Gobabis, Keetmanshoop, Rundu, Katima Mulilo and Walvisbay. The Windhoek-based centre is the head office (Main Campus) and therefore has the greatest number of enrolments compared to the other centres.

To provide a realistic picture of the state of mathematics competence, preliminary research, was conducted to help understand the Basic Mathematics course, failure and repetition rates at NUST. Basic Mathematics is a core subject that is offered in all undergraduate qualifications at NUST, therefore all undergraduate students will encounter it whilst being enrolled at NUST. The sections below provide an overview of enrolment and progression in Basic Mathematics course. Table 1 shows enrolments in Basic Mathematics and Figure 2 shows declining enrolments, per faculty.

Table 1: Basic Mathematics enrolment per faculty per year

Faculty	2016	2017	2018	2019
Human Sciences	439	355	308	119
Management Sciences	300	144	86	11
	739	**499**	**394**	**130**

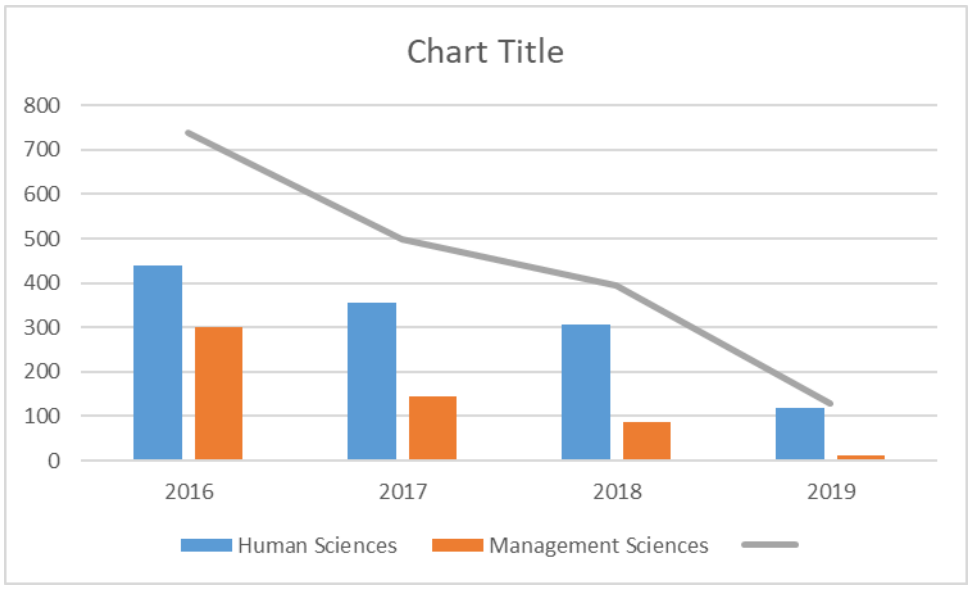

Figure 1: Basic Mathematics course enrolment per faculty per year

According to the Basic Mathematics results, students who struggle with Basic Mathematics are mainly those students who are enrolled in the Departments of

Human Sciences and Management Sciences as indicated in Table 1 and Figure 1. This is a concern because Basic Mathematics is a compulsory subject for all first-year students at NUST, and students cannot proceed to the next level if they fail it. For example, in 2016, 59% of the Human Sciences distance education students and 41% of the Management Sciences distance education failed Basic Mathematics.

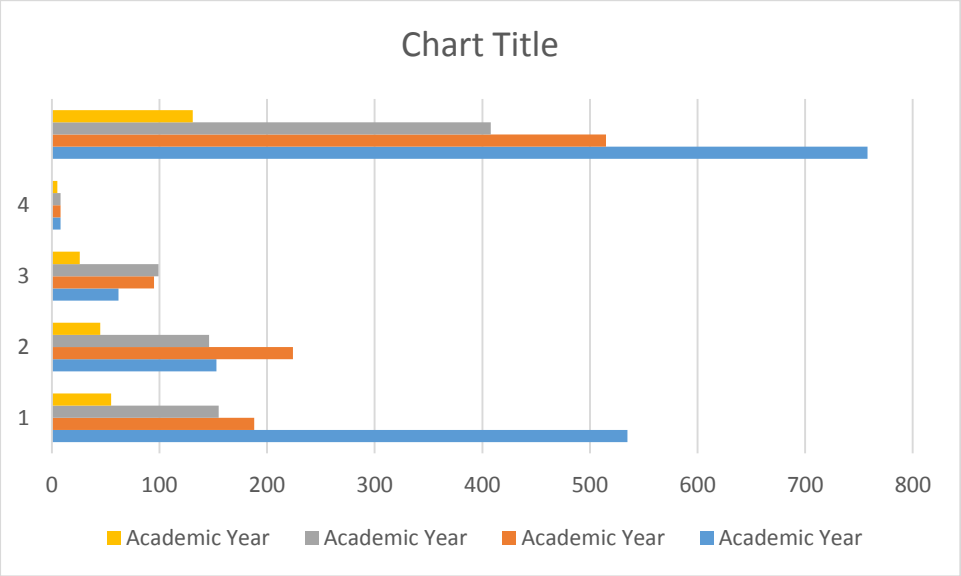

Figure 2: Basic Mathematics distance education repetition rates per academic year

When it comes to the repetition rate of Basic Mathematics on distance education per faculty (Health and Applied Sciences, Human Sciences, Management Sciences and Natural Resources and Spatial Sciences), statistics show that all faculties have students who have repeated Basic Mathematics on distance education thrice; some even up to four times (Figure 2).

Furthermore, the examination results of the distance education students who are enrolled for Basic Mathematics for the period 2016 – 2018 were also examined. Figure 3 clearly depicts the examination failure rate per faculty per year. The statistics clearly show that the Faculty of Human Sciences and Management Sciences has the highest rate of mathematics failure. The researcher only focused on filters '***Fail: No admission to examination' and 'Fail*: *Supplementary***' in order to provide an accurate overview.

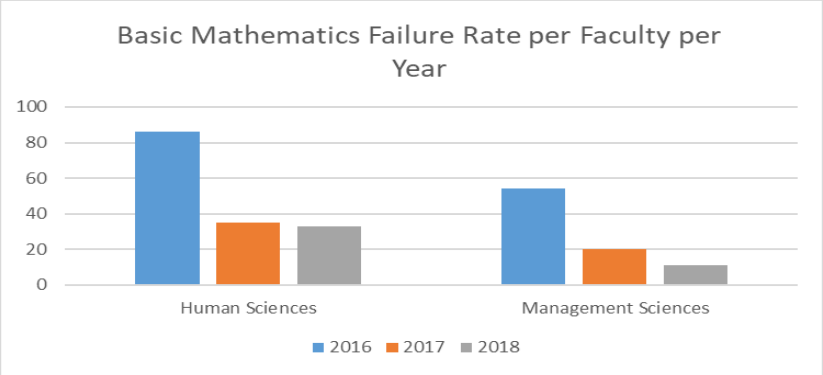

Figure 3: Mathematics examination failure rate per faculty per academic year

Figure 4 depicts that in general, females demonstrated a higher failure rate than their male counterparts for the period 2016 – 2018.

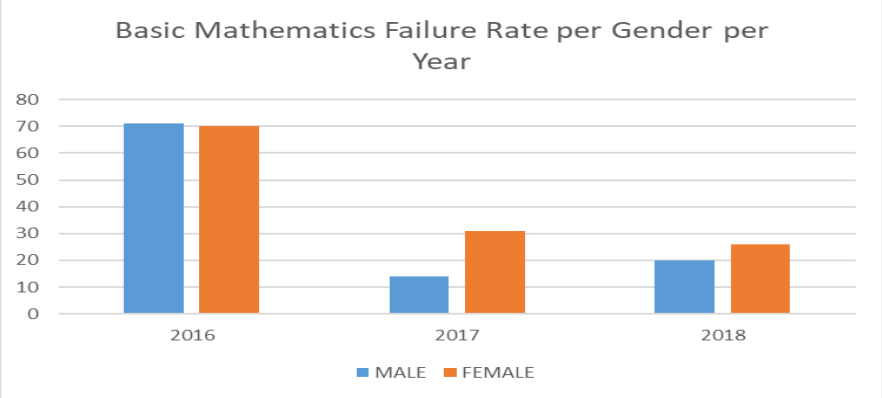

Figure 4:Basic Mathematics failure rate per gender per academic year

Considering the above-mentioned facts, the researcher is propelled to believe that learning difficulties such as dyscalculia and other related difficulties might be considered a contributing factor towards the low pass rate in Basic Mathematics. Therefore, this research might shed light on the challenges that are associated with maths in particular and mathematics-related subjects in general for adult learners at Nambia higher education institutions, which include Namibian Open and Distance Learning (ODL) institutions such as the Namibia University of Science and Technology (NUST).

1.3 RATIONALE FOR THE STUDY

One aspect of interest to the researcher (from an academic administrative support perspective) is the aspect of adult learning difficulties, especially those that are associated with Mathematical applications. The researcher's interest in this topic was triggered when she observed that many students at University end up repeating Basic Mathematics more than once which leads to not graduating or dropping out. The researcher suggests that Basic Mathematics is a gatekeeper course that prevents students from graduating, since they experience difficulties with the subject and cannot pass it. The researcher further proposes that there is a deeper root cause that is associated with the slow progression and low pass rate in Basic Mathematics at the Namibia University of Science and Technology, and this problem might possibly be associated with some learning difficulties like dyscalculia. Academic support administrators rarely investigate deeper causes or underlying factors that might contribute to the current phenomenon, therefore the researcher hopes that this study will shed new light on this problem.

Furthermore, limited research has been conducted about mathematics anxiety and adult learners with dyscalculia students above the age of 25, particularly within the context of Namibia. Mathematics is regarded as a critical subject, because it is not only linked to other subjects within the curricula but also affects our career paths (Mokotjo 2017:7). The researcher envisages that the findings of this study will help understand some causes of mathematics learning difficulties experienced by students at NUST. The findings will also help us to suggest relevant learning support strategies that can be used to support adult learners who experience learning difficulties and disabilities such as mathematics anxiety and dyscalculia. For future research, it is hoped the study will guide into exploring how educational technologies can be used to enhance the learning experiences of adult learners with Mathematics Anxiety and/or Dyscalculia.

1.4 STATEMENT OF THE PROBLEM

Most of the lecturers who offer STEM subjects at NUST are aware that some students are experiencing problems with mathematics. However, limited research

has been conducted to understand the nature of students' learning disabilities like dyscalculia.

Some NUST students experience difficulties in grasping and understanding basic foundational skills of Mathematics, for example the formulae, and the application of Mathematics in subjects like Basic Mathematics. However, lecturers remain oblivious to the problem. Dyscalculia may be one of the attributing factors to these challenges, mainly due to some of the experiences of mastering mathematics.

More recently, there was an uproar amongst the distance education students when the Mathematics and Statistics Department decided to introduce compulsory tests for mathematics subjects like Basic Mathematics. The Mathematics and Statistics Department introduced the tests as a learning support strategy to improve the performance of students in mathematics and enhance their chances of gaining entry for the semester examinations. This newly devised strategy was not well received by some of the students and the researcher suspects that students' rejection to the newly devised strategy is a sign that they are not confident enough to demonstrate their mathematics competency by engaging with the mathematics content and mastering it (facing their fears).

1.5 RESEARCH AIM

The aim of this study is to explore the experiences of distance education students in order to establish whether their poor performance in maths is due to dyscalculia and other maths learning difficulties. It is hoped that exploring students' experiences will help establish an understanding of their reasons for not thriving in maths and will help us devise appropriate learning support strategies that will enhance the learning experiences of students who suffer from dyscalculia and other mathematics difficulties such as anxiety, at the university.

1.6 OBJECTIVES

The following objectives were set to achieve the above aims:

1.6.1. To explore the experiences of Basic Mathematics students on learning mathematics at NUST.

1.6.2 To identify the prevalence of dyscalculia and other learning difficulties associated with mathematics

1.6.3. To suggest support strategies that could be used to assist adult learners who might be having dyscalculia and/or any other maths learning difficulties at NUST.

1.7 THE RESEARCH QUESTIONS

This study aimed to address the following research questions:

1. What are the experiences of students who do Basic Mathematics at NUST?
2. What is the prevalence of dyscalculia at NUST and what other learning difficulties associated with mathematics can we identify?
3. What learning support strategies can be recommended to support adult learners with maths learning difficulties such as dyscalculia at NUST?

Against this background, this study will follow the research process as displayed in Figure 5 below.

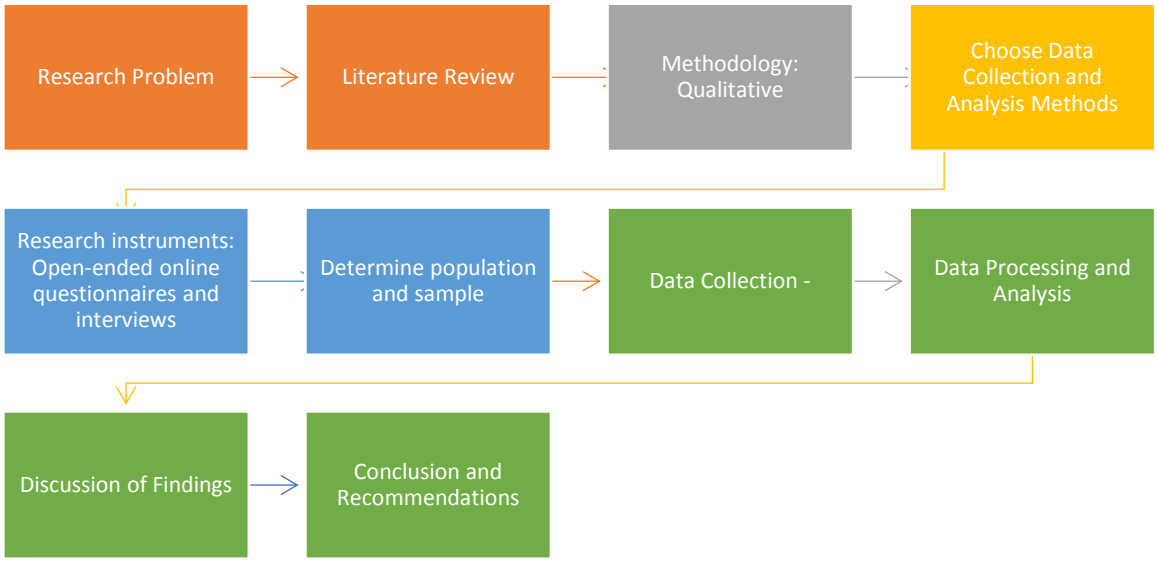

Figure 5: The Study's Research Process

1.8 EXPECTED CONTRIBUTION OF THE STUDY

This study provides an opportunity to advance our knowledge of mathematics learning difficulties with reference to dyscalculia and other mathematics learning difficulties. The findings that are derived from this study can be used by NUST Centre for Open and Lifelong Learning to support learners with dyscalculia and/or other maths learning difficulties; and enhance their learning experiences in mathematics as a science discipline.

Furthermore, a large and growing body of literature has investigated the prevalence rate, characteristics and learning support mechanisms that can be used for learning disabilities such as dyslexia. Dyscalculia on the other hand is a phenomenon that is under-researched within the context of Namibia and very few academics and academic administrative personnel might not be aware of mathematics learning disabilities and other maths learning difficulties experienced by students. This study is a contribution to address this gap.

1.9 SCOPE, LIMITATIONS AND DELIMITATIONS

1.9.1 SCOPE

This study was conducted with distance education students at the Namibia University of Science and Technology's Centre for Open and Lifelong Learning. The study gathered data from students who had failed maths twice or more, during the academic years 2016-2018.

1.9.2 LIMITATIONS

The limitation of this study was the low response rate towards the open-ended online questionnaire. This could have been caused by the fact that the researcher was not able to include all of the ten (10) regional centres that currently belong to the Centre for Open and Lifelong Learning. Another limitation was the unavailability of internet services and/or electricity in remote locations. The students needed access to the internet and electricity in order to complete the open-ended online questionnaire, however in some rural areas in Namibia internet access is not always reliable and electricity is not always available.

1.9.3 DELIMITATIONS

The researcher sent out numerous reminders to the participants that had agreed to partake in the study. The researcher also resorted to making individual telephonic follow-ups with the participants. This had minimal improvement, though.

1.10 DEFINITION OF TERMS

a) **Adult learner** – *An individual who is older than 25 years of age who is enrolled at an academic institution.*

b) **Developmental Dyscalculia** – *is a heterogeneous disorder resulting from individual deficits in numerical or arithmetic functioning at behavioural, cognitive/neuropsychological and neuronal levels* (Kaufmann, Mazzocco and Dowker et al 2013:4)

c) **Educational technology** – *Digital technology used to facilitate learning.*

d) **Inclusive education** – *Education or an educational policy which includes all students, especially one that enables students with disabilities, special needs or learning difficulties to be educated within mainstream schools*.

e) **Learning difficulties** – *Difficulties in acquiring knowledge and skills to the normal level expected of those of the same age, especially because of a mental disability or cognitive disorder. This phrase became more prominent in the 1980s…and emphasises the difficulty experienced, rather than the perceived 'deficiency'. It is considered a less discriminatory term … and is now the standard accepted term in Britain in official contexts* (adapted from the Oxford Online Dictionary).

f) **Learning disabilities** – *A condition giving rise to learning difficulties, especially when not associated with a physical disability*.

g) **Special needs education** – *Specific educational requirements resulting from learning difficulties, physical disability, emotional or behavioural difficulties.*

1.11 CHAPTER OUTLINE

The overall structure of the study takes the form of seven (7) chapters, including the introductory chapter.

CHAPTER 1: INTRODUCTION AND BACKGROUND OF THE STUDY

This chapter contains the introduction and background of the study.

CHAPTER 2: LITERATURE

Chapter two discusses the literature on dyscalculia and other maths learning difficulties and identifies key concepts and similar features related to these conditions. The literature relates to studies on dyscalculia, mathematics anxiety and other mathematics-related learning difficulties. This chapter will enable the reader to have a detailed understanding of the complexity and nature of Dyscalculia.

CHAPTER 4: DATA COLLECTION AND ANALYSIS

Chapter 4 is concerned with the study's methodology, research instruments and data collection and analysis methods.

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Chapter 5 discusses the findings, conclusions, and recommendations contained in the previous chapter (Chapter 4). The final chapter draws upon the entire thesis by bringing together aspects that were highlighted in the literature and supported by the findings as derived from the Content- and Thematic Analysis, the open-ended online questionnaire, and the interviews. This section also includes a discussion on the implications of the findings for future empirical research into the learning difficulties that are associated with mathematics, namely mathematics Anxiety and Dyscalculia, particularly within the context of Namibia.

CHAPTER TWO: LITERATURE STUDY

2.1 INTRODUCTION

The aims of this chapter are to give an overview of learning disabilities; describe dyscalculia and identify concepts related to dyscalculia; discusses in relation to learning disabilities such as dyscalculia and other maths learning difficulties. Secondly, it discusses the studies on dyscalculia and other maths learning difficulty; thirdly, it highlights the impact of learning difficulties on adult learners; and lastly describes learning support for students with dyscalculia.

2.2 LEARNING DISABILITIES

Various physical and cognitive disabilities exist around the world; however, one of the prominent mental impairments is a learning disability (Rosic 2016:50). According to Rosic (2016:50), a learning disability is a neurological condition that interferes with a person's ability to perceive, process, store and respond to information. Learning

difficulties can also be classified into categories, termed Specific Learning Difficulties (SLD). Park (2015:16-18) defines specific learning disabilities as:

> "*specific learning difficulties are defined as a disorder in one or more of the basic psychological processes involved in understanding or using languages spoken, or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations* "

One of the areas of SLD is mathematics difficulties (Park 2016:16). Various diagnostic criteria have been used to assess learning difficulties such as mathematics learning difficulties. Some of these measures used often include the student's performance in class, as well as the student's standardized achievement scores in mathematics (Park 2015:17). Park's (2015:18) observation is that only using the traditional IQ-achievement rating in order to diagnose a learning difficulty is biased and is more in favour of the '*Response to intervention*' (RtI) Model (Park 2015:18), which is a multi-tiered approach (three tiers) that can be used to identify children with learning disabilities, as opposed to the traditional IQ-score test.

When it comes to the challenges that students experience, students with mathematics learning difficulties often experience problems with numerosity skills (Park 2015:20-21; Cuskelly and Faragher 2019:152) and cognitive skills (Park 2015:20-21), amongst others. In addition to the above, Dyscalculia also has different 'faces'. According to Mavesere (2014:2), there are four (4) types of Mathematical difficulties, namely: General difficulties in mathematics, Acalculia, Dyscalculia and Pseudo-Dyscalculia.

In the next section, the researcher discusses the types, symptoms and behavioural patterns associated with Dyscalculia. From the studies that were consulted, it was evident that Dyscalculia is a complex phenomenon.

2.3 DYSCALCULIA

Dyscalculia is a complex cognitive learning disability that is associated with mathematics. In order to fully understand the concept and its relevance to mathematics as an educational discipline, it is imperative to consider the views of researchers such as Mokotjo (2017), Lewis and Lynn (2018), Aremu and Taiwo

(2014), De Visscher and Noël (2013) as well as Cuskelly and Faragher (2019) and others. Below the researcher elaborates on Dyscalculia as a learning difficulty as described by the various perspectives of various researchers.

Mokotjo (2017:27-32) was instrumental in providing a detailed background of the origins of Dyscalculia as a learning difficulty. According to Mokotjo (2017:27), the term 'Dyscalculia' was first introduced by the Czechoslovakian psychologist Ladislav Kosc in 1974. Mokotjo (2017) stated that there is a difference between Dyscalculia and Developmental Dyscalculia.

Dyscalculia is being perceived as a structural mathematical disability that originates from the brain or a congenital disorder that affects the part of the brain that is responsible for Mathematical abilities (Mokotjo 2017:27). This brain or congenital disorder results in poor Mathematical performance as a result of external factors (Mokotjo 2017). Other researchers (Kaufmann, Mazzocco and Dowker et al 2013:1) state that developmental dyscalculia is fostered by environmental factors to the effects of pre-/post-natal illness or socio-emotional adversity (for example mathematics anxiety). The researchers argue that arithmetic difficulties may be associated with other neuropsychiatric and pediatric disorders (for example ADHD or epilepsy) (Kaufmann, Mazzocco and Dowker et al 2013:1).

In addition to the definition of dyscalculia offered in Chapter 1, Dresler, Bugden, Gouet, Lallier, Oliveira, Pinheiro-Chagas, Pires, Wang, Zugarramurdi and Weissheimer (2018:3) describe dyscalculia as a learning disability

> "*that affects the acquisition of basic arithmetic skills, not explainable by poor schooling, deprivation or low intelligence, …however, it is unclear what underlying core deficits contribute to the inability in learning basic arithmetic*."

Researchers like Dresler et al. (2018) and Lewis & Lynn (2018) agree that students who suffer from dyscalculia experience challenges in processing quantity, number sense, magnitude representation and Arabic numerals.

According to Mokotjo (2017), there are three levels of Dyscalculia, namely biological, cognitive and behavioural dyscalculia as well as three difficulty subtypes, namely procedural, semantic and visuospatial difficulty (Mokotjo 2017:169-170). The

cognitive perspective of Dyscalculia relates to the cognitive deficit that inhibits the ability to grasp numerical concepts (numerosity and the number system), thus resulting in difficulty in understanding and developing more complex arithmetical concepts (Mokotjo 2017:34).

With regard to the behavioural perspective of dyscalculia entails slowness, helplessness, immature problem solving strategies, feeling embarrassed when asked to partake in group work or simply not liking school (Mokotjo 2017:36,182). Mokotjo (2017:36) states that dyscalculic students tend to be slower and are more prone to make errors when it comes to performing Mathematical calculations, mainly due to the fact that the learners experience difficulty in remembering basic arithmetic facts (Mokotjo 2017:35-36). Mokotjo (2017:36) highlights that the behavioural perspective of dyscalculia includes precursor skills (the ability to differentiate between small and large quantities), number skills (counting) and calculation skills (using fingers to execute basic arithmetic facts) (Mokotjo 2017:36).

Another researcher, Mavesere's (2013) study focused primarily on Dyscalculia and Pseudo-Dyscalculia. According to Mavesere (2014:3), Pseudo-Dyscalculia (secondary Dyscalculia), is regarded as a condition which develops in a person due to early experiences of failure in mathematics, and is primarily caused by emotions (Mavesere 2014:3). Dyscalculia (primary Dyscalculia) on the other hand, is regarded as difficulty in arithmetical skills (Mavesere 2014:3). Mavesere (2014:3) uses the term 'Dyscalculia' when referring to both Pseudo-Dyscalculia and Developmental Dyscalculia (Cuskelly & Faragher 2019:152), since the researcher was not primarily focused on the causes of the disability and regards the two concepts (Pseudo-Dyscalculia and Developmental Dyscalculia) as similar (Mavesere 2014:3).

Interestingly, Mavesere (2014:12) noted that dyscalculia is not commonly diagnosed and that measures specifically designed to diagnose Mathematical learning disabilities are not readily available (Mavesere 2014:12). Mavesere (2014:13) suggests that schools can detect Mathematical learning disabilities by identifying the types of errors that individual children make (Mavesere 2013:12-13).

Regarding the sub-types of dyscalculia, Mavesere (2014:20-21) states that different researchers provide different subtypes of dyscalculia, with each researcher providing

a different name for the same subtypes of dyscalculia. For example, automation difficulties (students requiring a long time to execute simple arithmetic tasks and often counting using their fingers) are similar to mathematical difficulties and Semantic Memory Difficulties (Mavesere 2013:20-21). Mavesere (2014) states that students with automation difficulties often face difficulties with simple addition, subtraction, multiplication, division and multi-step problems and often experience difficulties in retrieving basic arithmetic facts and/or commit procedural errors (Mavesere 2014:20-21). Apart from the automation difficulties, Mavesere (2014:22) also highlights that dyscalculic students can experience linguistic difficulties, one which is regarded as a subtype of dyscalculia, this being the language processing problem. Mavesere's (2014) research suggests, people with linguistic difficulties often find it challenging to grasp mathematical vocabulary terms, thus making it difficult for such individuals to understand and make use of instruction, and encode and represent mathematical information.

Another sub-type of dyscalculia is visual-spatial difficulties (Mavesere 2014:23). This difficulty is associated with difficulties in spatially representing numerical and other mathematical information and relationships (Mavesere 2014:23). This difficulty makes it hard for dyscalculic students to visualise patterns, reversals and substitutions, and they have problems copying information, following mathematical steps and remembering different signs/symbols or mathematical formulae, amongst others (Mavesere 2014:23).

Metacognitive difficulties (the inability for dyscalculic students to monitor and evaluate their own learning), attentional difficulties as well as behavioural difficulties were also highlighted as sub-types of dyscalculia. According to Mavesere (2014:24-25), some of the behavioural patterns exhibited by dyscalculic students include a lack of confidence as well as mathophobia or mathematics Anxiety. Researchers like Dowker, Sarkar and Looi (2016) have done some ground-breaking research about mathematics anxiety and research pertaining to it over the past 60 years. In their research, Dowker et al (2016:1) describe the phenomena '*number anxiety*'. According to Dowker et al (2016:1), '*number anxiety*' was first introduced by Dreger and Aiken in 1957. Their research highlighted the aspect of Mathematical (number)

anxiety, the symptoms associated with it and how it differs from other forms of anxiety.

On the other hand, Mavesere (2014) was able to provide a concrete definition of mathematics Anxiety. According to Mavesere (2014:25), mathematics Anxiety can be defined as the "*feeling of tension and fear that some children and adults experience, and which is often specifically associated with mathematical activity*" (Mavesere 2014:25). This anxiety can also be attributed to avoidance behaviours (Mavesere 2014:25; Sokolowski and Ansari 2017:2), with the consequences being frustration and excess anxiety, in addition to the underlying cognitive difficulty (Mavesere 2014:25).

In the next section of the chapter the researcher discusses dyscalculia and its associated learning difficulties in more detail.

2.3.1 Dyscalculia and related learning difficulties

This chapter discusses studies done in relation to Dyscalculia and other related learning disabilities. Firstly, it is important to clearly understand the difference between a learning difficulty and a learning disability. According to research (Kaufmann, Mazzocco and Dowker et al 2013:2), the difference between a learning difficulty and a learning disability is that a learning difficulty only comprises one part of the subject (for example a student may only experience problems in arithmetic fact retrieval, but performs well in other numerical tasks) (Kaufmann, Mazzocco and Dowker et al 2013:2). A learning disability, on the other hand, is related to a numerical core deficit, meaning that the learning disability is a "*coherent syndrome that is mainly linked to neurofunctional peculiarities of the intraparietal sulcus*" (Kaufmann, Mazzocco and Dowker et al 2013:2). The researchers (Kaufmann, Mazzocco and Dowker et al 2013:2) also state that:

> "*domain-specific numerical deficits may reflect multiple and distinct numerical deficits that affect magnitude representation, verbal number representations, arithmetic fact knowledge, visual-spatial number forms, ordinality, base-10-system or finger representation of numbers*".

During the literature review, it was evident that a vast pool of research pertaining to learning difficulties, such as Dyslexia, exists, however, dyscalculia (a mathematics learning disability) is an area that remains under-researched. The sections below shed light on the mathematics learning disability, dyscalculia, the challenges and symptoms associated with this learning disability and how it affects an individual's numeracy competence.

Dyscalculia refers to the genetic factors and brain conditions that contribute to the learning difficulty and therefore it can affect the procedural, semantic and visuospatial memory (Mokotjo 2017:33). Mokotjo is of the opinion that it is important to understand the foundational existence of dyscalculia in order to ensure that the proposed learning support intervention is relevant (Mokotjjo 2017:33-34). Mokotjo (2017:34) also highlights other attributing factors of dyscalculia that are linked to the development of the brain or brain injury, for example low birth weight, epilepsy or the genetic disorder of the X chromosomes, amongst others. Dyscalculia stems from brain development (Cuskelly & Faragher 2019:152) or injury, and often manifests in neurological disorders such as ADHD, developmental language disorder (Cuskelly & Faragher 2019:153), epilepsy and fragile X syndrome (Mokotjo 2017:34).

When it comes to mathematics, it is not uncommon to experience anxiety, stress (Sokolowski and Ansari 2017:1) and tension. Mathematics anxiety affects many people and is related to poor mathematics ability in school and later during adulthood (Sokolowski and Ansari 2017:1-2; Aremu and Taiwo 2014:113-114). This anxiety can often be aggravated when students enter college or university underprepared or unaware of the expectations pertaining to mathematics in higher education (Rosic 2016:43; Aremu and Taiwo 2014:113). In addition to the above, Smith (2004:7) states that Maths anxiety is caused by "*poor test grades, the inability (or unwillingness) to complete difficult assignments, negative predispositions of parents, and even the mathematics teacher*". Researchers (Sokolowski and Ansari 2017:2) suggest that it is important to understand when and how mathematics anxiety first appears, what is happening in the brain and how do we help students to cope with mathematics anxiety. Sokolowski and Ansari (2017:5-6) state that mathematics anxiety develops early and can be related to both social situations and brain processes (for example the working memory) (Sokolowski and Ansari 2017:5-6).

Students with mathematics anxiety tend to display more brain activity in the regions that are involved with negative emotions, as opposed to the actual mathematics processing (Sokolowski and Ansari 2017:5-6).

Apart from mathematics anxiety, there are various challenges associated with the learning disability, dyscalculia. Dresler et al (2018) and Lewis & Lynn (2018) states that students who suffer from Dyscalculia experience challenges in processing quantity, number sense, magnitude representation, and Arabic numerals. Like Aremu and Taiwo (2014:113), Rosic (2016:43) agrees that the students' persistence and completion rates in mathematics in higher education are low. Rosic's (2016) research focused on the low performance of college students in mathematics and how Quantitative and mathematics Support Centres (QMaScs) can assist such students to achieve their academic goals (Rosic 2016:43).

When it comes to the performance of students in mathematics, it is difficult to assess which factors are directly responsible for the low pass rates within this discipline, especially for dyscalculic students. Some of the attributes of dyscalculia include learners giving up on learning mathematics because they believe that it is too difficult or impossible to understand (Mokotjo 2017:45). Mokotjo (2017:45) is of the opinion that anybody can learn mathematics, provided that a proper strategy is in place. With regard to dyscalculia, Mokotjo (2017:45) stated that the difficulty that is associated with mathematics should be analysed and mathematics should be understood in relation to dyscalculia since this ensures that the intervention strategy is relevant to the problem. In order to add to the aspect of relation, Mokotjo (2017:46) stated that mathematics is dependent on various cognitive abilities, namely the short-term memory, the working memory (or long-term memory), visuospatial skills, processing speed as well as language skills (Mokotjo 2017:46). Cuskelly & Faragher (2019:157) are of the opinion that mathematical difficulties that are experienced by individuals with developmental disorders (for example Down Syndrome) might vary in form and origin.

Researchers like De Visscher and Noël (2013) raised another critical aspect when it comes to dyscalculia as a learning disability. Within their research, they highlighted the aspect of the profiles of dyscalculia (De Visscher and Noël 2013:50). The two

different types of dyscalculia, namely Dysculculia and Developmental Dyscalculia, have briefly been elaborated on by researchers like Mokotjo (2017:27-32). However, more has been mentioned about Dyscalculia as opposed to Developmental Dyscalculia by Mokotjo (2017:27-32). This is where researchers like De Visscher and Noël (2013) and Cuskelly and Faragher (2019:152) supplement the information that was provided by Mokotjo (2017). According to De Visscher and Noël (2013:50), Developmental Dyscalculia is a severe, persistent learning disability which emanates from defects that are associated with some mechanical functioning of the brain that concerns Mathematical skills (Mokotjo 2017:29; Cuskelly & Faragher 2019:152). Developmental Dyscalculia entails deficits in diverse general cognitive processing which can potentially prevent the development of mathematical skills (De Visscher and Noël 2013:51). One prevalent symptom of Developmental Dyscalculia is the difficulty in retrieving arithmetical facts (over-learned single-digit problems and/or multiplications) (De Visscher and Noël 2013:51; Cuskelly and Faragher 2019:152). Developmental Dyscalculic students also tend to be slower and produce more errors than their peers (De Visscher and Noël 2013:51).

When it comes to numerosity and the importance thereof, Mokotjo (2017) states that being numerate relates to the ability to understand the concept of a number, the relationship amongst numbers and the basic awareness of quantity (Mokotjo 2017:30). In addition to the above, it is also important to be aware of dyscalculia in relation to other developmental disorders. Cuskelly & Faragher (2019:151-161) are of the opinion that dyscalculia might also be of concern to Students with Down Syndrome. According to Cuskelly and Faragher (2019:151), Students with Down Syndrome mainly face problems with arithmetic aspects and this is a problem that is almost reported universally amongst them. In their research, Cuskelly and Faragher (2019) explored the educational difficulties that are associated with Down Syndrome and the exploration and identification of possible interventions, particular in the field of Developmental Dyscalculia and whether this learning difficulty forms part of the behavioural phenotype of Down Syndrome (Cuskelly and Faragher 2019:151). According to Cuskelly and Faragher (2019:151), behavioural phenotypes (of which Down Syndrome is one) form part of an external expression of the genotype and can provide clues about the mechanisms underlying development (Cuskelly and Faragher, 2019:151).

So, what exactly are the symptoms of dyscalculia? Research states that students with dyscalculia experience problems with low concentration span (Mokotjo 2017:4), learning, applying and recalling arithmetic concepts, facts or formulae (for example the multiplication time tables) (Mavesere 2014:54), the addition and subtraction of single-digit numbers (1+3=4, 5+1=6), and conceptualising (left from right or spatial orientation), computational skills (for example simple money transactions) and analytical or logical reasoning skills (Mokotjo 2017:1-2; Chinn 2009:133; Mavesere 2014:54). Some educators even equate dyscalculia with dyslexia, and simply refer to it as 'number blindness' (Mokotjo 2017:1-2). The frustration and anxiety as a result of dyscalculia can lead to distress, low self-esteem, stigmatization and a disruptive and/or aggressive behaviour (Mokotjo 2017:1-2). In addition to this, dyscalculia is characterised in the first years of school by struggling to remember or apply basic numerical facts and displaying immature counting skills (Mokotjo 2017:30), while older learners of about nine (9) to ten (10) years of age find it difficult to memorise mathematical time tables, as well as add, multiply, subtract and divide (Mokotjo 2017:30). Other symptoms of dyscalculia include confusing Mathematical symbols, computation, reversing or transposing numbers, difficulty with mental mathematics, difficulty with direction, difficulty with telling time, poor spatial orientation, finger counting, slowness in providing responses for Mathematical problem solving, difficulty in estimation and has a history of mathematics failure (Nagavalli and Fidelis 2015:1-2; Cuskelly & Faragher 2019:152-159). More symptoms have also been highlighted by Nagavalli and Fidelis (2015:1-2), apart from the above-mentioned ones.

Apart from the symptoms of dyscalculia that were highlighted by Nagavalli and Fidelis (2015:1-2), they also described the different types of dyscalculia. The types of dyscalculia include Verbal Dyscalculia (interpretation of verbal mathematics terms), Operational Dyscalculia (performing basic arithmetic operations), Lexical Dyscalculia (reading written mathematics terms and symbols), Graphical Dyscalculia (symbol manipulation), Ideognostic Dyscalculia (mental calculations) and Practognostic Dyscalculia (pictorial representation). For the purpose of this research, the researcher only focuses on [Developmental] Dyscalculia and not delve deeper into the different types of Dyscalculia. The human brain is a very interesting yet complex

system, therefore pinpointing the exact origins of Dyscalculia can be a challenge in itself.

It is evident that students with dyscalculia experience problems with memorizing and retrieving basic number combinations (for example 2x3=6 or 3x2=6) and this has led to a lot of myths and misconceptions about students' Mathematical abilities (Lewis & Lynn 2018:2). These myths and misconceptions pertaining to dyscalculia have predominantly stemmed from the lack of knowledge about learning disabilities amongst researchers and educators alike (Lewis and Lynn 2018:2). The researcher wishes to highlight that students with dyscalculia should not be regarded as less intelligent individuals when compared to the rest of the student population. Students with Dyscalculia still possess normal intelligence despite their learning difficulty that is associated with mathematics (Mokotjo 2017:31; Cuskelly & Faragher 2019:153).

In order to provide a brief overview of how our brain is wired, it is best to adopt the explanation provided by Cuskelly and Faragher (2019:152). According to Cuskelly and Faragher (2019:152), research into human cognition of mathematics indicates two subjects, namely the Object Tracking System (OTS) and the Approximate Number System (ANS) (Cuskelly and Faragher, 2019:152). The first system, OTS, is a non-verbal system that is present in our infancy stage, while the second system, ANS, is a verbal and/or symbolic system which only develops in our toddler stages (3-4 years of age) (Cuskelly and Faragher, 2019:152). This stage is responsible for the discrimination and application of arithmetic, arithmetic facts as well as number sense, verbal memory and spatial memory. From the viewpoint of their research conducted, Cuskelly and Faragher (2019:152) are of the opinion that the source of Dyscalculia could have either or both the OTS or ANS, or even in the connection between the non-verbal and verbal systems (Cuskelly and Faragher, 2019:152). Although their research focused predominantly on students with Down Syndrome (DS), the information is still useful since Cuskelly & Faragher (2019) presented a view on Dyscalculia and the challenges associated thereof for DS children.

When it comes to the prevalence rate of dyscalculia, Mokotjo (2017:1-2) states that dyscalculia is a learning disability that affects between two percent (2%) to ten percent (10%) of the world population. This percentage of the learning disability

warrants research to understand its prevalence. In a small country like Namibia, two percent (2%) to ten percent (10%) of the national population is a significant number. According to the World Bank Statistics, the current population of Namibia is two million four-hundred and forty-eight thousand two-hundred and fifty-five (2 448 255) people (World Bank 2018. Cuskelly and Faragher (2019:153) regards the prevalence rate of dyscalculia as being 3-6% of the general population, and that diagnosis is generally partially based on the students' performance and progression in mathematics. Students are often tested on their intellectual abilities and the assumption that performance in mathematics-related subjects can be generalised (Cuskelly and Faragher, 2019:153). When compared to other disabilities, Mokotjo (2017:27) highlights that various studies were conducted across the world and the prevalence rate of dyscalculia was between five percent (5%) to eight percent (8%), making Dyscalculia as prevalent as dyslexia. Even though the former has been existence as long as the latter, less research is conducted on dyscalculia as a learning disability. By considering the above-mentioned facts relating to Dyscalculia, it is interesting not also be aware that not all Mathematical disabilities result from cognitive disabilities (Dowker et al 2016:1). The researchers (Dowker et al 2016:1) are of the opinion that a considerable number of children and adults experience mathematics Anxiety, which can negatively affect the learning and performance in this subject. The impact of this anxiety can lead to avoidance (Mavesere 2014:53), overloading and/or disrupting of the working memory during the execution of arithmetical tasks (Dowker et al 2016:1) and such students tend to experience automatization difficulties, linguistic difficulties, procedural difficulties and metacognitive difficulties (Mavesere 2014:53). There is a distinction between Dyscalculia and mathematics phobia or anxiety, the latter being associated with discomfort that is experienced by the student when mathematics tasks are perceived to challenge an individual's self-esteem (Mokotjo 2017:27). mathematics Anxiety can also be attributed to panic, fear, helplessness, mental paralysis and disorganisation (Mokotjo 2017:27). Mathematics anxiety has also been termed Pseudo-Dyscalculia, which is regarded as the false belief in mathematics disability caused by a lack of inconsistent and/or poor or inappropriate mathematics instruction, inattention, fear, anxiety or emotion (Aremu and Taiwo 2014:114). When it comes to establishing the relationship between mathematics anxiety and dyscalculia, limited research could be located on this aspect, however available research suggests that dyscalculia may

increase the chances of mathematics Anxiety (Mavesere 2014:26). From the research consulted (Mavesere 2017:26), it is evident that there was a direct link between emotions, arithmetic and low achievement in mathematics. Having said this, the researcher is of the opinion that additional empirical research is needed in order to establish the exact relationship and impact that one phenomenon has on the other.

In addition to this, age and attitude were other factors that plays a role in Dyscalculia. Age can also be coupled to the aspect of attitude, since research suggests that your attitude towards mathematics deteriorates with age (it can transpose into anxiety the older you become) and this has negative implication for Mathematical development, mathematics education and adult engagement in mathematics-related activities (Dowker et al 2016:1). Expressing mathematics anxiety is common, although researchers are still unsure as to what extent mathematical difficulties cause mathematics anxiety and whether this anxiety affects the individual's performance in mathematics (Dowker et al 2016:2). The researchers (Dowker et al 2016) also sought to investigate whether there is a relationship between mathematics anxiety and other forms of anxiety, namely test anxiety and general anxiety (Dowker et al 2016:2). The researchers (Dowker et al 2016) concluded that mathematics anxiety correlates with general anxiety and may contribute towards test anxiety (Dowker et al 2016:2). However, mathematics anxiety cannot be reduced to test anxiety or general anxiety (Dowker et al 2016:2). According to Dowker et al (2016:2), "*mathematics is also known to elicit stronger emotional reactions* (especially anxiety), *than most other academic subjects"* (Dowker et al 2016:2-3). Dowker et al 2016 suggest that more empirical research is needed to compare mathematics in relation to other subjects, and the impact of attitude towards each of them.

Another aspect that contributes towards mathematics Anxiety is Cortisol (Dowker et al 2016:5). According to Dowker et al (2016:5), "*Cortisol secretion is a response to stress and therefore might be expected to be higher in people with high levels of mathematics Anxiety when presented with mathematical stimuli or activities*". The researchers conclude that the "*Cortisol profile modulates the relationship between mathematics Anxiety and mathematics performance, while mathematics anxiety modulates the performance between cortisol and performance*" (Dowker et al 2016:5). However, the researchers (Dowker et al 2016) caution that there is no

concrete evidence that the presence of Cortisol follows mathematics anxiety (Dowker et al 2016:5).

In addition to Cortisol, genetics, gender, culture and nationality (Dowker et al 2016:7, 8, 9) can also be an attributing factor towards mathematics anxiety. With regard to the mathematics anxiety and gender aspect, Dowker et al (2016:7) are of the opinion that females exhibit more anxiety and higher levels thereof, as opposed to their male counterparts. According to Dowker et al (2016:7), the increased level of anxiety may be due to several factors, such as the "*exposure to gender stereotypes, the influence and social transition of anxiety by female teachers who are themselves anxious about mathematics*" (Dowker et al 2016:7). Dowker et al (2016:8) stated that males are better in mathematics than females, thus causing females to feel more anxious due to this stereotype notion (Dowker et al 2016:8). Dowker et al (2016:8) concur that mathematics anxiety increases with age and that the findings are consistent with other research findings relating to the attitude towards mathematics and the change with age (Dowker et al 2016:8). Mathematics anxiety is closely related to mathematics performance, mainly due to the physical changes within the working memory (which changes with age) (Dowker et al 2016:9).

Coupled with other researchers (Navarro et al 2018:18, 52-53; Dowker et al 2016:1-3, 8, 10; Cuskelly & Faragher 2019:158), Mokotjo (2017) also touched on the aspect of attitude when it comes to Dyscalculia (Mokotjo 2017:161, 180-181). Research suggests that students' attitude towards mathematics is influenced by what is said at home, their communities or at school about mathematics (Mokotjo 2017:180-181). Mathematical competence is regarded as being linked to intelligence, meaning that you are respected in society if you are numerically competent and vice versa (Mokotjo 2017:180-181).

Knowing the impact and emotions that mathematics trigger in most children and adults, it is only fair to briefly touch on the methods of assessing mathematics anxiety. Once again, the research conducted by Dowker et al (2016:4-5) proved to be useful. Research conducted by Dowker et al (2016:4-5) suggests that most methods of assessing mathematics anxiety involve questionnaires and rating scales. Some of these instruments include the mathematics anxiety Research Scale (MARS), the *Mathematics Attitude Scale*, *Mathematics Attitude and Anxiety*

Questionnaire and the *Children's Attitude to Maths Scale* (Dowker et al 2016:4-5), to name but a few. Of the afore mentioned, the MARS test proves to be the most popular and a highly reliable mathematics anxiety diagnostic test (Dowker et al 2016:4-5).

After having discussed the effects and contributing factors of mathematics anxiety, one should also be alerted to the remedial strategies that can be employed to cope with and/or manage mathematics anxiety. One of the interventions of effectively dealing with mathematics anxiety is early intervention (Dowker et al 2016:10), especially when it comes to mathematics anxiety that is experienced by children. Research (Dowker et al 2016:10) suggests that parents and teachers should portray a positive attitude towards mathematics and the importance of mathematics as a science discipline could be strengthened by the media (Dowker et al 2016:10). Another possible intervention could be "writing out the negative effect", since "*writing enables a form of reappraisal that interrogates the need to worry in the first place. This in turn frees the working memory resources consumed by worrying, which can be deployed toward task performance*" (Dowker et al 2016:10). Another intervention strategy for managing mathematics anxiety is cognitive tutoring as well as non-invasive brain stimulation (Dowker et al 2016:11), a phenomenon which has only recently been explored. Dowker et al (2016:11-12) caution that non-invasive brain stimulation (also called Transcranial Electrical Stimulation) should be administered under strict supervisory conditions (Dowker et al 2016:11-12) and additional empirical evidence is needed to validate its 'effects'. Other remedial strategies of dealing with mathematics Anxiety, for example cooperative learning, has been suggested (Mokotjo 2017:59).

What is certain is that mathematics anxiety and the effects thereof on an individual's academic and future career prospects can simply not be ignored anymore. Research (Dowker et al 2016:3), suggests that "*eleven percent (11 %) of university students show high enough levels of mathematics anxiety to be in need of counselling*". In a small country like Namibia, eleven percent (11%) of university student population is a big concern, especially since the country has a population of less than 2.5 million people (World Bank 2018). In addition to this, Dowker et al (2016:11) state that sixty-eight percent (68 %) of students enrolled in mathematics classes experience high

mathematics anxiety, thus warranting a significant problem for the education sector (Dowker et al 2016:3).

It should also be noted that Aremu and Taiwo (2014:114) raised an interesting yet critical point by stating that many students choose their university courses based on how little Mathematical content is required by the degree programme (Aremu and Taiwo 2014:114; Mokotjo 2017:1). Aremu and Taiwo (2014) and Cuskelly and Faragher (2019) are of the opinion that mathematics anxiety is more attributed to emotional as opposed to intellectual problems (Aremu and Taiwo 2014:114; Cuskelly and Faragher 2019:153).

When it comes to Dyscalculia in adults, it is important to firstly understand the profile of the adult learner and his/her learning preferences. According to Rosic (2016), an adult learner is a student who is over the age of twenty-five (25) (Rosic 2016:46). These students are usually employed and have personal and professional commitments that serve as the driving factors for their lifelong learning. According to Rosic (2016:45), adult learners generally lack basic math skills and get anxious at the thought of taking a compulsory mathematics class. Despite the challenges associated with learning mathematics, adult learners are usually self-directed learners who take ownership of their own learning and have extensive life experiences (Rosic 2016:45-46). When it comes to the learning preferences of adult learners, the Andragogy learning theory is more appropriate. The Andragogy learning theory is best suited for adult learners, since is premised on the aspects of self-directed and autonomous learning. The learning theory was introduced by Malcolm Knowles in 1964 with the aim of creating a distinction between Pedagogy (the science of teaching) versus Andragogy (the science of teaching adult learners).

Someone might ponder about the impact that Dyscalculia has on adult learners, if any? When it comes to Dyscalculia in adults, Mavesere (2014:16) highlighted some warning signs that are associated with Dyscalculia in adults. According to Mavesere (2014:16), some of the warning signs include difficulties in acquiring Mathematical skills (Mavesere 2014:16), having trouble with more advanced Mathematical applications (especially if the foundational mathematics facts have not been mastered) (Mavesere 2014:16), have difficulties in understanding mathematics vocabulary (Mavesere 2014:17), are unable to calculate properly (Mavesere

2014:18) or have difficulty in the retrieval of arithmetic facts (Mavesere 2014:19). Other symptoms of Dyscalculia in adults include counting using their fingers, lacking number sense of numerosity above 1000 and failing to divide persisting up to higher education (Mavesere 2014:27). If these problems persist over a long period of time, then the learner (including adult learners) is prone to Dyscalculia (Mavesere 2014:19).

Although these challenges with mathematics may persist over a long period of time (Cuskelly & Faragher 2019:158), (Mavesere (2014:16) state that Dyscalculic students may perform well in other subjects, even though they demonstrate difficulty in mastering mathematics or mathematical-related subjects (Mavesere 2014:16). Mavesere (2014:16) also cautions that mathematical disabilities vary, and so do the signs and symptoms of Dyscalculia from person to person. Similar to the opinion of Mavesere (2014), Mokotjo (2017:36) advocates that more empirical research pertaining to Dyscalculia, especially within the context of South Africa, is needed and whether Inclusive Education policies have included Learners with Dyscalculic (Mokotjo 2017:36-37). Evidently, Dyscalculia is an area that is under-researched, especially within the context of Namibia and Namibian higher education institutions.

In order to establish a definite and accurate diagnosis of learning disabilities such as Dyscalculia, it is important to perform accurate diagnostic tests since Mathematical learning difficulties are often complicated and can result in a combination of difficulties (Mavesere 2014:24). These different types of problems associated with Dyscalculia are the result of the different types of tests used to conduct Dyscalculia and Mathematical learning difficulties screening (Mavesere 2014:24). Mavesere (2014) proposed various strategies for identifying Mathematical learning difficulties, such as the Dyscalculia Screener and Dyscalculium (Mavesere 2013:13-14). The Dyscalculia Screener is perceived to be more suitable for assessing Dyscalculia in children, whereas Dyscalculium is more suitable for adults (Mavesere 2014:13-14). Mavesere (2014), opted to use the Wrat-2 to diagnose Dyscalculia amongst her sample of fifty-two (52) students at her college in Bulawayo (Mavesere 2014:15). The researcher wishes to caution that diagnostic testing should only be performed by a trained professional, for example an educational psychologist, medical doctor or neurologist, in order to ascertain a definite diagnosis (Mavesere 2014:52). Lecturers

also play an important role when it comes to the early identification and referral stages when dealing with Dyscalculia.

2.4 IMPACT OF MATHEMATICAL LEARNING DIFFICULTIES ON ADULT LEARNERS

When it comes to successfully managing your finances as an adult, sound financial planning is heavily dependent on numerical efficiency and proficiency. Numerical competency is regarded as one of the basic life skills and consequences of failure to acquire such a skill results in minimum choices of programmes of study at tertiary institutions and limits employment opportunities (Mokotjo 2017:36-37; Navarro et al 2018:17,18; Park 2015:1). Numerical competence is dependent on various factors, one being your attitude towards the subject. According to research (Navarro et al 2018:18), there is a correlation between attitudes and experiences with mathematics and this will affect the performance of individuals in the subject.

Poor Mathematical competence is no exception within the South African context, resulting in high unemployment rates and an increase in poverty in many communities (Mokotjo 2017:37). From the research that was consulted, it is evident that South Africa is also affected by Dyscalculia and its after-effects. Research relating to fellow African states' numerical competence indicates that the South African numeracy was rated as one of the worst in the world in 2013, and in 2011 statistics have shown that South African learners have the lowest performance rate amongst 21 middle-income countries that participated in the survey that was conducted by the Trends in International mathematics and Science Study (TIMSS) (Mokotjo 2017:36-37). Individuals with Mathematical disabilities constitute about twenty-five percent (25%) of the United Kingdom (UK) population who are economically inactive and these individuals are said to contribute to the rate of unemployment, mental and physical illness, and some of them are incarcerated and cost the UK government approximately R54 billion South African Rand (Mokotjo 2017:37). Evidently, it is a financial burden on society if individuals lack the desired level of numerical competence. Mokotjo (2017) suggested that interventions in the

form of addressing dyscalculia not only empower students, but it also contributes to the overall well-being of our national economies (Mokotjo 2017:37).

When it comes to our Namibian context, the lack of numerical competence also has a negative impact on our society and country. Since there has been a steady increase in enrolments at Namibian higher education institutions, like the Namibian University of Science and Technology, it has been noted that there is a higher concentration of students enrolling for Managerial Science programmes (Navarro et al 2018:24-25), as opposed to the Engineering programmes. There is currently six (6) faculties at the Namibia University of Science and Technology, namely the Management Sciences, Human Sciences, Engineering, Health and Applied Sciences, Computing and Informatics and Natural Resources and Spatial Sciences (Navarro et al 2018:24-25). The programmes offered by these respective faculties vary in entry requirements, especially the level of Mathematical competence (Navarro et al 2018:24-25). Programmes offered in the Engineering fields require a higher level of Mathematical competence, as opposed to the Management Science related programmes (Navarro et al 2018:24-25). However, it should be noted that students that are enrolled for the Managerial Sciences programmes are required to take one (1) of the three (3) rudimentary mathematics classes, namely Basic Mathematics, Introduction to Mathematics or Basic Business Statistics (Navarro et al 2018:24-25). If students do not meet the mathematics requirements at the Namibia University of Science and Technology, then they should attend additional tutoring sessions in order to meet the demands of their classes (Navarro et al 2018:18).

Another researcher, Park (2015:1-3), also highlighted the importance of mathematics within the global society and concerns relating to mathematical learning difficulties. According to Park (2015:1), the United States of America (USA) also highly regards Mathematical proficiency as one of the vital components that is essential for individual fulfilment, active citizenship and career readiness in today's highly technical society (Park 2015:1). Park (2015:1-2) also stated that various state and federal educational policy makers encouraged a reform in the educational framework, with emphasis on the Science, Technology, Engineering and Mathematics (STEM) fields (Park 2015:1-2). This reform corresponds to the national initiative that was undertaken by the Namibian government (Gamundani and Jegede

2015:59) since the country gained its independence from South Africa in 1990. According to Park (2015:1-2), this reform within the STEM fields was established in order to focus on improving the students' Mathematical thinking (problem-solving), as well as to apply it to other related academic fields and to improve the number of students being admitted into college and eventually being absorbed into the workforce (Park 2015:1-3).

When it comes to the awareness surrounding dyscalculia, very few Namibians are aware of this mathematics learning disability and it is suspected that Dyscalculia may be an attributing factor to the low numerical competence of our students. Dyscalculia affects schooling, professional careers, as well as the physical and emotional wellbeing of individuals and has a direct impact on the socio-economic status, self-esteem and identity of an individual (Mokotjo 2017:36-37). As previously explained, mathematics is a complex subject that is dependent on various cognitive abilities (for example short-term memory, long-term memory, visuospatial skills, processing speed and language skills) (Mokotjo 2017:46), therefore the researcher is of the opinion that the learning disabilities that is associated with mathematics must be equally as complex.

2.5 LEARNING SUPPORT FOR STUDENTS WITH DYSCALCULIA

As part of a learning support strategy for teaching mathematics to students with dyscalculia, one has to understand the foundations of mathematics. The learning of mathematics is based on two (2) contrasting theories, namely the stimulus-response theory (teaching mathematics calculation skills) and the hypothesis testing theory (teaching mathematics reasoning skills) (Mavesere 2014:8). It is imperative to use both of these theories when teaching mathematics to Dyscalculic learners (Mavesere 2014:8). The mathematics learning disability Dyscalculia is regarded as an innate condition; however, it can be addressed (Mavesere 2014:55) if areas of Mathematical weakness are identified at an early age (Mavesere 2014:56). Mavesere (2014:56) suggests that early diagnosis of mathematics difficulties (as opposed to Dyscalculia), will assist the teacher in providing 'tailor-made' learning support strategies and/or interventions to the learner

Addressing negative perceptions that are associated with mathematics is also considered to be another form of learning support for dyscalculic students (Navarro et al 2018:18, 52-53; Dowker et al 2016:1-3, 8, 10; Mokotjo 2017:161 Cuskelly & Faragher 2019:158). Researchers like Cuskelly & Faragher (2019:158) suggested that the attitude towards teaching mathematics may affect the learning experiences and outcomes thereof. Cuskelly & Faragher (2019:158) stated that a strategy that was found to be effective (for Down Syndrome students with Dyscalculia) was the provision of external support (Cuskelly & Faragher 2019:158). They also made specific reference to the use of electronic calculators to teach Dyscalculic students (Cuskelly & Faragher 2019:158). The reason Cuskelly & Faragher (2019) advocate for the use of electronic calculators when teaching Dyscalculic students is that they are of the assumption that the calculating device will remove the computational load (an aspect which students with dyscalculia struggle with), thus enabling students to learn mathematics more effectively and efficiently (Cuskelly & Faragher 2019:159).

Another learning support strategy that was suggested by Rosic (2016:43) entails Quantitative and Math Support Centres (QmaSCs). The researcher suggests that these support centres could help different groups of students achieve their academic goals by providing a conducive learning environment, opportunities for collaboration amongst staff and students, as well as promote tutoring services (Rosic 2016:43). Namibia University of Science and Technology has a mathematics tutoring centre that is based on campus and has previously elaborated on the research that was conducted by Navarro et al (2018) on the effectiveness of the mathematics Tutoring Centre at the Namibia University of Science and Technology. Rosic (2016:45) also suggested the aspect of peer tutoring as part of a learning support strategy for Students with Dyscalculia.

Aremu and Taiwo (2014:113-115) are of the opinion that Dyscalculic students should focus on their successes as opposed to their failures, as part of a learning support strategy. The researchers are of the opinion that students should realise that they play a huge role in their problem-solving abilities. The researchers used the term ‘Emotional Freedom Techniques’ (EFT) (Aremu and Taiwo 2014:115). The EFT tool is a psychotherapeutic tool that is used to relieve many psychological conditions, including anxiety, low achievement, depression, post-traumatic stress disorders,

stress, addictions and phobias (Aremu and Taiwo 2014:115). When it comes to mathematics Anxiety, the EFT can be used to redirect old thought patterns or response mechanisms and create a new set of useful patterns or mechanisms of behaviour to replace the old phobic response (Aremu and Taiwo 2017:115). In their study, Aremu and Taiwo (2017) used a dual approach as part of their learning strategy, namely the Emotional Freedom Technique (EFT) and expanded upon their knowledge of Numerical Cognition Strategy (Aremu and Taiwo 2017:115). The study conducted by Aremu and Taiwo (2017) was predominantly focused on emotional problems associated with mathematics anxiety (as opposed to intellectual challenges) and the use of appropriate support strategies to address the emotional challenges. Researchers like Sokolowski and Ansari (2017:5) support the theory of students writing down their thought and feelings about mathematics (this is almost similar to the EFT technique). This will make students feel less nervous since the thought which has occupied their working memory has now been eliminated and they could focus more on solving mathematics problems using their working memory (Sokolowski and Ansari 2017:5). The researchers are adamant that students with mathematics anxiety can be helped to overcome or deal with it ((Sokolowski and Ansari 2017:5).

When it comes to screening for mathematics learning disabilities as part of the learning support strategies, research suggests the use of the Dyscalculia screener (Mokotjo 2017:5-6). A Dyscalculia screener is a computer programme that is designed to assess children's Mathematical achievement and their numeracy ability by measuring their response to number-based tasks (Mokotjo 2017:5-6). The challenge with this support strategy is that the dyscalculia screener test was published twenty-five (25) years ago and it does not consider the age of the student. An alternative suggestion was the Davis Dyslexia and Attention Deficit Hyperactivity Disorder (ADHD) assessment (Mokotjo 2017:5-6). Mokotjo (2017:3) also suggested the aspects of inclusivity, gaming (Nfon 2018:22-23; Mokotjo 2017:3) and an Active Learning Strategy (Mokotjo 2017:44) in order to assist Dyscalculic students (Mokotjo 2017:3). Mokotjo (2017:44) is of the opinion that an active learning strategy will not only assist Dyscalculic students to conceptualise learned theories, but it will also

assist them to independently reason and derive answers to their Mathematical problems.

Although Technological support strategies do not form part of this study, the researcher feels that it is worth including some aspects thereof as an alternative option. Gaming software has proven to be a popular option when it comes to mathematics technological learning support. Some of the examples are briefly discussed. With regard to the multimedia learning support aspect, mathematical software such as '*Might Math*' (which is available for classroom and home use that incorporates interactive videos, stories, music and visual cues that are related to Mathematical concepts), Electronic Math Worksheets (worksheets that are available in electronic format can be customised for students suffering from visual difficulties and provide immediate feedback as well as offer homework help topics) and the 'Number Race' Mathematical Software (assists with making visual-spatial connections and is able to track problem areas and adjust the level of difficulty as the student progresses and caters for all ages and learning styles) (Nagavalli and Fidelis 2015:3) can be beneficial as mathematics teaching aids. Other multimedia devices such as the Adapted Measuring Devices (regular measuring devices which contain a text and voice synthesizer), books such as *Teach Yourself Visually: Algebra*, a *Babakus* (a calculator that combines a slide ruler and Abacus and assists in performing arithmetical functions), Computer Assisted Instruction (CAI) (effective in motivating students, providing individual instruction, monitoring of progress as well as drill and practice activities), and iPad applications (for example the MathBoard and Long Division application) (Nagavalli and Fidelis 2015:4) could also prove useful when teaching Students with Dyscalculia. Different types of electronic pens, electronic calculators, text-to-speech engines, graphic tablets and virtual classroom have also been suggested as part of the educational technology and multimedia learning support strategies for dyscalculic students (Nagavalli and Fidellis 2015:5). Emphasis has been placed on software like *Kurzweil 3000,* which is a programme that has specifically been designed for dyscalculic students (Nagavalli and Fidelis 2015:6). With the *Kurzweil 3000*, students can scan an article and the programme reads it aloud according to the reading pace that is pre-set by the learner as well as highlights text and takes notes (Nagavalli and Fidelis 2015:6).

Apart from the technological learning support that was suggested, one can also explore the multisensory approach as part of the learning support intervention for dyscalculic students (Nagavalli and Fidelis 2015:6). Software that can be used for multisensory learning support includes '*TouchMath*', which encourages learners to establish a tactile connection by conducting number and symbol tracing (Nagavalli and Fidelis 2015:6). Another programme is '*Namicon*' , which allows students to interact with the numbers and to create a realistic effect (Nagavalli and Fidelis 2015:6-7, as well as '*Stern's Structural Arithmetic'*, which is a multisensory mathematics game that builds up number knowledge and number facts in a logical and structured manner in such a way that enables the learner to think logically and reason mathematically (Nagavalli and Fidelis 2015:8).

Lastly, the evidence that was presented in this section indicates that learning difficulties that are associated with mathematics are complex in nature and warrant further empirical research, particularly within the African context. These studies outlined important aspects pertaining to the importance of mathematics within society, the challenges associated with mathematics as a scientific discipline, the impact on future career and lifelong learning prospects, as well as learning support for students with mathematics learning disabilities. In the chapter that follows, the researcher provides an overview of the research design and methodology (Chapter 4) on which this study is premised.

CHAPTER 3 – METHODOLOGY

3.1 INTRODUCTION

The purpose of this chapter is to describe the paradigm, methodology, methods and techniques used in the study. The chapter also addresses issues of trustworthiness and ethical considerations.

3.2 PARADIGM AND METHODOLOGY

The study employed qualitative methodology. Qualitative methodology is located within interpretivist paradigm and thus interpretivism design. According to Creswell (2003), a researcher working under the interpretivist paradigm has to rely on the participants' perspective of the subject under study. This is supported by Cohen, Manion and Morrison (2011:17-18), who believe that the interpretivism design is characterised by a concern for the individual and the central idea is to understand the subjective world of human experience. Interpretivist theorists believe that the cause of the behaviour displayed by the subject under study lies in their past experiences (Cohen, Manion and Morrison 2011:17). They also believe that theory should not precede research, but should follow it (Cohen, Manion and Morrison 2011:18). Thus, the theory yields insight and understanding into the individual's behaviour (Cohen, Manion and Morrison 2011:18). The Interpretivist paradigm is suitable for this study because it will help me understand the experiences of students who have difficulties in mastering mathematics.

3.2 POPULATION

The population used for this research was 131 Distance education adult students above the age of 25 and above, enrolled for Basic Mathematics course during the first semester of the 2019 Academic year, at NUST, from the ten regional centres. This population excluded the late registrations. Rosic (2016:46) has classified this group as the age group for adult learners, which is the primary age group for this study. This population was made up of students who were struggling to pass Basic Mathematics and had repeated the course at least twice or more during the academic years 2016 to 2018.

3.2.1Sample and sampling technique

A sample of 50 students was drawn from population using Purposive Homogeneous Sampling technique, to students who are struggling to pass Basic Mathematics and should have repeated the Basic Mathematics at least two times or more in order to form part of the sample. This type of sample enables researchers to hand-pick the cases to be included in the sample, provided that they possess the desired characteristics being sought after by the researcher (Cohen et al 2007:156-156). The sample consisted of five students from each of the ten regional centres of the Centre for Open and Lifelong Learning at NUST. The sample size was deemed sufficent .

3.3 DATA COLLECTION METHODS

Data collection methods in this study are interviews and an open-ended online questionnaire. These data collection methods were found suitable to collect data that would help us understand some prevalence of dyscalculia and other maths learning difficulties among students at NUST. The purpose of the study is to explore and understand the experiences of NUST students in order to establish whether their poor performance in maths is due to dyscalculia and other maths learning difficulties.

3.3.1 Research Instruments

For this study, the researcher used an open ended online questionnaire and interview guide to collect data. The online questionnaire was developed using *Google Forms*, which is a web-based application that can be used to develop and administer surveys online. The questionnaire consisted of “Yes”/”No” questions and open ended questions.

In addition to the questionnaire, the researcher also developed an interview guide to collect data. The online questionnaire and interviews allowed the researcher to collect the perceptions and attitudes towards Mathematics amongst students in Open and Distance Learning within Namibia. Participation in the survey was on a voluntary basis and anonymity was ensured in all phases of the research. The online survey contained questions such as participant age, year of first registration for Basic

Mathematics, questions on attitude towards Mathematics, questions on challenges associated with Mathematics such as the areas in which they experience difficulty when it comes the application of Mathematical concepts and learning support associated with Mathematics for distance education students. The advantage of using an online survey is that it is cost-effective and convenient. The participants can complete the survey where ever and whenever (within a given time frame). The disadvantage might be the aspect of authenticity (although the participants' email addresses are included in the response summary which is provided by *Google Forms*) on behalf of the respondents with regard to the responses provided for the online survey and a low response rate amongst the participants.

The open-ended online questionnaire was developed using *Google Forms*, which is a web-based application that can be used to develop and administer surveys online. In addition to the open-ended online questionnaire, the researcher also used interviews (telephonic and one-on-one). The questions that were contained within the open-ended online questionnaire and interviews, was informed by the Content Analysis.

The open-ended online questionnaire and interviews allowed the researcher to collect the perceptions and attitudes towards mathematics amongst students in Open and Distance Learning within Namibia. Participation in the survey was on a voluntary basis and anonymity was ensured in all phases of the research. The open-ended online questionnaire contained questions such as participant age, year of first registration for Basic mathematics, questions on attitude towards mathematics, questions on challenges associated with Mathematics such as the areas in which they experience difficulty when it comes to the application of mathematical concepts and learning support associated with mathematics for distance education students. The advantage of using an open-ended online questionnaire is that it is cost-effective and convenient. The participants can complete the survey where ever and whenever (within a given time frame). The disadvantage might be the aspect of authenticity (although the participants' email addresses are included in the response summary which is provided by *Google Forms*) on behalf of the respondents about the responses provided for the open-ended online questionnaire and a low response rate amongst the participants.

3.3.2 Credibility, Trustworthiness and Reliability

To ensure reliability of the open-ended questionnaire, the researcher used literature and concepts on dyscalculia to generate the questions. Furthermore, credibility and the trustworthiness of the results were enhanced by collecting data using the online open ended questionnaire and conducting interviews. According to Patton (2002), credibility of the findings of a study depend on the richness of data.

3.4 ETHICAL CONSIDERATIONS

Ethical clearance was sourced through the Namibia University of Science and Technology (NUST) as well as the University of South Africa's (UNISA), considering the respective institutions' research policy guidelines. After ethical clearance was granted, the research commenced with the data collection. At the Namibia University of Science and Technology, the ethical clearance application with the relevant supporting documents (the approved research proposal and research instruments) was submitted to the Registrar's office and approval was granted. Since the researcher had to make use of enrolment and examination statistics, the researcher had to ensure that all personal information such as the students' names and surnames, identification numbers and personal contact details was handled and treated in accordance with the research guidelines and ethical requirements. This personal information would not be disclosed at any stage of the research process and only the researcher would have access to the student's personal information. Participants were reassured as part of the Informed Consent Form that their personal information will be kept confidential and their participation was based on a voluntary basis. The purpose of the Informed Consent Form was to protect the rights of the participants, as well as the researcher.

The following information was contained in the Informed Consent Form:

- The researcher's name, surname, contact details, UNISA student number and research supervisors' details
- Sponsoring institution
- Sampling method
- The purpose of the research

- Benefits for the participants
- Level and type of participation required
- Note of the risks involved
- Confidentiality guaranteed
- Withdraw policy and consequences to the participant
- Contact details of the researcher
- Any other applicable information that the Ethical Clearance Committee might have deemed fit for the purpose of this research

The students' personal information will be kept confidential and will only be disclosed at the consent of the participant(s) for the sole purpose of supporting the research. The results that were derived from the survey would be available only to the researcher and released to relevant stakeholders through the consent of the participants. Anonymity was ensured through all stages of the research. No personal information was reflected in the capturing and analysis of data.

CHAPTER 4: DATA COLLECTION AND ANALYSIS

4.1 Introduction

This Chapter will provide a description of the data collection process and a discussion on data analysis. The study had to address the following objectives:

- To explore the experiences of Basic Mathematics students on learning mathematics at NUST.
- To identify the prevalence of dyscalculia and other learning difficulties associated with mathematics
- To suggest support strategies that could be used to assist adult learners who might be having dyscalculia and/or any other maths learning difficulties at NUST

4.2 Data Collection

Data were collected from a sample of 50 distance education students who were enrolled for Basic Mathematics in 2019, at the Namibia University of Science and Technology, a University that offers its education through the distance learning mode. Data collection was in two phases. During the first phase, data were collected using an online questionnaire consisting of closed and open-ended questions. In the second phase, interviews were used to supplement the questionnaire in order to enhance the credibility of the study.

First Phase: The researcher used Google Forms, a web-based application, to develop and administer the questionnaire to the participants. Prior to administering the open-ended online questionnaire, the researcher contacted the participants via email and telephonic calls in order to explain the purpose and the importance of the study. Thereafter, the researcher emailed the hyperlink for the open-ended online questionnaire to the participants. The participants had to complete the open-ended online questionnaire within the given time frame. Once the due date for the survey had passed, then the researcher extracted the information from *Google Forms* and the data were analysed accordingly.

Second Phase: The interview tool was administered telephonically (individual interviews) and in print format (one-on-one interviews). One-on-one interviews were conducted with students who attended the Basic Mathematics weekend face-to-face tutorials at the Main Campus (Windhoek). The one-on-one interviews enabled the researcher to validate the findings as outlined within the open-ended online questionnaire. The one-on-one interviews also enabled the students to discuss underlying issues that were affecting their performance in Basic Mathematics, something which might not have been addressed within the open-ended online questionnaire.

The questions contained within the interviews were derived from the literature that was consulted for this study. A total number of twenty-five (25) students who attend weekend face-to-face tutorials for Basic Mathematics at the Main Campus in Windhoek were interviewed. The one-on-one interviews were conducted with a group of eighteen (18) students, of which seven (7) students were interviewed

telephonically since they were remotely located and eighteen (18) students were interviewed whom were based locally and whom attended the Basic Mathematics weekend face-to-face tutorial sessions at the Main Campus. The same survey, which contained five (5) open-ended questions, was used for the telephonic and one-on-one interviews. The interviews were conducted on an anonymous, voluntary basis. After conducting the telephonic interviews and the one-on-one interviews, the researcher analysed the responses. The purpose of the interviews was to supplement the findings of the open-ended online questionnaire and to explore any additional underlying perceptions and feelings which previously did not form part of or were addressed in the open-ended online questionnaire.

The one-on-one interviews were very valuable for the researcher. The researcher provided an overview of the study to the participants and highlighted its importance. After a brief discussion with the group of students, the researcher administered a paper-based survey. Using the Thematic Analysis approach, the researcher transcribed the responses onto a word document in order to classify and code data that was derived from the interviews.

4.3 Data Analysis

In this section, the researcher presents the analysis of interviews, followed by the content analysis results.

4.4.1 Interviews Analysis

Thematic Analysis (Braun, Clarke, Hayfield & Terry 2019:57-70) was used to analyse the data. The researcher followed 5 steps as explained below.

Step 1: During the first step of the Thematic Analysis, the researcher transcribed the data after the data collection process.

Step 2: The second step entailed reading and re-reading the information.

Step 3: The third step entailed identifying codes by underlining the words related to the interview questions. For example, every aspect entailing an element of support

(extra classes, lecturers assisting distance education students) would be classified and coded under Learning Support which is one of the objectives of this study.

Step 4: This step entailed reviewing the themes. During Step 3 (searching for themes), the researcher realised that some themes seemed similar and therefore had to review and refine the themes in order to avoid any duplication in meaning or having themes that does not suit the research questions. Some of the themes that overlapped includes online learning support and learning materials, both relating to learning support as the overall theme.

Step 5: During this step, the researcher sifted the data that corresponded to the objectives of this study. The data were analysed using the objectives of the study, namely symptoms, related learning difficulties and learning support. The themes that were derived from the content analysis were coded.

Step 6: During the final step of the process, the researcher produced a report that highlighted the working themes and the relationship amongst them. The relationship amongst the themes was demonstrated in the form of a Learning Support Pyramid.

4.4.2 Open-Ended Online Questionnaire

The open-ended online questionnaire contained seventeen (17) questions, which entailed ‘clicked options’ (a list of options was provided from which the participant made a selection from by clicking on the relevant option) and detailed written responses in the form of short answers or paragraphs. The researcher sent out numerous reminders to the respondents that had agreed to partake in the survey. Despite having sent the online form to at least fifty (50) participants, only sixteen (16) responses or a thirty-two percent (32%) response rate was received. The findings from these sixteen (16) responses are explained in relation to the objectives of this study and these objectives have been changed themes

Theme 1: Students experiences learning maths.

If we consider the performance of the Basic Mathematics students who are currently enrolled in the distance education mode of study, it seems as if some students

(Figure 6) have been enrolled for Basic Mathematics from 2012 to date and have still not been able to pass it.

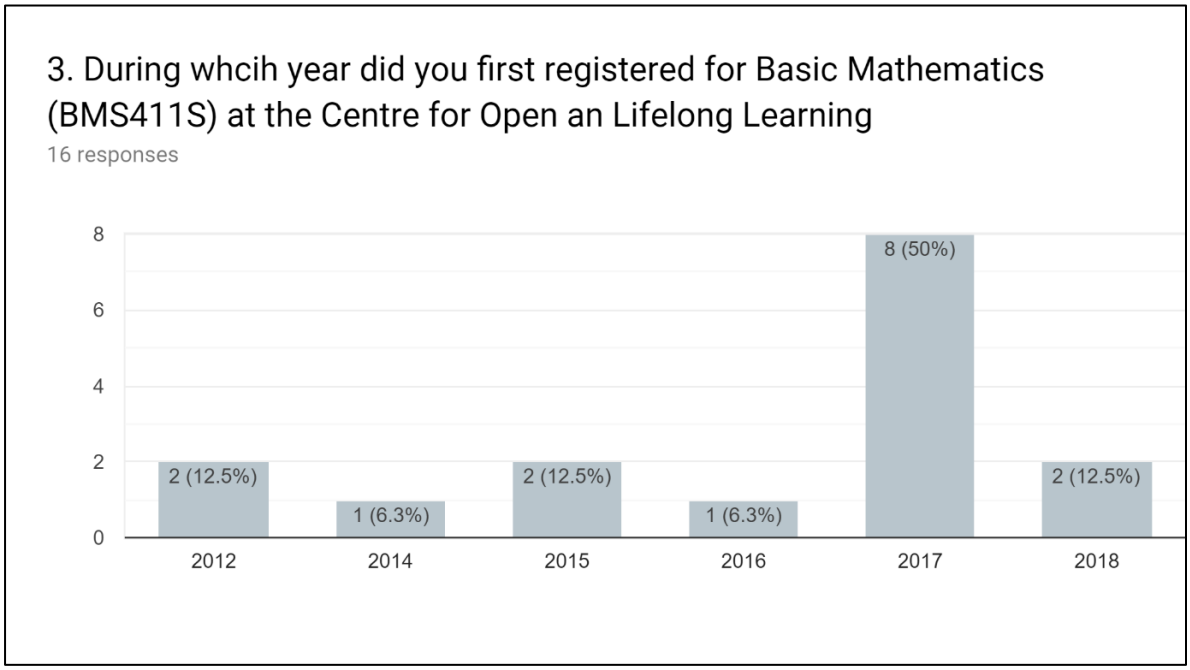

Figure 6: First year of registration for Basic Mathematics at the Namibia University of Science and Technology

It was no surprise that 100% of the participants admitted to having repeated Basic Mathematics (Figure 7).

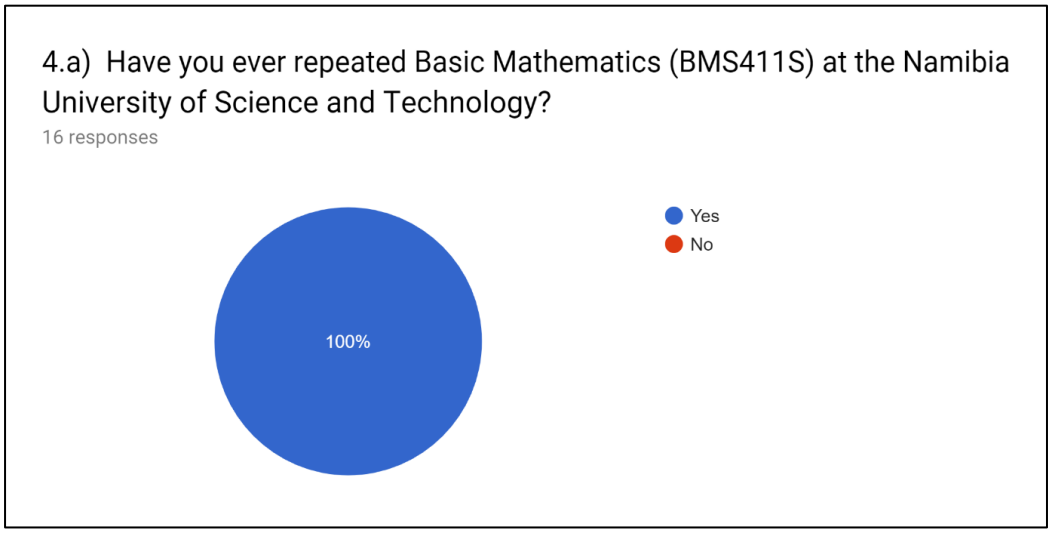

Figure 7: Basic Mathematics repetition

When participants were asked about the problems that they have experienced with mathematics, 87.5% (14/16 participants) responded that they experience problems with a simple calculation, subtraction, multiplication, and division (Figure 8A).

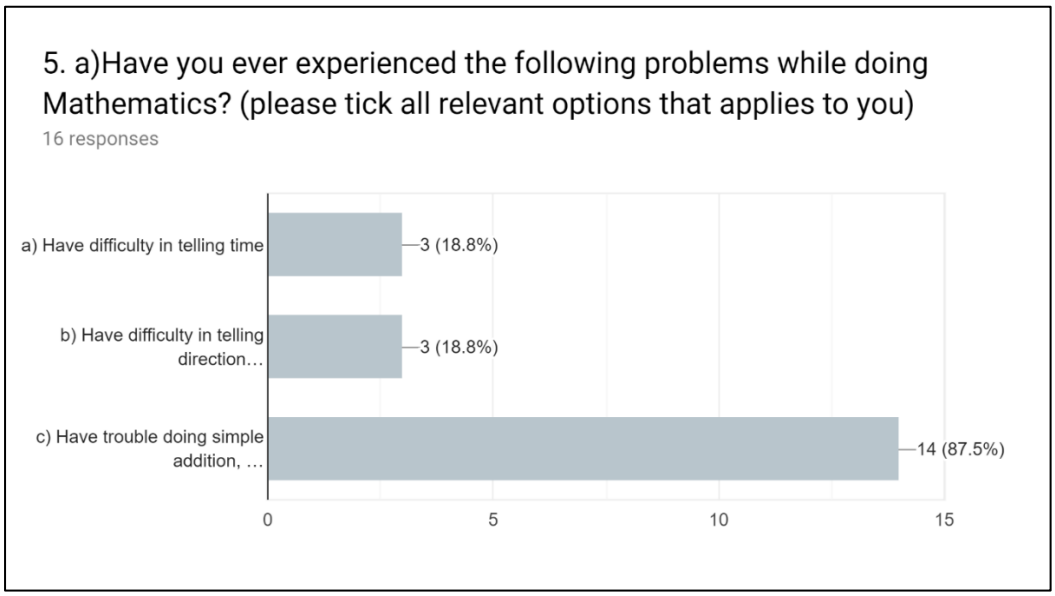

Figure 8: Challenges faced when doing mathematics

The participants also confirmed that multiplication was the most challenging application (Figure 9).

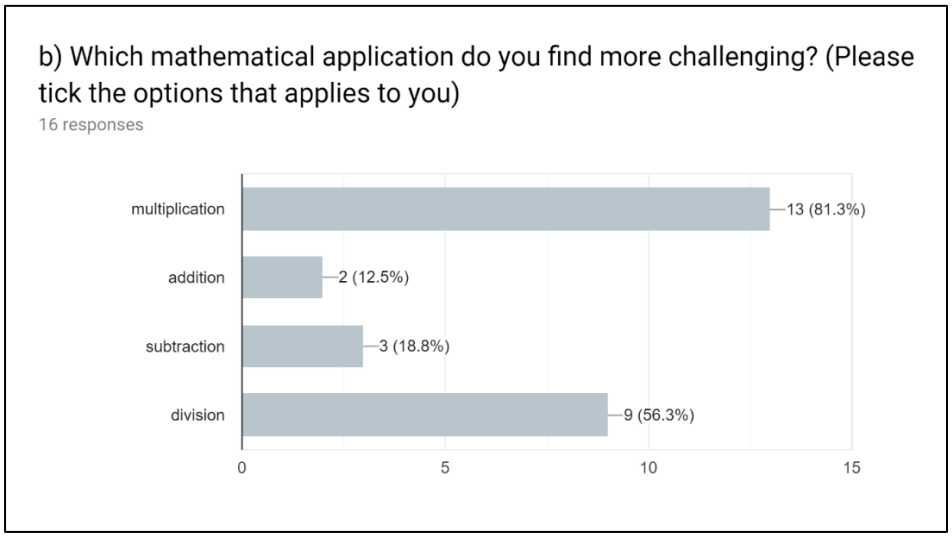

Figure 9: Challenges with mathematics applications

When it comes to the challenges that are associated with mathematics in relation to numeracy and literacy skills, it was also interesting to note that 50% of the

respondents experienced challenges with recalling of numbers, 12.5% experienced challenges with writing and 43.8% confirmed that they did not experience any of the challenges listed (reading, writing and recalling of numbers) (Figure 10).

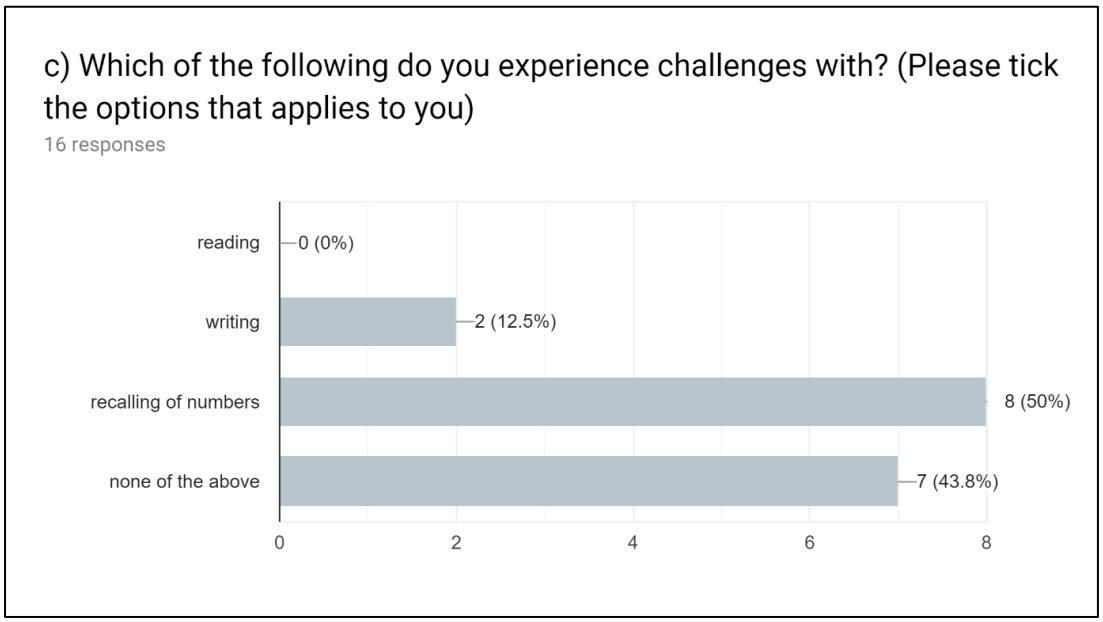

Figure 10: Challenges with Numeracy and Literacy skills

In addition to the above, 93.8% of the participants confirmed that they experience challenges with remembering mathematics formulae (Figure 11).

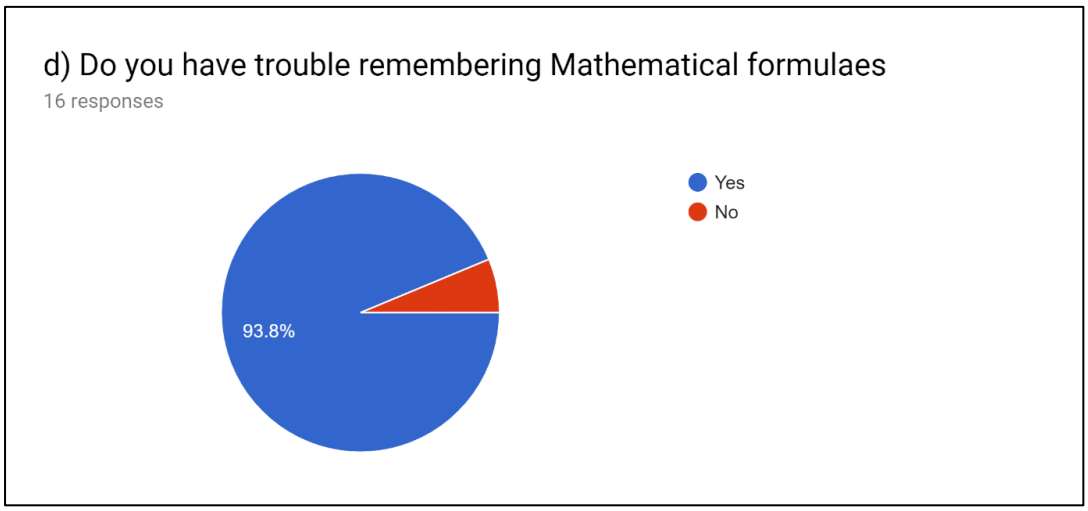

Figure 11: Challenges with remembering mathematics formulae

When participants were asked if they experience trouble with remembering mathematics concepts (numerosity and the number system), 93.8% of the participants responded “Yes” (Figure 12).

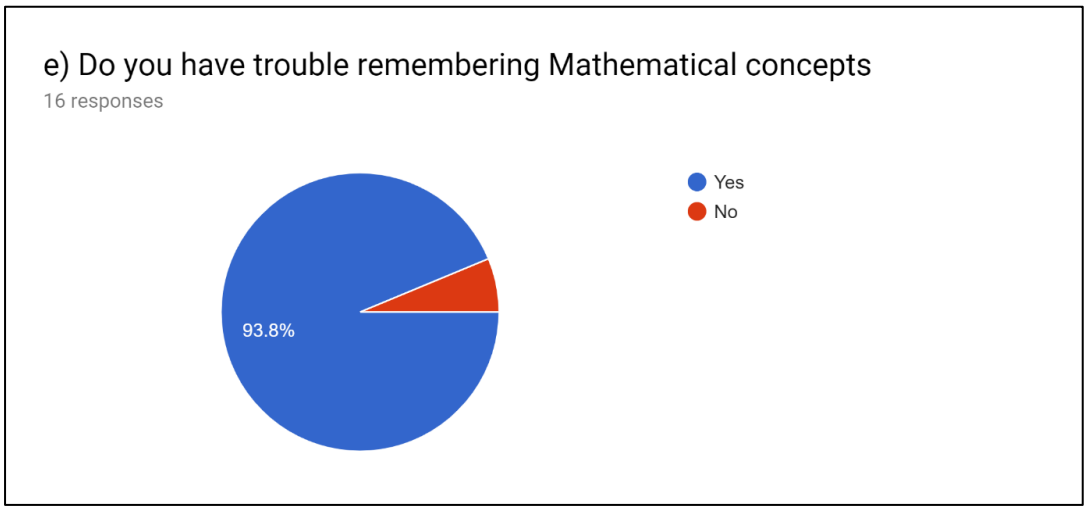

Figure 12: Challenges with mathematics concepts

Participants were also asked if they experienced trouble reading mathematics graphs and 68.8% of the participants responded “Yes” (Figure 13).

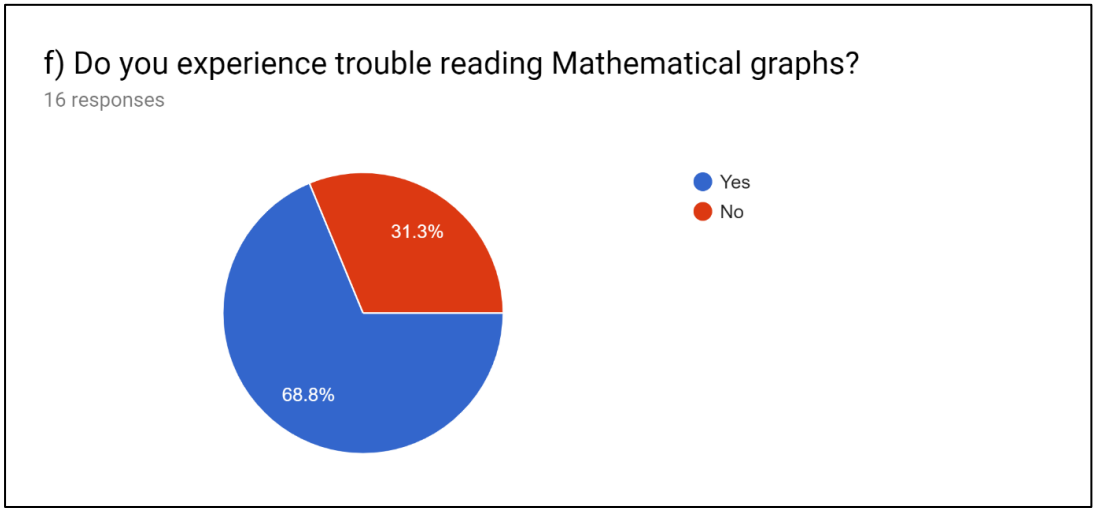

Figure 13: Challenges with mathematics graphs

When it came to the challenges that are associated with reading mathematics charts, 62.5% of the participants confirmed that they did experience challenges with reading mathematics charts (Figure 14).

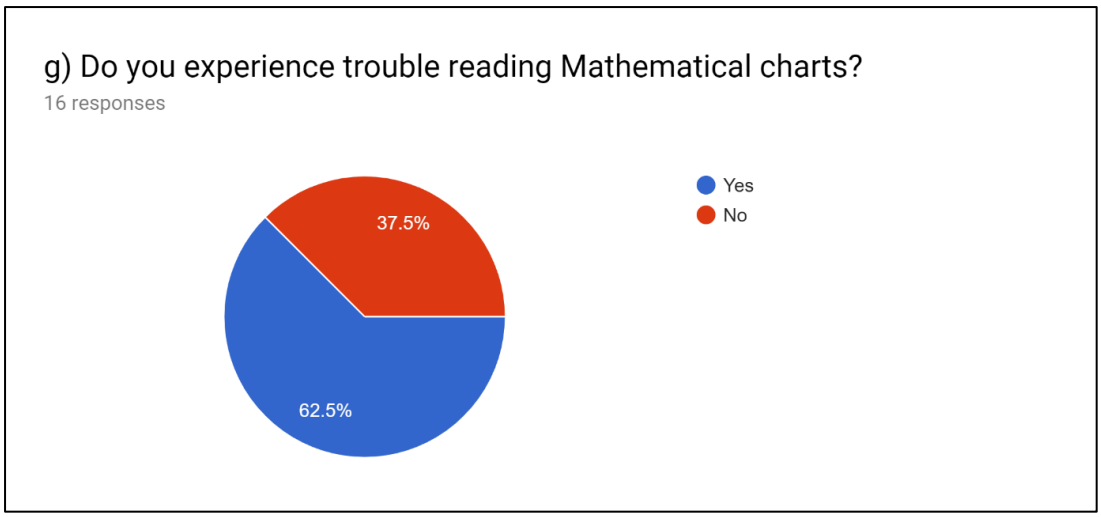

Figure 14: Challenges with mathematics charts

Regarding mathematics estimations, 87.5% of the participants acknowledged that they have challenges with mathematics estimations (Figure 15).

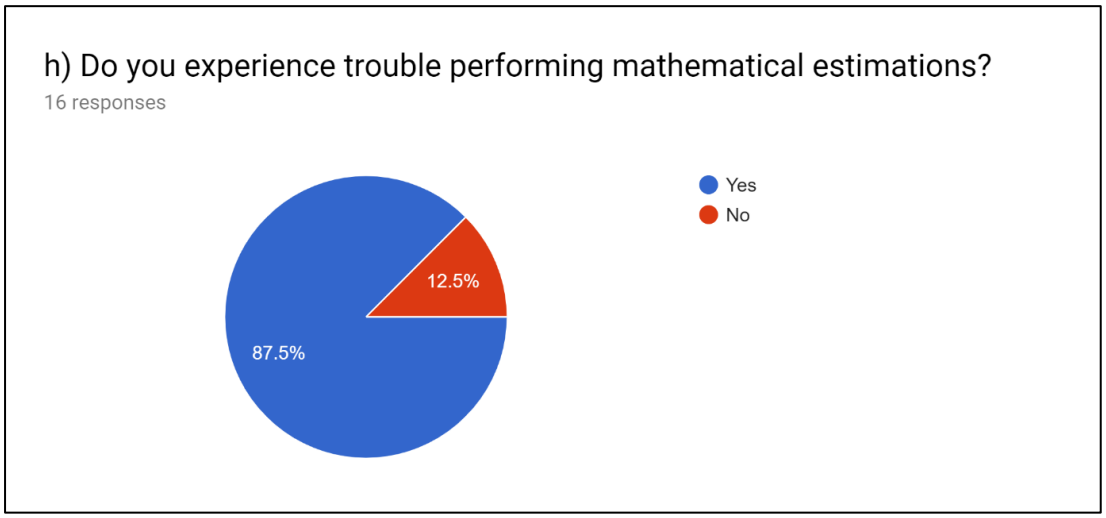

Figure 15: Challenges with mathematics estimations

Interestingly, 50% of the respondents acknowledged still using their fingers to count on or perform simple mathematics calculations (Figure 8I). Finger counting has been identified as one of the symptoms of Dyscalculia in adults by researchers (Mavesere 2014:27; Nagavalli and Fidelis 2015:1-2; Cuskelly & Faragher 2019:152-159)

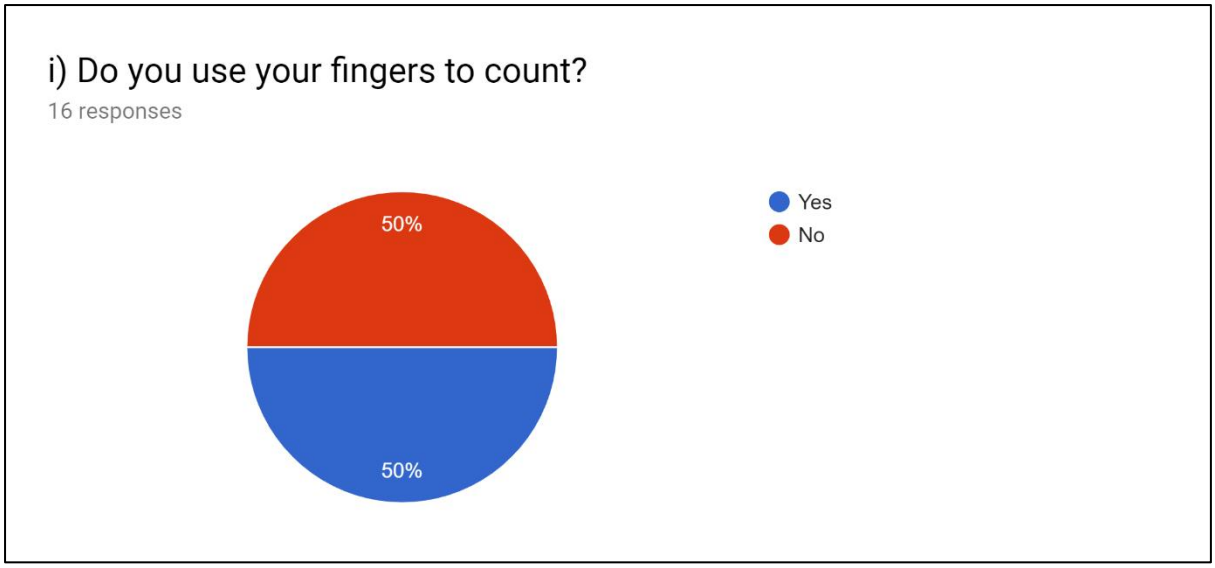

Figure 16: Prevalence of finger counting amongst participants

However, the despite having to use finger counting, some of the participants acknowledged that they can perform mental mathematics task without using a calculator (Figure 17).

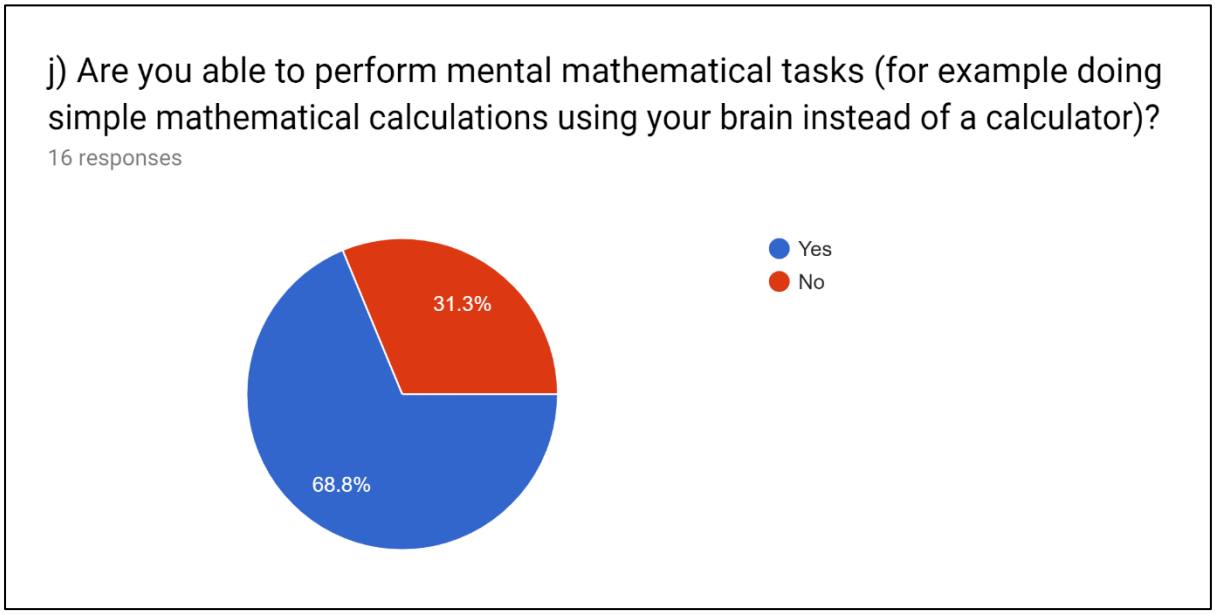

Figure 17: Challenges with performing mathematics mental tasks

The participants (87.5% of them) also confirmed that it took them longer to perform mathematics tasks in class as opposed to their peers (Figure 18).

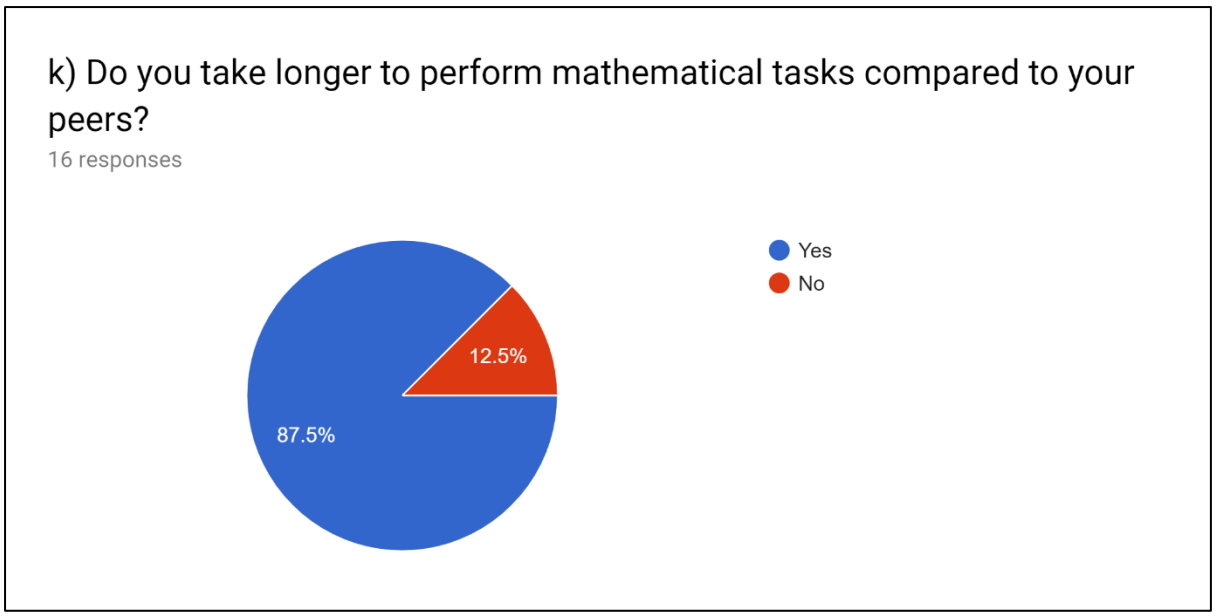

Figure 18: Challenges with mathematics task completion in relation to the participants' peers

By looking at the above results as derived from the open-ended online questionnaire, it confirms that Dyscalculia cannot be ruled out amongst the participants, especially since some of the conditions that are associated with Dyscalculia are evidently present within the responses provided. Some of the symptoms of Dyscalculia entails adults using finger counting (Mavesere 2014:27), having trouble with performing simple mathematics calculations, having trouble with remembering or recalling of mathematics concepts and formulae (Mavesere 2014:16-19; Mokotjo 2017:28, 30; Lewis & Lynn 2018:2; Nagavalli and Fidelis 2015:1 and Cuskelly & Faragher 2019:152-159).

When the participants were asked if they were aware of the mathematics learning disability, Dyscalculia, 68.8% of the respondents answered 'No' (Figure 19).

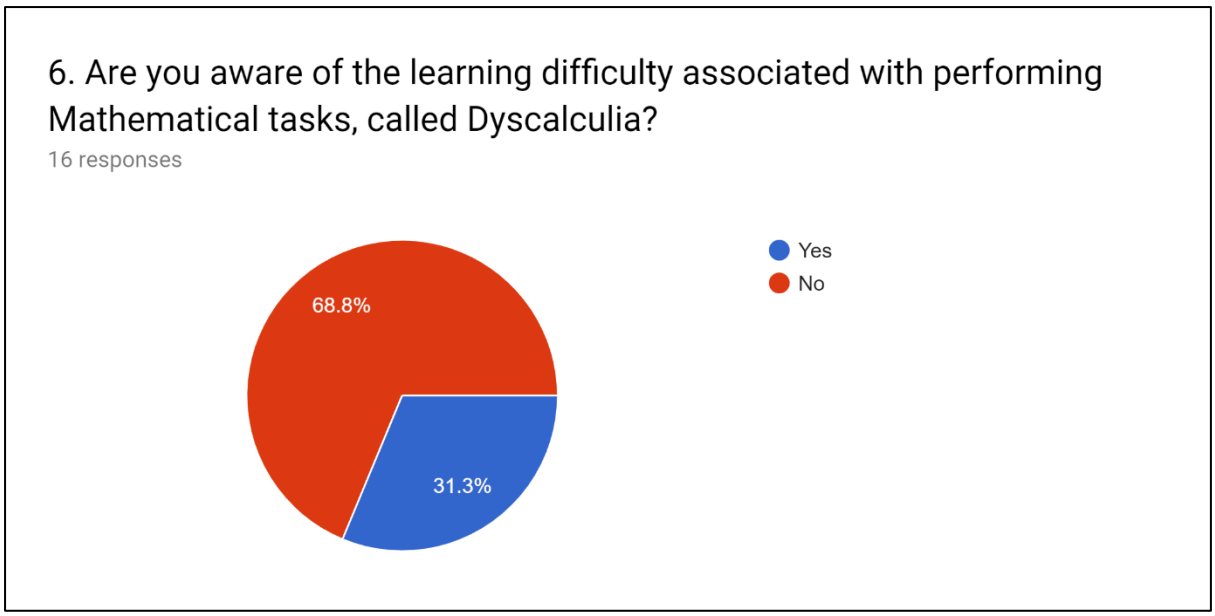

Figure 19: Awareness about the mathematics learning disability, Dyscalculia

In addition to this, participants were also asked if they were ever diagnosed with a learning disability at school or university, and 100% of the respondents answered 'No' (Figure 20). The early identification and screening of learning disabilities such as Dyscalculia is crucial (Mokotjo 2017:170) and should form part of the learning support services that are offered by our schools and universities if we were to successfully address the challenges of low pass rates in mathematics. The aspect on learning support will be discussed in more detail under Objective 3 of this Chapter.

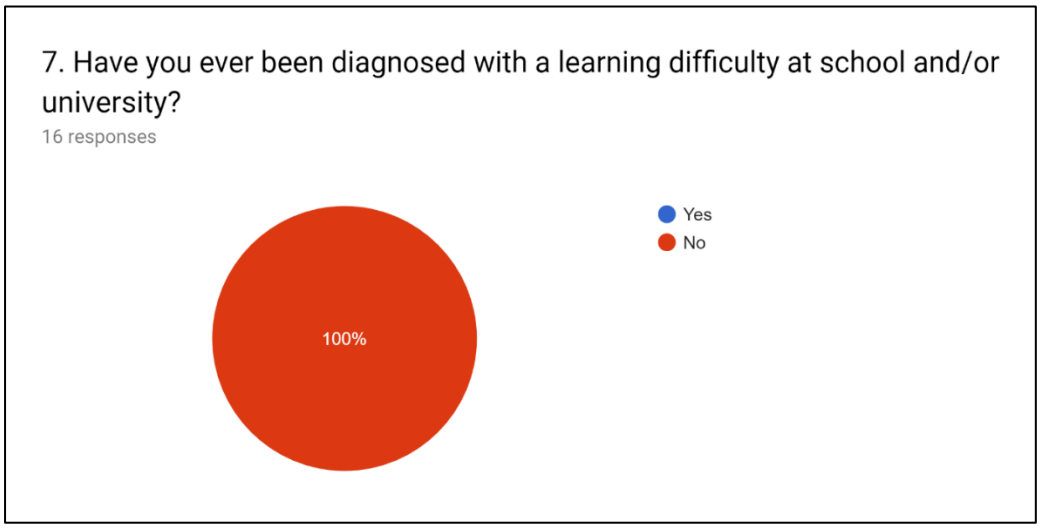

Figure 20: Diagnosis of a mathematics learning disability amongst the participants

Some of the reasons that were provided for the lack of early identification and screening for mathematics learning disabilities amongst the participants included '*I've never been diagnosed befo*re', '*No I don't have any learning difficulty*', '*not at all'* and '*no*' (Figure 21). No year of diagnosis could also be provided by the participants since they have acknowledged not having a mathematics learning disability (in the absence of a formal diagnosis) (Figure 21).

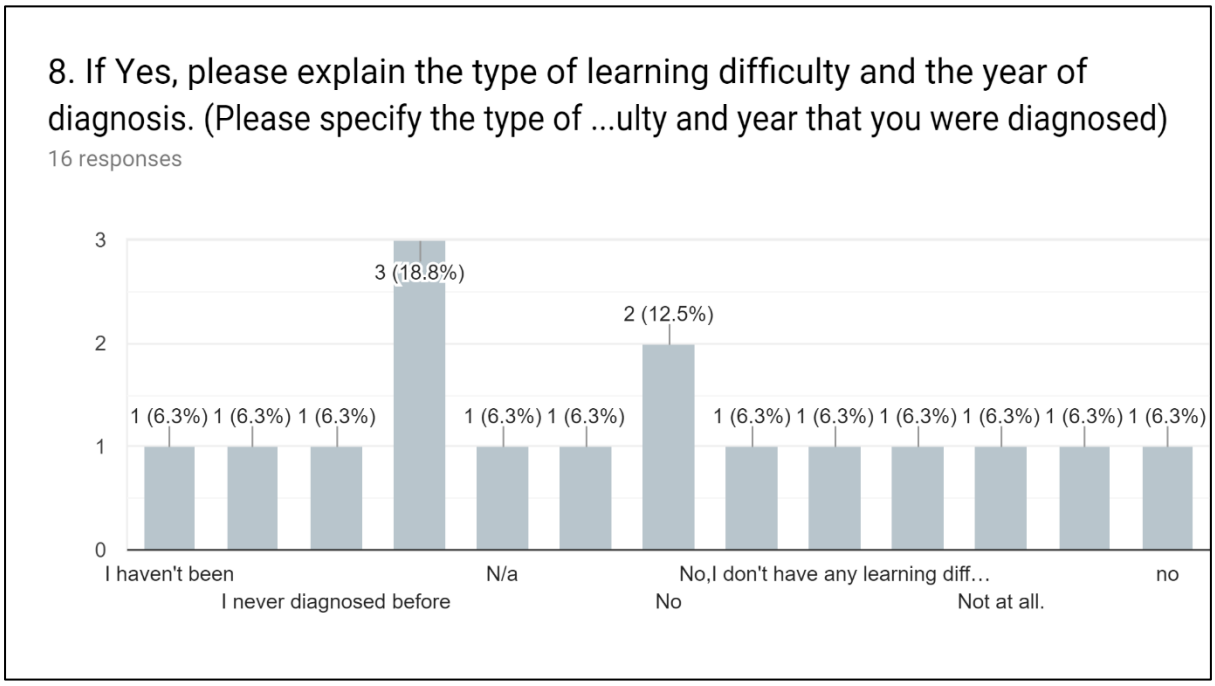

Figure 21: Type of learning disability and year of diagnosis

By looking at the responses provided for the open-ended online questionnaire, it was evident that the respondents lacked knowledge and awareness about the mathematics learning disability, Dyscalculia, and the researcher is of the opinion that the respondents might be oblivious that this lack of awareness about Dyscalculia only adds insult to their injuries.

When it comes to the technical aspects (for example the application of formulae, recalling of facts) of the subject, some students admitted to having problems with the application of formulae. Some students even hinted saying that their last interaction with mathematics was in school and they did not have to deal with it again for some time until they started their studies at university again, while others suggested that this subject (Basic Mathematics) needs to include the foundational skills (starting from scratch with mathematics). This means that the Basic Mathematics tutors

cannot just 'assume' that their students conversed in the basics pertaining to mathematics.

Theme 2: Other learning difficulties associated with mathematics.

Whilst analysing the data, the researcher was able to identify other learning difficulties that were associated with mathematics. Interestingly, the results from the open-ended online questionnaire attest to the presence of mathematics anxiety. When students were asked if they have ever experienced anxiety when dealing with mathematics, 93.8% of the participants responded "Yes" (Figure 22). This confirms the suspicion of the researcher that adult students who are dealing with mathematics might suffer from mathematics anxiety and this might have a direct impact on their performance. According to research (Aremu and Taiwo 2014:113-114; Mokotjo 2017:27; Cuskelly and Faragher 2019:153), mathematics anxiety affects many individuals through feelings of tension, apprehension and fear and can be attributed to pre-existing difficulties with mathematics (Dowker et al 2016:4).

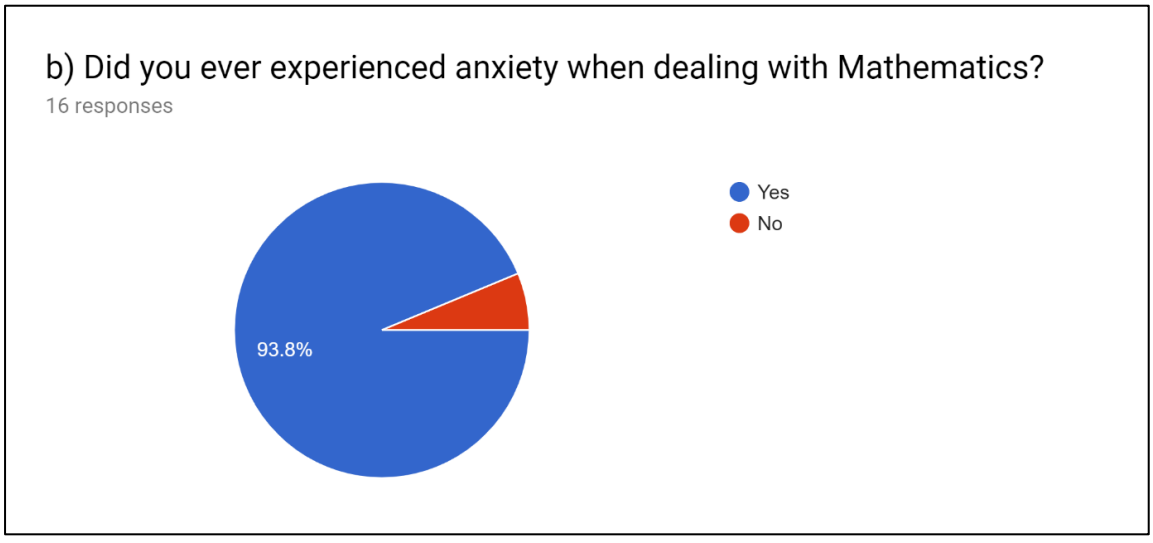

Figure 22: Prevalence of mathematics anxiety

In addition to the open-ended online questionnaire, the telephonic interviews also attested to the element of fear being present when participants had to deal with mathematics. From the respondents' tone of voice, the researcher could sense the frustration and fear when participants responded "*So the performance it's quite… I've*

had to deal with some of my fellow students who find this very difficult and then they have to repeat the subject most times" and "*I think most common challenge is linked to fear because students generally fear mathematics and thus they end up not having an understanding of it*" (respondents 1 and 6 – Appendix 9) that was associated with this course. More than one student responded that "*I've been suffering with mathematics for the whole time. It's the only subject I have left. And I just can't seem to graduate and I'm like if I don't finish it this year and it's all over I have to start all over again and I'm sitting with a problem*" and "*Otherwise you end up just having a lot of those people who do not pass mathematics? And they're not even graduate*" which confirmed that this is the only subject that is preventing them from graduating (respondents 1 and 4 – Appendix 8), while all of the participants agreed that they were struggling with mathematics. One participant even stated that she had to '*repeat the subject most times*' (respondent 1 – Appendix 8). Another student admitted that she was not aware of a mathematics learning problem called Dyscalculia when she stated "*Most of you probably don't know that there is this learning difficulty that there is so they just feel that mathematics is not for them. But they just don't understand the subject at all. I have also got the same thing to me that I don't understand mathematics at all. I never thought that maybe oh, I never knew that they could be a difficulty in itself*") (respondent 1 – Appendix 8) and related her experience to learning about the phenomenon as a 'wow' moment by responding "*Unknown to me. It was a wow moment. Oh, okay, and then when you do such a thing the challenges associated with mathematics that can actually be clinically proven*" (respondent 1 – Appendix 8), while others felt that mathematics was just not for them (respondents 1 and 2 – Appendix 8). One respondent even admitted saying that when she hears the word mathematics then the "*pressure goes up*" (respondent 1 – Appendix 8).

These responses confirm that mathematics anxiety and fear can be regarded as other learning difficulties that are associated with mathematics. This fear can then result in the respondents becoming frustrated since they feel that they simply cannot master mathematics.

Theme 3: Support strategies that could be used to assist adult learners who suffer from Dyscalculia and/or mathematics anxiety at the NUST.

The researcher feels that support is the most important element and a crucial objective which forms part of this study since it has a direct impact on the quality of learning for the Basic Mathematics distance education students. The researcher is of the opinion that early identification and screening should form of the learning support services that are currently offered to the Basic Mathematics distance education students if were to successfully address the challenge of low pass rates in Basic Mathematics at the university. Research also shows that early identification and screening for learning disabilities, such as Dyscalculia, is crucial (Mokotjo 2017:170). Against this background, the researcher felt that it was necessary to include a question on early identification and screening for Dyscalculia as part of the open-ended online questionnaire. In order to determine how the participants felt about screening for specific learning disabilities, they were asked if they think that they might need diagnostic testing for Dyscalculia and 50% of the participants responded "Yes", while 31.3% responded "Maybe" and 18.8% responded "No" (Figure 23).

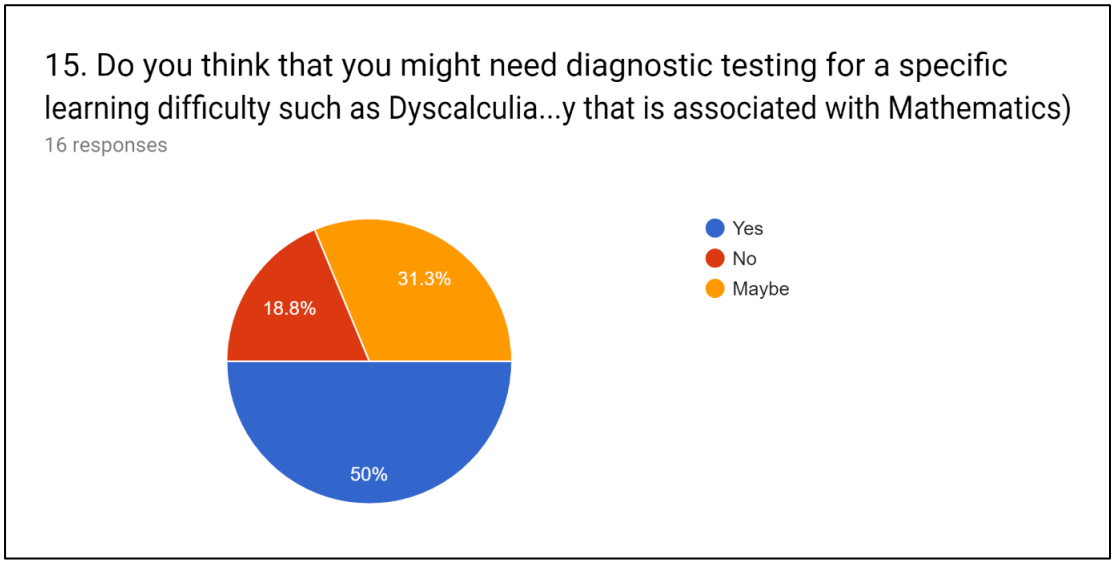

Figure 23: Diagnostic testing

The findings that were derived from the individual interviews also supported the aspect of early identification and screening. This aspect (the early screening and identification) corroborates with the findings of Park (2015:12) and Mavesere (2014:12, 56). Park (2015:12) and Mavesere (2014:12, 56) strongly agree that early

screening and identification of mathematics learning disabilities, such as Dyscalculia, is key when it comes to the performance of students (and the impact thereof) in mathematics.

Some felt that the university should have addressed the issue of high failure rates in Basic Mathematics a long time ago. One respondent stated that "*you know with them [the university] not coming and asking why are you having this problem? There's no question from you know, the institution itself asking us. Why do you keep on failing what is your problem?"* (respondent 1 – Appendix 8). One respondent stated that if you are aware of this type of problem (dyscalculia), then maybe somebody can do something about it in the form of introducing some remedial action that can curb the mathematics anxiety. The issue of adults needing additional learning support when it comes to mathematics was also raised in some of the responses, for example one participant noted that "*Extra support for adult students like having those classes only Mm like me when I was in grade ten, I last did mathematics. So, all these days I did not do mathematics. Then I encounter mathematics"* (respondents 1– Appendix 8).

The respondents were also asked whether they think that students can benefit from voluntary dyscalculia screening, and 87.5% of the participants agreed that students would benefit and 12.5% felt that students would not benefit (Figure 24). The positive reaction that was received was a good indication for the researcher that students were open to being tested and have realised that there might be a deeper cause to their continuous failure in Basic Mathematics.

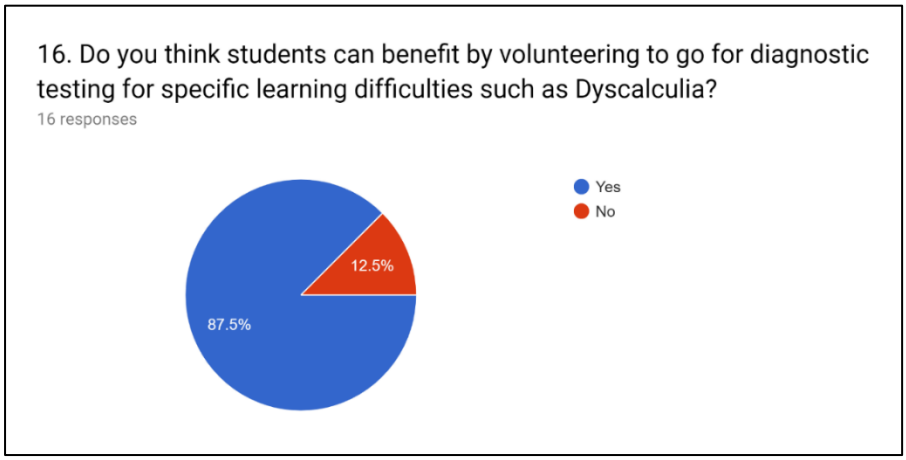

Figure 24: Benefits of undergoing learning disability tests such as Dyscalculia

The respondents were also asked to motivate the reason for their response provided in Question 16 (Figure 24) and some of the responses were " *So those with difficulties can be treated and taught differently*", " *In my case I am doing media studies, I might need the test in my field of study, in languages perhaps, meaning that mathematics isn't important in every field of study*", " *It helps the learners not to repeat the subject many times and gives them a better understanding about the subject", "Perhaps the approach will be different after diagnosis"* and *"It would be much more easier to identify the problem at an early stage of learning"* .

The most important (and valuable) responses that were received that confirms the value of early identification and screening for dyscalculia were the respondents who said "*It will be beneficial because then the Namibia University of Science and Technology will be able to implement a programme to help students with dyscalculia pass basic mathematics*" and "*Then students don't need to suffer with mathematics as a subject. It's disheartening doing mathematics for a number of years without any success. If one is diagnosed with dyscalculia one can seek immediate help and remedial processes can take place instead of suffering and feeling a sense of rejection. Some of us only have this subject left to graduate and its quite frustrating not passing it. Had I known of this learning difficulties I could have seek help and check myself out if I am suffering from this condition"* as well as "*Yes, in order to for the institution to know how many students are affected and needs more attention in math. To avoid having a lot of students failing this subject in future while it's not that they're lazy to study but it's because of dyscalculia effects. And for satisfying results in this specific subject as it's now acting as a blocking stone for many students to graduate upon the completion of their courses*".

The positive responses (which entails 87.5% of the total responses) confirms that there is a need for early identification and screening for dyscalculia in order to address the continuous repetition in this subject. This is also one of the subjects that delays student graduation and it is 'gatekeeper' course (meaning a blockage)

In addition to early identification and screening for dyscalculia, the researcher also focused on the attitude of students and how it affected and or impacted the learning support services that are currently being offered by the NUST. Attitude is one of the

main aspects that was identified by researchers (Dowker et al 2016:2-4; Mokotjo 2017:161; Navarro et al 2018:18, 52-53; Dowker et al 2016:1-3, 8, 10; Cuskelly & Faragher 2019:158) that has an impact on the performance of students studying mathematics. This attitude towards mathematics can also include avoidance strategies (Mavesere 2014:25,53; Hung , Huang and Hwang 2014:152), meaning that students simply do not attend classes or makes use of the support services at their disposal.

In terms of the open-ended online questionnaire, students were asked if they were aware of the Mathematics Tutoring Centre at the Namibia University of Science and Technology, and 66.7% responded yes (Figure 25). This provides a positive indication that the distance education students are aware of the learning support services that are offered by the Mathematics Tutoring Centre.

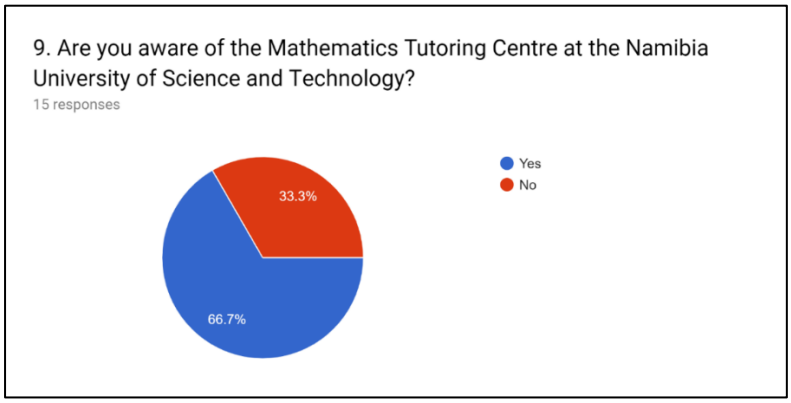

Figure 25: Awareness of the Mathematics Tutoring Centre at the Namibia University of Science and Technology

However, when the participants were asked if they have ever utilized the services of the Mathematics Tutoring Centre, 62.5% of the participants responded 'No' (Figure 16). This is a clear indication that despite the distance education students being aware of the existence of the Mathematics Tutoring Centre at the Namibia University of Science and Technology, they do not utilise the mathematics learning support services at their disposal optimally. Various reasons may exist why the participants are not using the service optimally.

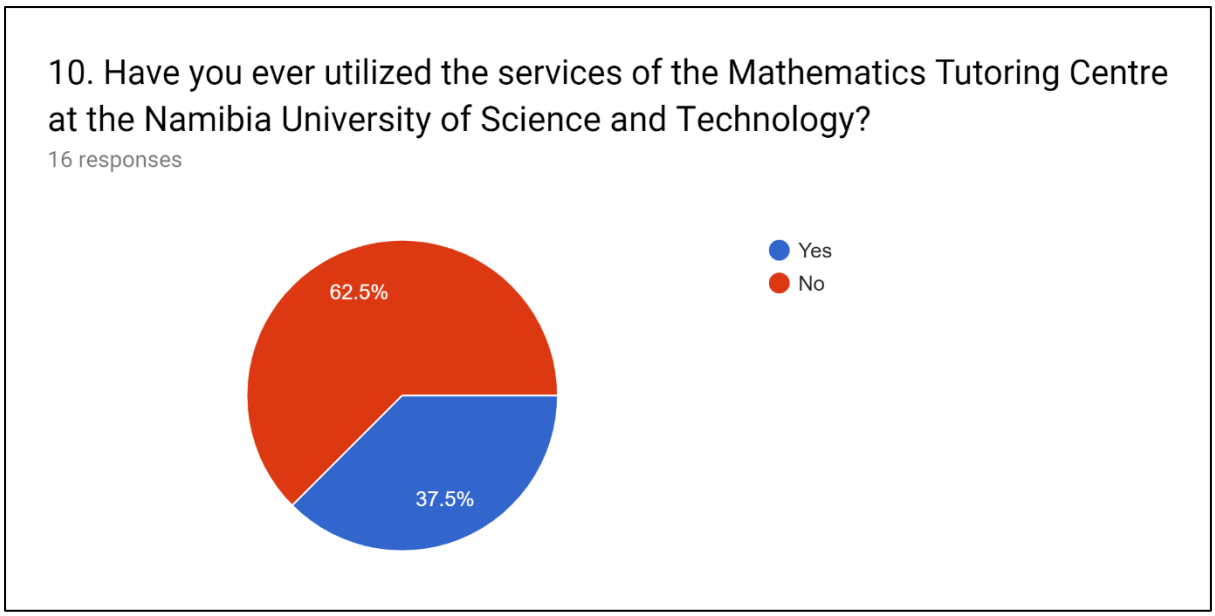

Figure 26: Utilization of Mathematics learning support services offered by the mathematics Tutoring Centre at the Namibia University of Science and Technology

Some of the responses that were provided as to the reasons why the participants are not using the services of the Mathematics Tutoring Centre was "*A regional student*", "*because it's a big challenge for me to partake in services offered since I am staying far from where the centre is", "I do not know about it", "Pressure to understand things in short time" and "Because I'm doing it on distance and sometimes I find myself far from Windhoek".* Currently, the Mathematics Tutoring Centre is based at the Main Campus and regional students are not able to make use of this service at their respective centres. The option of video tutorials and online learning support (video calls with the regional students) are available, however the distance education students also seldomly makes use of these services.

Interestingly, a study that was conducted by Navarro et al (2018) concluded that the problem with the Namibia University of Science and Technology's Mathematics Tutoring Centre itself, but rather the students' attitude towards Basic Mathematics as a subject (Navarro et al 2018:52-53). The researchers concluded that the availability of resources, such as the Mathematics Tutoring Centre, is insufficient if students lack self-motivation (Navarro et al 2018:52-53). The researchers also observed that the attendance of Basic Mathematics classes for distance education students remains a challenge, especially for those students who are remotely located (Navarro et al 2018:52-53). From the responses that were derived from the open-ended online

questionnaire in terms of Attitude, it is evident that the attitude of students towards Basic Mathematics remains a concern and does have an impact on their overall performance in the subject.

About the tutoring support that is offered to the Basic Mathematics distance education students, some students felt that the full-time lecturers do not really give the same amount of attention to the distance education students as they do for the full-time students. Some of the responses that were provided that confirms this includes "*Students attend full-time classes maybe benefit more*" and " *marker tutor will also have their WhatsApp groups, then sometimes you would ask them to put you on those groups and then they just don't because they now don't know who you are because you are a regional student. So, they mostly they will ignore you. They won't put you on that WhatsApp group, but I think if the markers can put everybody on those WhatsApp groups or give those facilities for of all of the students, even if they're giving the full time students whatever they're doing with a full-time student"* (respondents 1 and 3 – Appendix 8). Some students even resorted to paying someone to assist them with private mathematics classes. Some responses included "*Yes, and then I ended up having a personal tutor that I could pay myself"* (respondent 5 – Appendix 8) or seeking online tutoring support via YouTube. One response indicated that some tutors request additional reimbursement, if tutoring is offered outside the normal duration of two hours for the regional students, in order to assist students with mathematics ("*You only have that contact with the tutor for the two hours after then the person is not interested in teaching any further. If you have to ask then they also demand that you pay for reimbursement for their time that they're spending with you*") (respondent 1 – Appendix 8). It should be noted that the face-to-face weekend tutorials that are offered as part of the learning support that is offered by the Namibia University of Science and Technology's Centre for Open and Lifelong Learning also sparked some debate amongst the respondents. Normally, the regional face-to-face weekend tutorials are a two-hour session, while the Windhoek-based (main campus) distance education students' session is four hours long. Some students felt that the time allocated for these regional face-to-face classes was not sufficient, especially if they were staying out of town and still needed to travel in order to attend these sessions, while others felt that the sessions should not just be held on Saturdays, since some of them belong to the Seventh Day

Adventist religion and they attend church on Saturdays. They are of the opinion that alternative arrangements need to be put in place in order to cater for the Seventh Day Adventist students. One student suggested that a regional centre should be opened in Eenhana ("*the University to possibly look into getting a regional center Eenhana*), since the nearest regional centre in Ongwediva is too far from them (respondent 3 – Appendix 8).

Some students also raised concerns about the commitment and reliability of their regional mathematics tutors. These regional tutors are appointed as part-time staff by the Namibia University of Science and Technology's Centre for Open and Lifelong Learning and are paid an hourly rate (which is also determined by the attendance of students). Some respondents alerted the researcher by confirming that some regional mathematics tutors do not always show up for class or are not prepared and/or cannot handle the level of complexity as required on the university level (meaning that the tutor is under-qualified to teach Basic Mathematics at University level). Some students also admitted that some regional (Basic Mathematics) tutors are claiming that the subject is more complex and includes content relating to a higher level of mathematics (as opposed to the fundamental level). Some of the suggestions offered that could possibly address the time and distance issue was the provision of online mathematics tutoring assistance and support and notes to be uploaded onto the e-learning platform. Some respondents also touched on the aspect of catering for the different learning styles of their mathematics students. Suggestions were also made to have more than one mathematics tutor and/or to appoint a new mathematics tutor, especially within the regions, while another student suggested that the regional students should come to the main campus for a week in order to receive tutoring services [from the full-time lecturer who is based at the main campus] in Basic Mathematics.

Some students also shed light on the assessment criteria and the challenges that were associated with it, while other students suggested that they need more practice with mathematics in order to master the subject. When it comes to other aspects that were not addressed within the open-ended online questionnaire, transport (the affordance and reliability thereof) seemed to be another reason why some of the distance education students might not be able to attend the weekend face-to-face

tutorials and/or end up dropping out. Responses that confirms the aspect of access in relation to transport include "*Well A lot of the distant students do not always attend classes maybe because of transport or being too busy to attend classes*" and "*Transport for attending classes also is a challenge and some [students] drops out due to this*" (respondents 3 and 7 - Appendix 8).

The respondents felt that this was the area (support) that needed to be addressed in order to cater to their needs when it comes to Basic Mathematics. The participants were also asked which additional support should be rendered by the university that can assist the distance education students with mathematics and some of the responses were "*Mathematics tutoring centre might help*.", " *Tutor should be availed on a 24/7 basis", " Contact classes for slow students is needed*" , " "*EG NUST can Arrange weekly classes and arrange for test open book test and we should go through old questions papers with Tutors and they should bring down the passing marks from 50 percent to at least 40*", "*Willingness to assist*", " *Maybe change lecturers from the usual COLL lecturers. They are not motivating enough*" and "The *math they are teaching isn't basic and doesn't relate to my course*" amongst others.

When students were asked whether the university offered support in order to deal with the challenges associated with mathematics subjects, 43.8% responded "Yes", while 56.3% responded "No". The participants explained the support was not sufficient and that they had bad experiences with the support that was offered by the NUST Mathematics Tutoring Centre. One of the students said:

"The students asked assistance from local teachers they are not willing to assist", "Apart from the 2hours classes on weekends no extra effort is done. If you contact the tutors it takes a while before they come back to you"

Such responses cause the researcher to ponder about the frustration that these students might be experiences due to the continuous repetition of subjects like Basic mathematics. Furthermore, after the researcher concluded the data analysis phase of this study, three (3) themes emerged. The findings in relation to the three (3) themes are discussed in Chapter 6 of this study.

CHAPTER 5: DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter entails the findings of the open-ended online questionnaire and interviews in relation to the objectives; recommendations and the conclusion. The researcher used Braun et al (2019:57-70) Thematic Analysis Technique to analyse the individual interview data. During the Thematic Analysis phase, the researcher was able to identify and code the interview data (Figure 27).

Summary of the prevalence of themes	
Theme	**Number of times it occurred in the individual interviews**
1) Attitude	**19**
2) Symptoms	**5**
3) Performance	**41**
4) Impact of Mathematics learning difficulties on adults	**23**
5) learning support	**53**

Figure 27: Summary of the prevalence rate of the themes as identified in the TA

5.1. SYMPTOMS OF MATHEMATICS ANXIETY AND/OR DYSCALCULIA

An extensive overview of both phenomena (mathematics anxiety and Dyscalculia) has been provided in Chapter 2 of this study. The data analysis of this study correlates with the findings of researchers like Mokotjo (2017:28, 30) and Mavesere (2014:16-19, 22, 27, 52, 54) especially in terms of the symptoms that are associated with Dyscalculia as a learning disability.

Some of the symptoms that were highlighted in the interviews include automation (formulas and equations) and language processing difficulties. Again, this data suggests the presence of symptoms that are associated with mathematics Anxiety and Dyscalculia. The researcher also wishes to reiterate the importance of a formal

diagnosis to be done by a trained professional, for example an educational psychologist, when it comes to mathematics learning difficulties. This is also where early identification and screening is important since it will inform the learning support strategy to be adopted.

Attitude, which according to researchers on dyscalculia is linked to mathematics anxiety, is important in this study. Research (Dowker et al 2016:3) has shown that having a negative attitude towards mathematics can lead to and/or increase the level of mathematics anxiety. The prevention of mathematics anxiety is key, especially since motivation and success are interlinked (Dowker et al 2016:13). According to these results, attitude, confidence and mathematical ability may all be contributing factors towards mathematics anxiety, therefore warranting future empirical research. These aspects and learning support are discussed in the next sections.

5.2 Mathematics related learning difficulties

This study was also highly concerned with the performance of adult students in mathematics. Like prior studies (Park 2015:20-21; Cuskelly and Faragher 2019:152 and De Visscher and Noël 2013:51), this study concurred that adult learners face problems with the acquisition and application of Mathematical concepts (formulas, equations and number processing). Mathematics is a complex subject (Mokotjo 2016:34, 46; Lewis & Lynn 2018:2; Nagavalli and Fidelis 2015:1 and Mavesere 2014:53) that requires a certain degree of competency (Mokotjo 2017:30, 36-37). The aspect of fluency and competence also affect the performance of adult learners, and the researcher believes that adult learners cannot acquire fluency and competency if they have not mastered the basic (fundamental) skills of numeracy. The researcher also wishes to reiterate the stance of other researchers (Mokotjo 2017:31 and Cuskelly & Faragher 2019:152-159) that dyscalculic students still possess normal intelligence, despite their learning difficulty that is associated with mathematics.

According to the data that was derived from the individual interviews, the fears of mathematics being a ‘gatekeeper’ course was confirmed. Some respondents alluded that Basic Mathematics is the only subject that they must still pass in order to graduate; however, they were unable to pass this subject numerous times. This

confirms the observation mentioned earlier that Basic Mathematics has an impact on the adult student's career and lifelong learning prospects. This means they are unable to enrol for higher degrees if they do not pass the lower degrees, since one degree might be a pre-requisite for another.

An individual's numerical competence has also been a topic for discussion by other researchers (Mokotjo 2017:36-37; Aremu and Taiwo 2014:113 and Mavesere 2014:8), and is of interest to our African context. The results from the interviews support the views of Mokotjo (2017), who stated that people who lack numerical competence are twice as likely to be unemployed (Mokotjo 2017:35, 36, 38).

Undoubtedly, the application and retrieval of mathematical concepts in everyday life is inevitable; for example, we need to retrieve Personal Identification Number (PIN) codes, Identification (ID) numbers and telephone numbers (Mokotjo 2017:11), amongst others. The application and retrieval of such mathematical concepts daily might seem easy for some people; however, for people suffering from mathematical learning difficulties and/or Dyscalculia, this seems like a challenging, anxious task. This anxiety-driven phenomenon (the fear that is associated with mathematics) has the tendency to rob an individual with Dyscalculia of a better quality of life (Mokotjo 2017:11).

5.3 Learning Support

Some of the learning support that is offered by the Namibia University of Science and Technology's Centre for Open and Lifelong Learning consists of weekend face-to-face tutorials. There are currently ten (10) regional centres across Namibia. These regional centres also sparked some debate within the individual interviews. Some researchers (Rosic 2016:43) are in support of mathematics tutoring centres (like the university's regional centres and the Mathematics Tutoring Centre that is based at the main campus), since they regard this as conducive learning environments that support students with Mathematical learning difficulties. The regional centres are used not only for the weekend face-to-face tutorials, but also render assistance in terms of registration, facilitation and administration of assessments as well as the dispatch of learning materials to the distance education students who are located within that region. During the individual interviews, certain aspects were highlighted

that pertained to the regional centres and the effectiveness of the learning support services that are rendered to them.

As much as we consider mathematics tutoring centres to be part of the learning support strategy, the researcher is of the opinion that the learning support that is offered by these centres should be customised in order to address the unique learning preferences and styles as required by our adult learners. We also need the full commitment of our students and tutors (locally and within the regions) in order to strengthen this support network. From the data that was gathered, it seems as if students are aware of the Mathematics Tutoring Centre at the Namibia University of Science and Technology, however they have experienced some disappointment when the booking made at the Mathematics Tutoring Centre could not be honoured by the lecturers there. This leads the researcher to the conclusion that the Mathematics Tutoring Centre at the Namibia University of Science and Technology needs to assess the effectiveness of their current learning support system (for example their appointment booking system and lecturers honouring appointments scheduled), since this not only affects the performance of students who need mathematics tutorial assistance, but also their perceptions of the effectiveness and usefulness of the Mathematics Tutoring Centre.

In addition to the above, research also suggests that for dyscalculic students to successfully master mathematics, they need to regain their confidence as part of an intervention strategy (Mokotjo 2017:4). There is also a need to first understand the extent of the problems that are associated with mathematics, before devising the relevant pedagogical strategy (Mokotjo 2017:5-6). One way of assessing the extent of the problems associated with mathematics is using a Dyscalculia Screener. According to Mokotjo (20175-6), a "*Dyscalculia Screener is a computer programme that is designed to assess children's mathematical achievement in their numeracy ability by measuring their response to number-based tasks*".

The exposure to mathematics at an early age was also highlighted within the data that was derived from the individual interviews. Early childhood interactions with mathematics have been a concern for researchers (Mokotjo 2017). In our Namibian context, some learners have not attended pre-school and therefore lack early exposure to mathematics. When learners lack pre-school education before resuming

with Grade one (1), such learners are already lacking early stimulation in mathematics and this affects their aptitude in mathematics (Mokotjo 2017:170). The lack of early interaction could affect the early identification of mathematical learning difficulties (MLD) such as Dyscalculia (Mokotjo 2017:170), since early detection is key when addressing mathematical learning difficulties like Dyscalculia.

However promising educational technology and multimedia might be in addressing the educational needs of the Dyscalculic students, the reality is that it also has its limitations and drawbacks. Some of these limitations include the lack of recent knowledge in assistive technology amongst educators, money is needed in order to purchase learning material, as well as effective training and implementation strategies (Nagavalli and Fidelis 2015:8). From the individual interview data, the aspect of awareness creation and the advocation for mathematics learning support has also been raised by the respondents as well as the learning support provision of specially trained mathematics tutors that understand mathematics learning disabilities. The lack of properly trained special needs educators who specifically deal with Dyscalculia within the context of special and mainstream schools is another challenge that was highlighted by researchers (Nagavalli and Fidelis 2015:1). Researchers like Nagavalli and Fidelis (2015:1) conclude by recommending that the "*treatment of dyscalculia should address the multiple facets of the disorder while focusing on educational interventions to improve study skills in general and strengthening number perception and arithmetic concepts in particular*" (Nagavalli and Fidelis 2015:1).

When it comes to the instructional design aspect of dealing with Mathematical difficulties and Dyscalculia, research (Mavesere 2014:57) suggests that curriculum designers should design appropriate curricula for all types of learners, and learning material should cater for the needs of learners with learning difficulties as well (Mavesere 2014:57). There is a wide array of education technology and multimedia available that cater to the needs of Dyscalculic students, however, the reality is that these learning aids are expensive and are sometimes considered a luxury item, especially within the African context. Mavesere (2013:57) gave a perfect example within the Zimbabwean context, where she stated that computer games cannot be afforded by all learners to improve their mathematics skills in Zimbabwe (Mavesere

2014:57). The applicability and relevance of educational technology as a learning support mechanism for Namibian adult students with mathematics learning difficulties warrants further empirical research to be conducted.

From the findings that were derived from the interviews, it was evident that the data could be perfectly matched to the objectives of this study and conforms to the Conceptual Framework. From the interview data, the most important aspect was Learning Support. The motivation for the existing three-tiered Pyramid (Figure 28) is that there are certain Symptoms that we display when dealing with mathematics and this might be caused by certain mathematics related learning difficulties which in turn would affect our Learning Support strategy that we ultimately need in order to address the challenges that are associated with mathematics anxiety and Dyscalculia. The three-tiered Pyramid (Figure 28) can also be interpreted in reverse (from the bottom up) if we were to address the challenges as part of the learning support intervention. This means that an effective Learning Support strategy would inversely be affected by other mathematics related learning difficulties, which in turn would affect the symptoms that need to be addressed as part of the learning support strategy. Motivation is an important aspect when dealing with learning disabilities, since research (Hung, Huang and Hwang 2014:152) has shown that if the student's learning motivation is promoted then it will improve their learning achievement in mathematics. Secondly, research also shown that mathematics anxiety could affect a student's learning motivation (Hung, Huang and Hwang 2014:153). Therefore, it is advisable to improve the student's self-efficacy, attitude and interest if we were to address mathematics anxiety (Hung, Huang and Hwang 2014:153).

5.4 Limitations

This study not only highlighted critical aspects that broadened our knowledge about mathematics anxiety and Dyscalculia, but it also encountered some limitations. Some of the limitations of this study were the low number of responses that were received for the interviews, especially the open-ended online questionnaire. The researcher sent out numerous reminders to the respondents that have agreed to partake in the survey. The researcher also resorted to making individual telephonic follow-ups with the respondents and this yielded a low number of additional responses to the online open-ended questionnaire, although it was still considered to

be a low response in totality. There were also a low number of consent forms that were returned for the open-ended online questionnaire. The researcher did include a clause within the open-ended online questionnaire stating that by continuing with the survey they provide consent to partake in the study. This might be the reason the other participants might also not have returned the form since they might have assumed that by continuing with the open-ended online questionnaire, they 'automatically' give their consent.

5.5 RECOMMENDATIONS

Through this study, the researcher wishes to encourage the Namibia University of Science and Technology to conduct a similar survey on all the students that are enrolled for Basic Mathematics on the full-time and part-time modes of study, in order to come to a definitive conclusion pertaining to the reasons associated with the low performance of their students in the subject. The researcher also wishes to encourage the Namibia University of Science and Technology to introduce the early identification and screening of mathematics learning difficulties, such as mathematics Anxiety and Dyscalculia. The researcher is of the opinion that this early identification and screening will enable the University to evaluate and customise their learning support services in order to address the needs of their students and enhance their learning experience in mathematics as a scientific discipline.

In addition to the above, the researcher also wishes to encourage the investigation into the high failure rates in Basic Mathematics, particularly within the Faculty of Health and Applied Sciences and Management Sciences, since the data that was derived from the Basic Mathematics enrolment and examination statistics have highlighted these faculties as an area of concern.

Basic Mathematics entails components of self-directed learning, particularly for the distance education students who seldom get to interact with their tutors and who are mostly left to fend for themselves. Self-directed learning requires personal motivation, which in turn may be difficult for adults with special educational needs, particularly if they did not have a positive educational experience while in the school system (McKnight and Davies, 2012:58). Research shows that if teachers

understand the symptoms of Dyscalculia, then they can customise their teaching strategies in order to cater to the needs of those suffering from Mathematical learning difficulties, such as Dyscalculia (Mokotjo 2017:171). It is imperative for dyscalculic students to have proper learning support strategies and interventions, as well as a robust support system that includes Educational Psychologists, educators and parents alike.

Other learning support intervention strategies entail dealing with dyscalculia in a holistic manner, meaning that we must consider the biological, cognitive and behavioural approaches in order to enhance one's understanding of dyscalculia (Mokotjo 2017:26-27). The lack of the existence of a proper dyscalculia diagnosis tool, particularly for use within our Namibian context, also adds fuel to the fire. The researcher suggests that a proper mathematics learning disability diagnosis tool should be developed by the respective experts that possess knowledge about mathematics anxiety and dyscalculia, for use in our Namibian context. In addition to this, the students' progress in Basic Mathematics should also be monitored on a regular basis. This will enable the lecturer to introduce a suitable learning support strategy, for example additional classes, at an early stage which in turn might lower the failure rate in Basic Mathematics. In addition to this, exploring the use of educational technology as a learning support tool to address Mathematics learning disabilities, such as mathematics anxiety and dyscalculia, is also recommended. Lastly, the researcher suggests that the Namibia University of Science and Technology uses the 3-tiered Dyscalculia Learning Support Triangle (Figure 18) as a learning support mechanism to address the low pass rate of the distance education Basic Mathematics students.

In addition, when we address learning support strategies, we cannot exclude the aspect of technology as part of the support mechanisms or sub-systems, although it does not form part of the scope of this research. Research (Nagavalli and Fidelis 2015:3-8) supports the use of educational technology and multimedia when teaching mathematics to dyscalculic students. Assistive technology can enable dyscalculic students to learn independently, as well as offer remedial and compensatory support (Nagavalli and Fidelis 2015:3).

In order to propose an effective learning support strategy, the researcher felt it was best to portray the learning support strategy as a three-tiered pyramid (Figure 28) which contains three themes, namely Symptoms, Mathematics related learning difficulties and Learning Support, as a learning support strategy. The researcher decided that “Attitude” can be classified under “Symptoms”, while “Performance” and “Impact of mathematics learning difficulties on adults” can be classified under “ mathematics related learning difficulties”, thus only having three (3) main themes of “Symptoms”, “Mathematics related learning difficulties” and “Learning Support”.

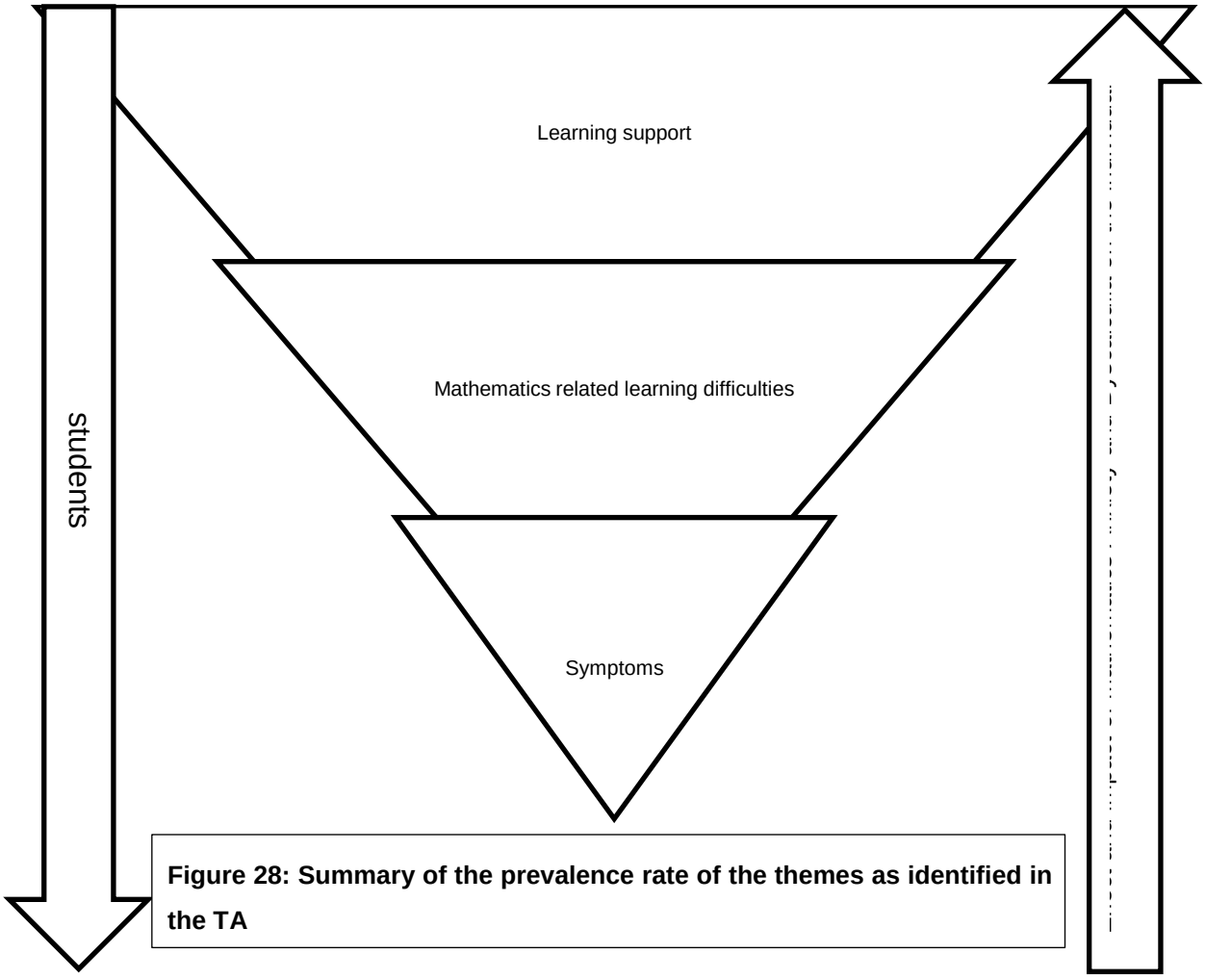

Figure 28: Summary of the prevalence rate of the themes as identified in the TA

5.6 CONCLUSION

This paper argued that the high failure rate in Basic Mathematics amongst adult learners at the Namibia University of Science and Technology might be caused by mathematics anxiety and/or Dyscalculia. The study presented various views from prior studies that were conducted on the aspects of dyscalculia and other

mathematics learning difficulties such as anxiety, in order to broaden our knowledge about maths learning difficulties experienced by many learners. The focus of this study was a group in a distance education institution. The findings that were derived from this study can serve as a basis to investigate similar trends in the Basic Mathematics performance of students who are enrolled on the full-time and part-time modes. Until recently, there was no reliable information about mathematics learning difficulties the learning support systems that were implemented might not have effectively served the purposes for which they were intended, particularly in the area of addressing the high failure rate in mathematics. The researcher wishes to clarify that this phenomenon, mathematics anxiety and dyscalculia, should not only be seen as a unique case pertaining to distance education students only, however the same problem might be prevalent in other modes of study as well.

The researcher feels that the Namibia University of Science and Technology should be acknowledged and applauded for having invested a lot of time and resources into the establishment of the Mathematics Tutoring Centre, however, this service is only located at the main campus in the capital city, Windhoek. This Centre offers tutoring support to students who are enrolled in mathematics subjects, regardless of the mode of study. The researcher also wishes to disclose that not many distance education students make use of this service for various reasons, therefore the researcher is of the opinion that the root of the problem that is associated with the low pass rate in mathematics subjects (like Basic Mathematics) first needs to be identified and then the learning support strategy can be linked to it. The researcher agrees that the introduction of the Mathematics Tutoring Centre at the University was a good initiative; however, the researcher feels that students first need to be screened for specific learning difficulties, before ‘general’ academic learning support can be rendered.

In addition to the above, there were other areas of concern that were highlighted by the findings. These entail access, gender stereotyping and the impact on mathematics performance, course and assessment weighting and cost implications (especially for those repeating the subject numerous times) amongst others. The researcher feels that these additional concerns warrant future empirical research in order to establish its relationship with the low pass rate in Basic Mathematics.

REFERENCES

Aremu, A.O. and Taiwo, A.K., 2014. Reducing mathematics anxiety among students with pseudo-dyscalculia in Ibadan through numerical cognition and emotional freedom techniques: moderating effect of mathematics efficacy. *African Journal for the Psychological Studies of Social Issues*, *17*(1), pp.113-129.

Booysen, D. (2019, January 02). Maths set to cripple results. *The Namibian*, pp.1-2. Available at:https://www.namibiansun.com/news/maths-set-to-cripple-results (Accessed on 2019 02/01/2019)

Braun, V., Clarke, V., Hayfield, N. and Terry, G., 2019. Thematic analysis. *Handbook of Research Methods in Health Social Sciences*, pp.843-860.

Chinn, S., 2009. Dyscalculia and learning difficulties in mathematics. *The Routledge companion to dyslexia*, p.126.

Cohen, L., Manion, L. and Morrison, K., 2011. Planning educational research. *Research methods in education. New York: Routledge Editors*.

Cuskelly, M. and Faragher, R., 2019. Developmental dyscalculia and Down syndrome:Indicative evidence. *International Journal of Disability, Development and Education*, *66*(2), pp.151-161.

De Visscher, A. and Noël, M.P., 2013. A case study of arithmetic facts dyscalculia caused by a hypersensitivity-to-interference in memory. *Cortex*, *49*(1), pp.50-70.

Dresler, Thomas, Stephanie Bugden, Camilo Gouet, Marie Lallier, Darlene G. Oliveira, Pedro Pinheiro-Chagas, Ana C. Pires, Yunqi Wang, Camila Zugarramurdi, and Janaina Weissheimer. "A Translational Framework of Educational Neuroscience in Learning Disorders." *Frontiers in Integrative Neuroscience* 12 (2018): 25.

Dowker, A., Sarkar, A. and Looi, C.Y., 2016. Mathematics anxiety: What have we learned in 60 years?. *Frontiers in psychology*, *7*, p.508.

Gamundani, A.M. and Jegede, S.O., 2015. A Mathematics Cloud Based Learning Model (MCBLM) Towards Addressing Mathematics Learning Challenges: A Case of Namibia Grade 12.

Hung, C.M., Huang, I. and Hwang, G.J., 2014. Effects of digital game-based learning on students' self-efficacy, motivation, anxiety, and achievements in learning mathematics. *Journal of Computers in Education*, *1*(2-3), pp.151-166.

Kaufmann, L., Mazzocco, M.M., Dowker, A., von Aster, M., Goebel, S., Grabner, R., Henik, A., Jordan, N.C., Karmiloff-Smith, A.D., Kucian, K. and Rubinsten, O., 2013. Dyscalculia from a developmental and differential perspective. *Frontiers in psychology*, *4*, p.516.

Kaufmann, L. & von Aster, M. (2012). The diagnosis and management of dyscalculia. *Dtsch Arztebl Int*, 109(45), 767–78. DOI: 10.3238/arztebl.2012.0767

Knoema. (2019). Sustainable Development Goals Report 2019. Open Data Portal Namibia. [online] Available at http://namibia.opendataforafrica.org/sdg# (Accessed on 25/06/2019).

Knowles, M.S., 1973. A neglected species. *Houston, TX: Gulf Publishing*.

Lewis, K. and Lynn, D., 2018. Against the Odds: Insights from a Statistician with Dyscalculia. *Education Sciences*, *8*(2), p.63.

Mavesere, M., 2014. *The prevalence of dyscalculia among the Mathematics bridging course students at United College of education in Bulawayo* (Doctoral dissertation).

McKnight, L. and Davies, C., 2012. The Kellogg College Centre for Research into Assistive Learning Technologies. *Journal of Assistive Technologies*, *6*(2), pp.158-162.

Mokotjo, L.G., 2017. *An active learning strategy for addressing dyscalculia in a mathematics classroom* (Doctoral dissertation, University of the Free State).

Nagavalli, T. and Juliet, P., 2015. Technology for Dyscalculic Children. *SALEM*, *16*, pp.1-10.

Namibia Statistics Agency. Namibia Labour Force Survey Report 2018. [online] Available at: https://d3rp5jatom3eyn.cloudfront.net/cms/assets/documents/NLFS_2018_Report_Final_.pdf (Accessed on 25/06/2019).

Navarro, B.M., Brewster, J.L., Myers, J.L. and Schimmel, Q.W., 2018. Improving the Mathematics Tutoring Center at NUST through Structured Online Teaching Modules.

Nfon, N.F., 2018. The use of mathematical games and secondary school students' achievement in mathematics in Fako Division, South West Region of Cameroon. *Journal of Education and Entrepreneurship*, *5*(1), pp.20-31.

Oxford Online Dictionary accessed on 09/07/18. Available at: https://en.oxforddictionaries.com (Accessed on 09/07/2019)

Park, J.Y., 2015. A Comparison of Two Instructional Sequences in an Intelligent Tutoring Program on Multiplicative Concepts and Problem Solving of Students with Mathematics Difficulties.

Patton, M. Q. (2002). Qualitative evaluation and Research Methods 3rd ed. Newbury Park: Sage.

Rosic, I., 2016. 04. Addressing Diversity. Available at: https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1003&context=qmasc_handbook (Accessed on 09/07/2019)

Smith, A., 2004. Making mathematics count: The report of Professor Adrian Smith's inquiry into post-14 mathematics education. Available at: http://hdl.voced.edu.au/10707/149916. (Accessed on 02/03/2020)

Sokolowski, H.M. and Ansari, D., 2017. Who is afraid of math? What is math anxiety? And what can you do about it. *Frontiers for Young Minds*, *5*(57), pp.1-7. doi: 103389?/rym. 2018.00057.

APPENDICES

Appendix 1 - Consent to conduct research at the Namibia University of Science and Technolgy's Centre for Open and Lifelong Learning

NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

13 Storch Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 2118
F: +264 61 207 9118
E: registrar@nust.na
W: www.nust.na

Office of the Registrar

12 December 2018

Ms Fiona B Anderson
Email: fanderson@nust.na
Windhoek
NAMIBIA

Dear Ms Anderson

RE: CONSENT TO CONDUCT YOUR RESEARCH WITH THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY STUDENTS

Your letter dated 12 December 2018, by Dr F Goolam, Registrar at University of South Africa (UNISA) and Technology has reference.

Approval is hereby granted for you to conduct the research on "*Exploring academic support strategies for Mathematics students with dyscalculia: a case study of an Open Distance Learning University in Namibia*" in the Namibia University of Science and Technology. Any information gathered during the research is to be used for the purpose of the study only and must be treated as confidential. The results of the study should be shared with the University. Individual information of staff and students will not be made available, nor will biographical information of students be made available in such a way that individual students can be identified.

You are advised to contact the Director of Center for Open and Lifelong Learning: Dr Delwaline Möwes, to compile a list of possible respondents to your data collection instrument.

I wish you all the best with your research.

Yours sincerely,

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
P/Bag 13388 Windhoek NAMIBIA
2018 -12- 12
REGISTRAR
OFFICE OF THE REGISTRAR

Mr Maurice Garde
REGISTRAR

CC:
Director: COLL
Deputy Vice-Chancellor: Academic Affairs
Assistant Registrar

Appendix 2 - Ethical Clearance Form (Unisa)

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2019/04/17

Ref: **2019/04/17/61929654/04/MC**
Name: Ms FB Anderson
Student no: 61929654

Dear Ms Anderson

Decision: Ethics Approval from 2019/04/17 to 2022/04/17

Researcher(s): Name: Ms FB Anderson
E-mail address: 61929654@mylife.unisa.ac.za
Telephone: +264 81 244 4826

Supervisor(s): Name: Prof S Ngubane-Mokiwa
E-mail address: mokiwsa@unisa.ac.za
Telephone: +27 12 337 6188

Title of research:

Exploring academic support strategies for Mathematics students with dyscalculia: A case study of an Open and Distance Learning University in Namibia

Qualification: M. Ed in Inclusive Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2019/04/14 to 2022/04/17.

*The **low risk** application was reviewed by the Ethics Review Committee on 2019/04/14 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
7. No field work activities may continue after the expiry date **2022/04/17**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2019/04/17/61929654/04/MC** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
ACTING EXECUTIVE DEAN
Sebatpm@unisa.ac.za

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Appendix 3 - Informed consent to conduct research

Reference Number: 2019/04/17/61929654/04/MC

Dear Prospective participant,

You are invited to participate in a survey conducted by Ms. Fiona Anderson under the supervision of Professor Sindile Ngubane-Mokiwa, a Professor at the Institute for Open and Distance Learning towards a MA (Open and Distance Learning) at the University of South Africa.

The survey you have received has been designed to study the challenges associated with Mathematics learning by adult students at the Namibia University of Science and Technology's Centre for Open and Lifelong Learning. You were selected to participate in this survey because you are currently in your second year of studies and enrolled for Basic Mathematics as a subject on the distance education mode of study. By completing this survey, you agree that the information you provide may be used for research purposes, including dissemination through peer-reviewed publications and conference proceedings.

It is anticipated that the information we gain from this online questionnaire will help us to develop learning support strategies for adult learners who experience challenges with Mathematics as a subject at the Namibia University of Science and Technology. You are, however, under no obligation to complete the survey and you can withdraw from the study prior to submitting the survey. The survey is developed to be anonymous, meaning that we will have no way of connecting the information that you provide to you personally. Consequently, you will not be able to withdraw from the study once you have clicked the send button based on the anonymous nature of the online questionnaire. Any identifying information that is obtained in connection with this survey will remain confidential and will be disclosed only with your permission or as required by law. If you choose to respond to this online questionnaire, attending to the questionnaire will take up no more than twenty (20) minutes of your time. You will not benefit from your participation as an individual, however, it is envisioned that the findings of this study will effective inform the design, development and implementation of effective learning support strategies that will assist adult learners who experience challenges with Mathematics as a subject. We do not foresee that you will experience any negative consequences by responding to the online questionnaire, such as being discriminated against in any form, being victimised due to the findings of this survey, having a negative

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impact on your academic performance in Basic Mathematics as a subject. The researcher(s) undertake to keep any information provided herein confidential, not to let it out of our possession and to report on the findings from the perspective of the participating group and not from the perspective of an individual.

The records of the online questionnaires will be kept for five years for audit purposes where after it will be permanently destroyed Hard copies will be shredded and electronic versions will be permanently deleted from the hard drive of the computer. You will not be reimbursed or receive any incentives for your participation in the survey. You are free to withdraw from the research at any time prior to clicking the send button.

The research was reviewed and approved by the Ethics Review Committee of the University of South Africa and the Namibia University of Science and Technology. The primary researcher, Ms. Fiona Anderson, can be contacted at cell phone number +264 812444826 or email address andersonbrigette2605@gmail.com. The study leader, Professor Sindile Ngubane-Mokiwa can be contacted during office hours at +27123376188 or mokiwsa@unisa.ac.za. Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the CEDU Research Ethics Committee, Professor Abraham Tlhalefang Motlhabane, at telephone number (w) +27 12 429 2840 . Alternatively, you can report any serious unethical behaviour at the University's Toll Free Hotline 0800 86 96 93.

If you have decided to participate in this research as a respondent to the online questionnaire, confirm your decision to participate by signing the consent form on the next page.

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Appendix 4 – Online Questionnaire

Appendix 4 – Online Survey Questionnaire

Dear Participant, thank you for agreeing to partake in this online survey. The answers provided by the participants will be used for research purposes only and no personal information of the participants will be disclosed at any stage of the research. The online survey will take approximately 20 minutes to complete. The findings that are derived from this survey, will be used to improve the learning support service provision of the Basic Mathematics students that are enrolled at the Namibia University of Science and Technology's Centre for Open and Lifelong Learning.

1. **Age**: …….
2. **Centre of Registration**: (drop down box will be available to select the relevant centre of registration. There are ten regional centres for the Centre for Open and Lifelong Learning). The options will be as follows:

- Windhoek
- Otjiwarongo
- Ongwediva
- Walvis Bay
- Rundu
- Opuwo
- Outapi
- Keetmanshoop
- Gobabis
- Tsumeb
- Katima Mulilo

3. Year when you first registred for Basic Mathematics (BMS411S) at the Centre for Open an Lifelong Learning ……
4. Please answer the following questions by indication of Yes (Y) or No (N):
   a) Have you ever repeated the subject Basic Mathematics (BMS411S) at the Namibia University of Science and Technology? ……..(Y/N)
   b) Did you ever experience anxiety when dealing with Mathematics as a subject? ……..(Y/N)
5. Have you ever experienced the following problems while doing Mathematics as a subject?
   a) Have difficulty in telling time ……..(Y/N)
   b) Have difficulty in telling direction (for example left from right or right from left) or have a poor sense of direction (you get lost easily) …….(Y/N)
   c) Have trouble doing simple addition, subtraction, multiplication or division ……..(Y/N)

d) If yes, please state with which (addition, subtraction, multiplication or division) ……..
e) Have trouble in writing, reading or recalling of numbers? …….(Y/N)
f) If yes, please state with which (writing, reading or recalling) ……
g) Have trouble remembering Mathematical formulaes ……(Y/N)
h) Have trouble remembering Mathematical concepts ……..(Y/N)
i) Do you experience trouble reading graphs? ……(Y/N)
j) Do you experience trouble reading charts? …….(Y/N)
k) Do you experience trouble performing mathematical estimations? ……(Y/N)
l) Do you use your fingers to count? ……(Y/N)
m) Are you able to perform mental mathematical tasks (for example doing simple mathematical calculations using your brain instead of a calculator)? …….(Y/N)
n) Do you take longer to perform mathematical tasks compared to your peers? ……..(Y/N)

6. Are you aware of the learning difficulty associated with performing Mathematical tasks, called Dyscalculia? ……(Y/N)
7. Have you ever been diagnosed with a learning difficulty at school and/or university? …….(Y/N)
8. If Yes, please explain the type of learning difficulty and the year of diagnosis. Type: …….. Year of diagnosis: …….
9. Are you aware of the Mathematics Tutoring Centre at the Namibia University of Science and Technology? …….(Y/N)
10. Have you ever utilized the services of the Mathematics Tutoring Centre at the Namibia University of Science and Technology? ……(Y/N)
11. If No, please state the reason(s) why
    .....
    .....
12. Do you think that the Namibia University of Science and Technology's Centre for Open and Lifelong Learning's Basic Mathematics students are offered support in order to deal with the challenges associated with mathematics-related subjects? (Y/N)
13. If Yes or No, please explain your answer
    ……
    ……
14. In your opinion, which additional support should be rendered to the distance education students in order to assist them with the challenges associated with doing mathematical-related subjects (for example Basic Mathematics)?

……
……

15. Do you think that you might need diagnostic testing for a specific learning difficulty such as Dyscalculia? ……..(Y/N)
16. Do you need students can benefit by volunteering to go for diagnostic testing for specific learning difficulties such as Dyscalculia? ……..(Y/N)
17. If Yes or No, please state your reasons why it might be beneficial for the Namibia University of Science and Technology's students to go for voluntary learning difficulty (for example Dyscalculia) testing at an early stage?

……
……

Appendix 5 – Interview Questionnaire

Reference Number: 2019/04/17/61929654/04/MC

Appendix 5: Individual Interview Questionaire

Dear Participants

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1. What are you views on the academic performance of students in mathematics-related subjects?

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2. What do you think are the challenges faced by students with learning difficulties in mathematics?

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3. What are some of the common difficulties experienced by students in learning mathematics?

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4. How can the difficulties stated in question 4 be managed in the university?

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5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

……
……
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……

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Appendix 6 - Individual Interviews Transcripts (previously called Focus Group Interviews)

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Reference Number: 2019/04/17/61929654/04/MC

Focus Group Attendance Register

	PARTICIPANT SIGNATURE	DATE
1		10/08/19
2		10/08/19
3		10.08.19
4		10.08.19
5		10.08.19
6		10.08.19
7		10.08/19
8		10.08/19
9		10.08.19
10		10.08.19
11		10.08.19
12		10.08.19
13		10.08.19
14		10.08.19
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Appendix 7: Focus Group Discussion Guide

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1. What are you views on the academic performance of students in mathematics-related subjects?

The performance rates are observed to be traditionally low for mathematics related subjects. Students enrolled in fields such as science, engineering and technology mostly experience hardships with a number of subjects.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

The background knowledge of the subject, mastering formulas and a lack of access to tutor engagement. Some students experience psychologically related conditions which deter the learning opportunity.

3. What are some of the common difficulties experienced by students in learning mathematics?

- Lack of knowledge in subject theory
- Unfamiliarity with equations and formulas
- lack of practice
- Avoiding class and math related info

4. How can the difficulties stated in question 4 be managed in the university?

Engagement with social workers. Campaigns and workshops to raise awareness and tackle difficulties faced by math related subjects. Offering extra classes to the students in need of extra lessons.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Student campaigns and workshops to raise awareness and offer aid to students.

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1. What are you views on the academic performance of students in mathematics-related subjects?

As a communications student the use of mathematics will be very minimal and at the most basic or lowest level of use. Therefore I do not see the need of doing mathematics as a core module at University.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

There are numerous challenges faced by students such as being out of formal school for a very long time hence haven't been expose to maths for years. Some students never had mathematics at Secondary level thus not exposed.

3. What are some of the common difficulties experienced by students in learning mathematics?

Sufficient face to face learning
Electronic assignments
~~No~~ Less ~~on~~ Student engagements with the CoIL centre

4. How can the difficulties stated in question ~~4~~ 3 be managed in the university?

Basic Maths should be a non exam module such as CUS and CIS introduce more practicals and test the students understanding

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Do away with ~~electronic~~ soft/electronic assignment
Provide more opportunities to engage lectures
Be lenient with students repeating the module for more ~~than~~ two attempts

Signature of participant: [signature] Date: 10/08/19

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1. What are you views on the academic performance of students in mathematics-related subjects?

It is very disappointing observing many of my friends and colleagues having to struggle with mathematic-related courses for eg. I was awarded with Best Student of the Year for all my majors but I still struggle with mathematics and it is discouraging

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

1. Lack of motivation / reason to do a subject that is not very relevant to their field i.e English, Communication, HR. 2. Time management - maths takes alot of practice and in university it is difficult to balance time 3. Dyslexic (An inability to read)

3. What are some of the common difficulties experienced by students in learning mathematics?

1. Not enough one-to-one time with lecturers 2. Embarrassment to engage with students who know the coursework better. 3 Learning approach is 'one size fits all'

4. How can the difficulties stated in question 3 be managed in the university? In the event that a student has failed more than twice, Uni should give last chance rest to let them go.

1. Emphasise the relevance & importance of mathematics in ALL fields of study i.e why would I need maths in Logistics? 2. Teach students time & prority management. 3. Get an institutional psychologist to test students for A.D.D / AD+D / dyslexia incase there is more to them failing than a bad mark but a psychological stresses.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

1. A support service for students who have been failing the module many times. 2. A service that helps slow students 3. A service that offers face-to-face tutorials at random i.e Dial-A-tutor to do video-audio sessions [Facetime, video call] outside of scheduled lessons.

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1. What are you views on the academic performance of students in mathematics-related subjects?

Not all Students are Very good with numbers those that are excelling are only the ones that are good in Maths and have done it in the Senior Secondary learning To us Maths is new and we finding it difficult

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Students are not afforded enough lectures and they are Obliged to keep up with the class where Students that are very good in Maths

3. What are some of the common difficulties experienced by students in learning mathematics?

To understand and grasp the concept of Maths. Although at the University level you cannot start to be taught from scratch atleast the methods should be made easy for us

4. How can the difficulties stated in question 4 be managed in the university?

More lecture classes
Qualifying mark for Maths should atleast be a minimum of 40% at the examination because Sometimes a Student Score 41 and Still fail

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

More lectures
Decrease qualifying minumum %pass rate at the exams.

Signature of participant: [signature] Date: 10 August 2019

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1. What are you views on the academic performance of students in mathematics-related subjects?

Mathematics is in itself not an easy subject and students find it hard to pass it because of the workload and the fact that students do not really attend classes.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

The challenges faced is the mentality that is not an easy subject, and it does not make it easier for the students when every single equation has a long process

3. What are some of the common difficulties experienced by students in learning mathematics?

For Distance students, not enough face to face classes, and the typing of math assignments and to top of the test and assignments are set so near each other that students are not having ample time.

4. How can the difficulties stated in question 3 be managed in the university?

Fustly it will be much easier is distance students had face to face time every other week and assignments to be done the old fashion way through writting it helps in remembering an equation.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Tutors to be available on call when needed For mathematics on computers to be taught to the students before general classes start.

Signature of participant: ..... Date: 10.08.19

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1. What are you views on the academic performance of students in mathematics-related subjects?

Slightly bad, those struggling with the subject fail with poor results and those ~~off~~ that manage to pass if they pass with minimum maks required.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Mostly the many different calculations and steps one has to master before getting to the actual answer.

3. What are some of the common difficulties experienced by students in learning mathematics?

- Time when writting a test or exam (Limited time)
- mastering calculations
- many students in one class

4. How can the difficulties stated in question 4 be managed in the university?

I insist that the moderators expand time for students as it requires for one to accuralely work out equations with time.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Students obviously need to be tutored in smaller numbers than being in a lecture with many students

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1. What are you views on the academic performance of students in mathematics-related subjects?

It is not good because maths is a challeges students because some did not do mathematics in Grade 12 they did Commerce for instance or Social field not all learners did science in grade 12

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

End up doing one course for so many years without graduating or worse just give up/end up not graduating just because of mathematics

3. What are some of the common difficulties experienced by students in learning mathematics?

Like for distance Students have limited few time for classes its hard to digest so many informa tion in 5 long hours in one session and its tiring, d

4. How can the difficulties stated in question 3 be managed in the university?

Distance student given more time slot for classes just like full-time student. and avoid 5 hours lesson which is exhausting and students loose Concentration

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

They should change the percentaged of passing to minimum at least even required 30 from exam, they shouldn't except too much like 50 or 40%

Signature of participant: [signature] Date: 10/05/2019

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1. What are you views on the academic performance of students in mathematics-related subjects?

Math requires alot of extra work. As a single working mom of two, I just don't have enough time. The addition of tests for distance students also eats into my time.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Time constraints, subject the student did in high school

3. What are some of the common difficulties experienced by students in learning mathematics?

A student might need extra work or revision. This can be done on the internet but NUST do not have enough computers available ~~in~~ in the library to accommodate distance, part-time and full time students

4. How can the difficulties stated in question 4 be managed in the university?

Make reliable wifi available

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Memo's to assignments should be made available 5 days after the due date.

Signature of participant: [signature] Date: 16/05/19

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1. What are you views on the academic performance of students in mathematics-related subjects?

poor performance.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

delaying dem from graduating which is very stressful at de end of de day because namibia financial student fund stops paying for such a student if he or she is a loan holder once de duration of year agreed upon lapse.

3. What are some of the common difficulties experienced by students in learning mathematics?

didnot do de subject at high school

4. How can the difficulties stated in question 4 be managed in the university?

those of who didnot do it not to be forced to do it because its delaying deir studies or dem from graduate.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

give dem all de necessary materials needed

Signature of participant: ..... Date: 19 August 2019

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1. What are you views on the academic performance of students in mathematics-related subjects?

Students poorly performed in mathematics-related subjects. And lot of them do supplementary exams but they still fail.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

- Understanding some of the course.
- I think that some students do not interested in the course, but because it's compulsory to do the course they have no choice but to do it though they really don't like it.

3. What are some of the common difficulties experienced by students in learning mathematics?

- Equations
- I think some the students fail because they have no interest in the course.
Some Units in the course are just difficult e.g. Set & theory and

4. How can the difficulties stated in question 3 be managed in the university?

I think some of the Units must be removed or must be done to students who will use them in their careers

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

I think students must watch videos on Youtube related to the topics they don't understand.
Lecturers must also explain nicely to students.

Signature of participant: ..... Date: 10.08.19

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1. What are you views on the academic performance of students in mathematics-related subjects?

Most students are really struggling with math and this is what cause bad performence when it comes to their academic records.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

These students end up not attending their every day lessons, especially those ones on full time, because they think that being in class without participating is meaningless.

3. What are some of the common difficulties experienced by students in learning mathematics?

Lack of understanding. And the use of correct methods.

4. How can the difficulties stated in question 4 be managed in the university?

In my opinion, I think it will be better, if the management comes up with the idea of after school classes, this will be a benefit to this students.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

* after school classes lessons
* B. Being having acces to computer.

Signature of participant: M. Springe Date: 10.05.19

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1. What are you views on the academic performance of students in mathematics-related subjects?

I ~~this~~ Personally think that the academic performances of student are affected by the mathematics subjects as some courses, mathematics is not needed in a long run. The institution should look onto this.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Students keep failing the modules and than end up being delayed to their graduations. And this really decreases their self esteem towards their studies.

3. What are some of the common difficulties experienced by students in learning mathematics?

Lack of understanding. Since some of them had left Mathematics in grade, just to start over with it. Some courses do not need mathematics. Students end up failing and repeating the same module over and over. I have been doing it for over 5 years now.

4. How can the difficulties stated in question 4 be managed in the university?

University should really consider taking mathematics out of some courses, such as Journalism, Communications all these courses do not need math in the working industry.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

To have special tutors or extra individuals hired by the institution to help students that do not get or understand ~~not~~ lessons during lectures. This might help reduce failing since some students are afraid to speak out in ~~at~~ class.

Signature of participant: ..... Date: .....

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1. What are you views on the academic performance of students in mathematics-related subjects?

Well, most of the students finds it more challenging as they are not all computer ~~thera~~ literacies and it is alway difficult to for them to get excess to e learning platforms.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

The interpretations of numbers and letters during activity and other ~~ma~~ mathematics-related subject workings.

3. What are some of the common difficulties experienced by students in learning mathematics?

It up to a university level that most students ~~st~~ still need to ~~ha~~ get a knowledge of using calculators and other methods of the subject.

4. How can the difficulties stated in question 4 be managed in the university?

I suggest each student to recieve tutorials in his or her prefered way of classes delivery.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Better uses of e learning platforms and improved tutorials.

Signature of participant: [signature] Date: 10/08/19

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1. What are you views on the academic performance of students in mathematics-related subjects?

I see it as average

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Failure to be groomed well at a secondary school level, or never did mathematics in grade 11 and 12.

3. What are some of the common difficulties experienced by students in learning mathematics?

Depression from other social issues and lack of understanding

4. How can the difficulties stated in question 4 be managed in the university?

It would be better managed at a university level if mathematics would be compulsory to all learners in high school

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

Face to face interaction with lecturers
Attend classes of mathematics more often including extra classes.

Signature of participant: ..... Date: 10-05-2019

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1. What are you views on the academic performance of students in mathematics-related subjects?

The performances aren't that bad. Lack of face to face tutorials probably affects students.

2. What do you think are the challenges faced by students with learning difficulties in mathematics?

Lack of internet access to those that don't have the required devices to access the online resources supplied by the university.

3. What are some of the common difficulties experienced by students in learning mathematics?

Students having to type and submit assignments online while tests and all examinations are written manually.

4. How can the difficulties stated in question 4 be managed in the university?

The university should stick to one way of doing all the work types. If its online it should be online.

5. Name the support services you would like to be implemented to help students with difficulties in mathematic perform better.

More face to face tutorials will do

Signature of participant: [signature] Date: 10/08/2019

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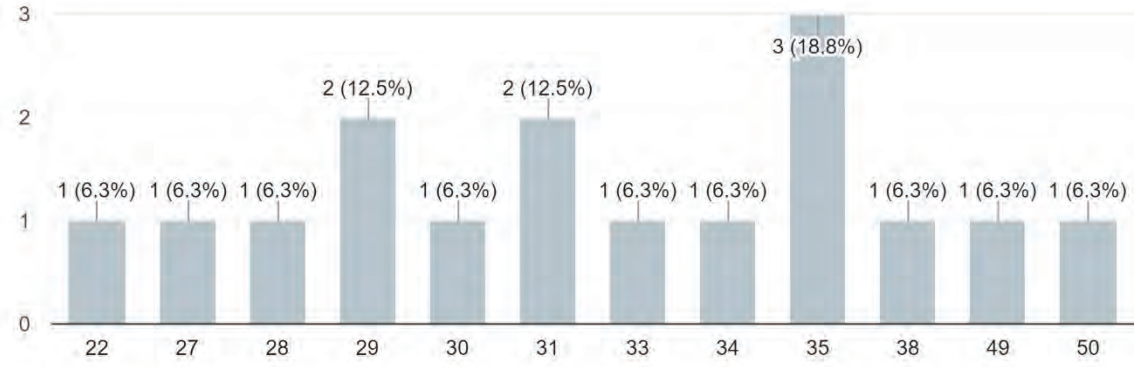
Appendix 7 - Results from the online survey

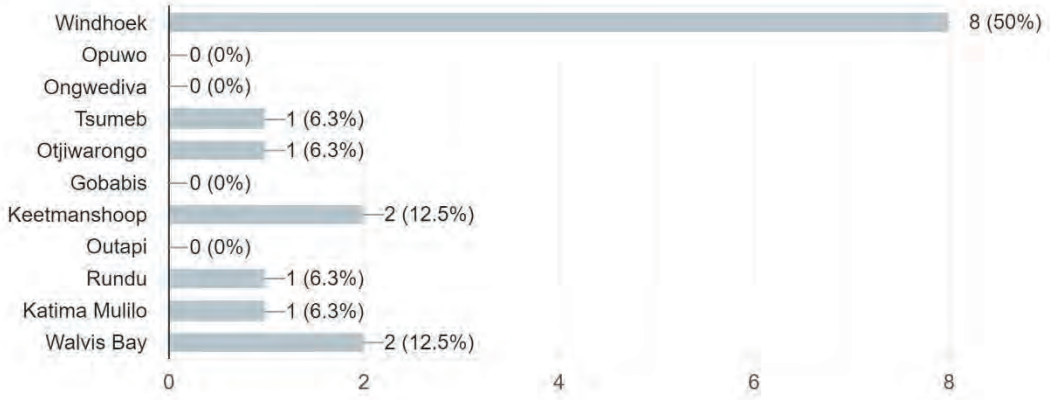
1. Age of the participant (how old are you)

16 responses



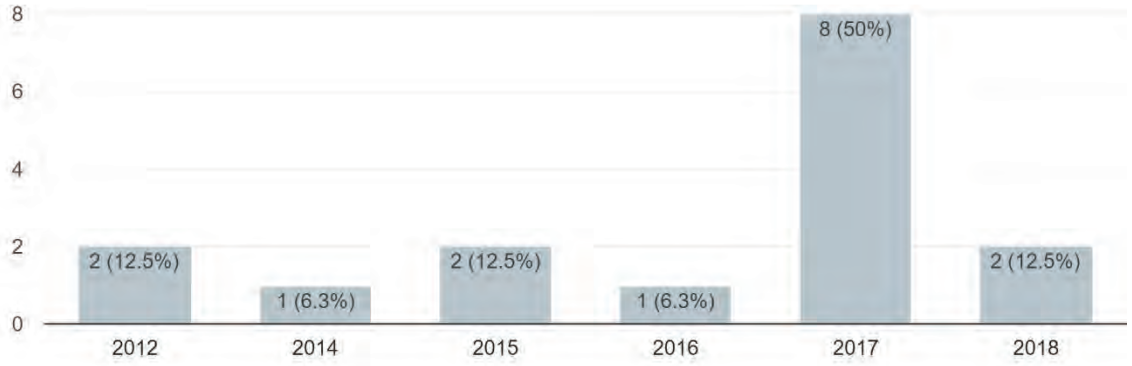
2. COLL Centre of registration (where did you register)

16 responses



3. During whcih year did you first registered for Basic Mathematics (BMS411S) at the Centre for Open an Lifelong Learning

16 responses

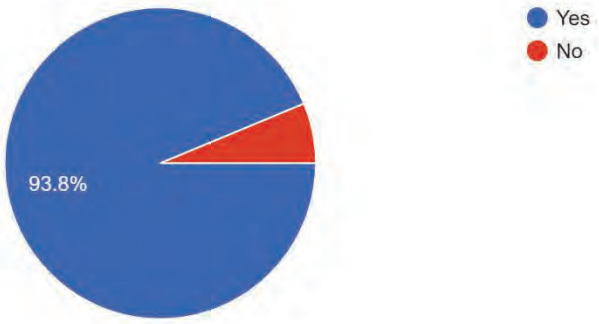


4.a) Have you ever repeated Basic Mathematics (BMS411S) at the Namibia University of Science and Technology?

16 responses

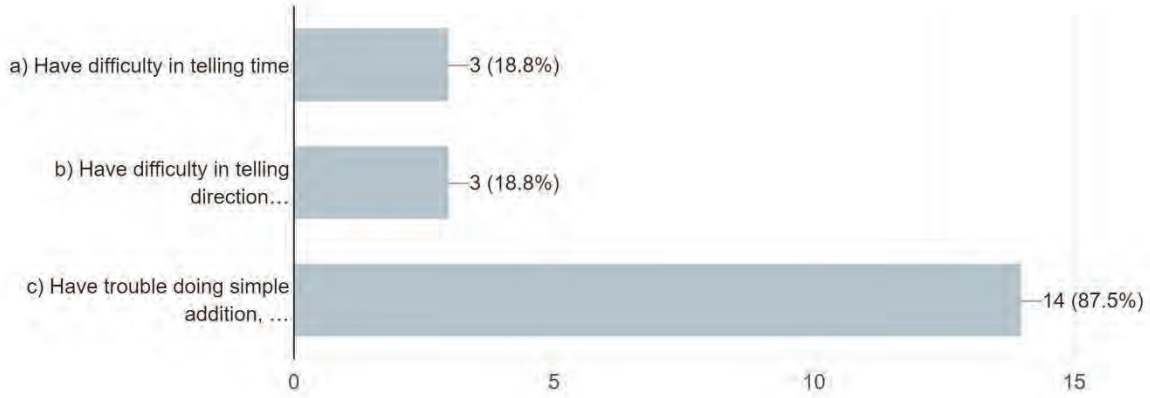
b) Did you ever experienced anxiety when dealing with Mathematics?

16 responses



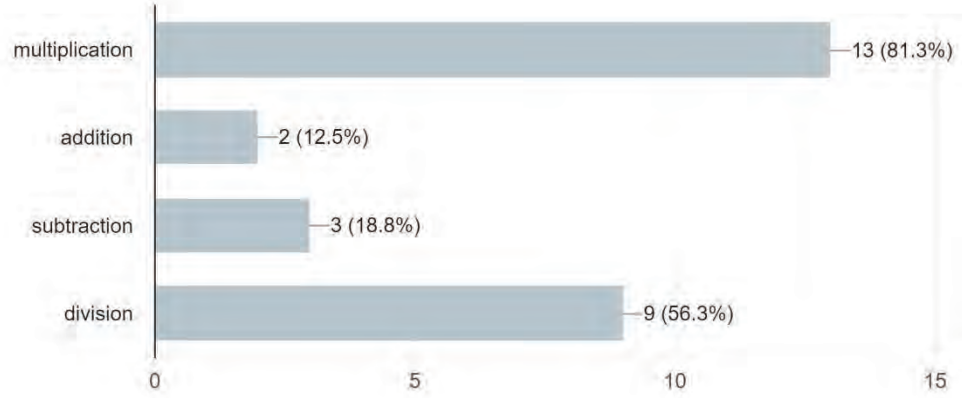
5. a)Have you ever experienced the following problems while doing Mathematics? (please tick all relevant options that applies to you)

16 responses



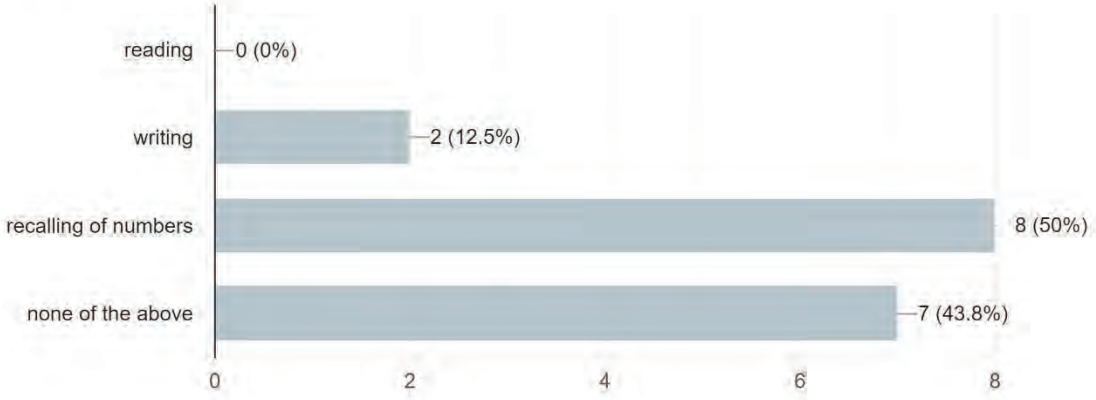
b) Which mathematical application do you find more challenging? (Please tick the options that applies to you)

16 responses



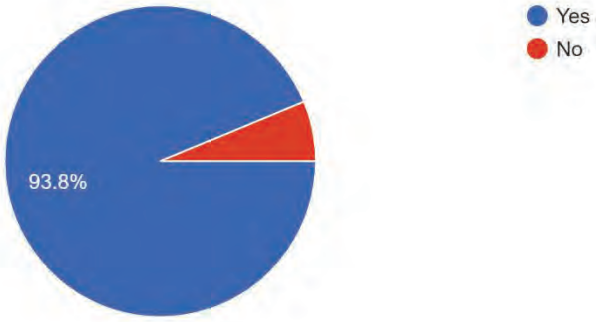
c) Which of the following do you experience challenges with? (Please tick the options that applies to you)

16 responses



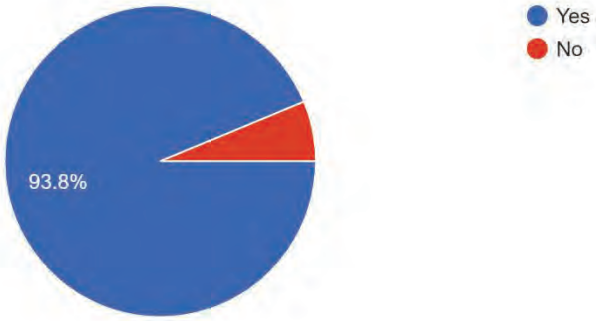
d) Do you have trouble remembering Mathematical formulaes

16 responses



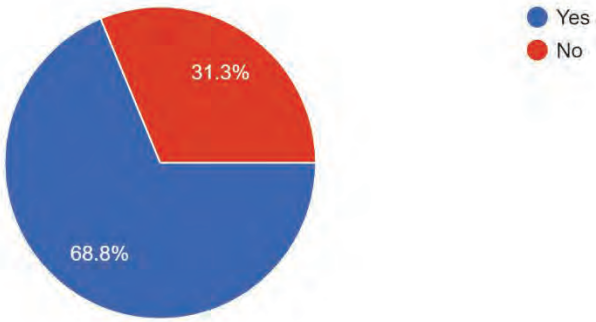
e) Do you have trouble remembering Mathematical concepts

16 responses



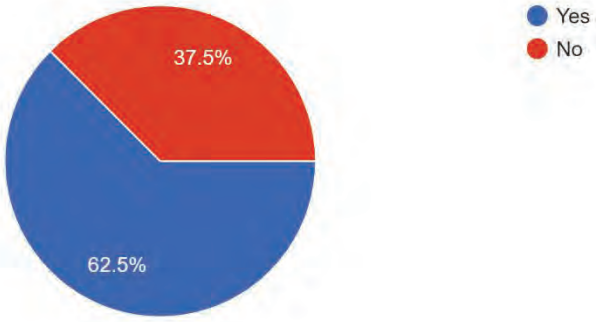
f) Do you experience trouble reading Mathematical graphs?

16 responses



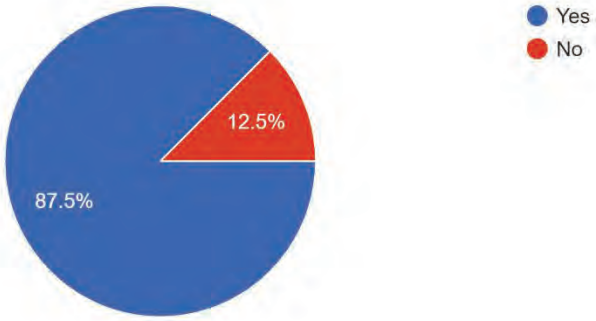
g) Do you experience trouble reading Mathematical charts?

16 responses



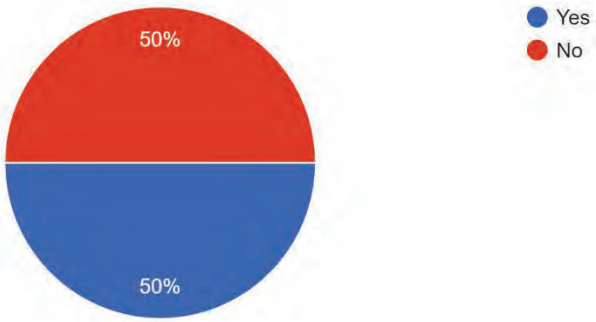
h) Do you experience trouble performing mathematical estimations?

16 responses



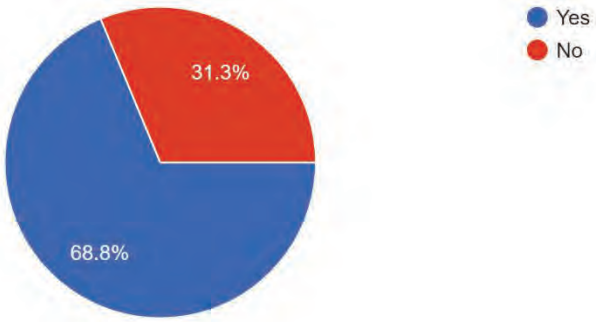
i) Do you use your fingers to count?

16 responses



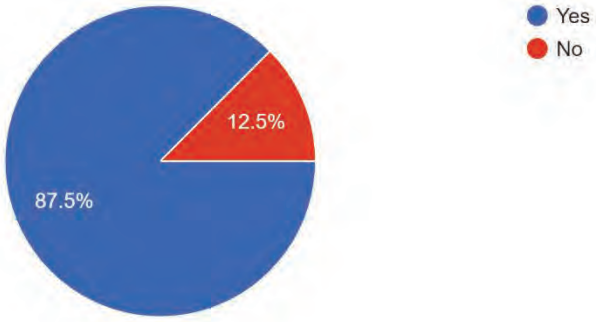
j) Are you able to perform mental mathematical tasks (for example doing simple mathematical calculations using your brain instead of a calculator)?

16 responses



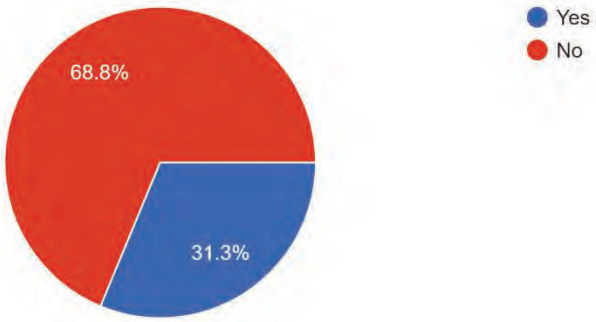
k) Do you take longer to perform mathematical tasks compared to your peers?

16 responses



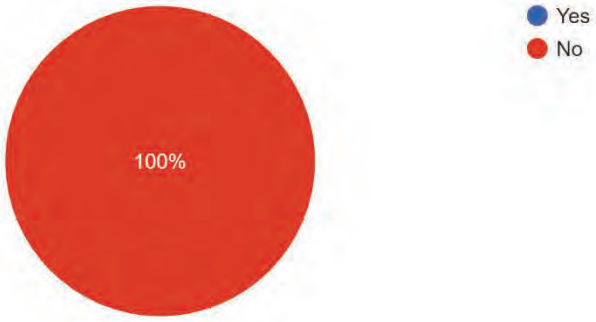
6. Are you aware of the learning difficulty associated with performing Mathematical tasks, called Dyscalculia?

16 responses



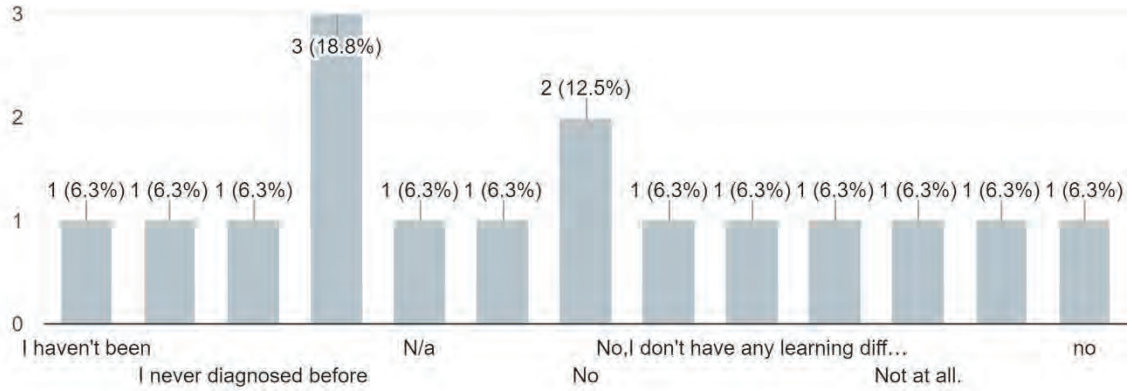
7. Have you ever been diagnosed with a learning difficulty at school and/or university?

16 responses



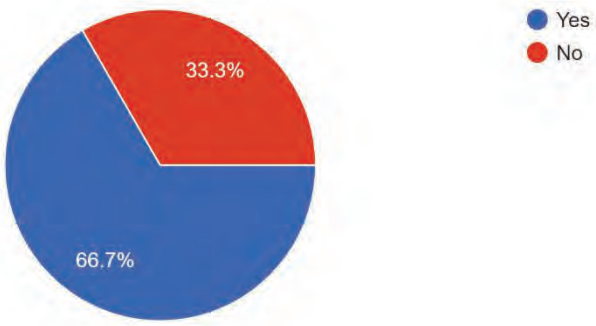
8. If Yes, please explain the type of learning difficulty and the year of diagnosis. (Please specify the type of ...ulty and year that you were diagnosed)

16 responses



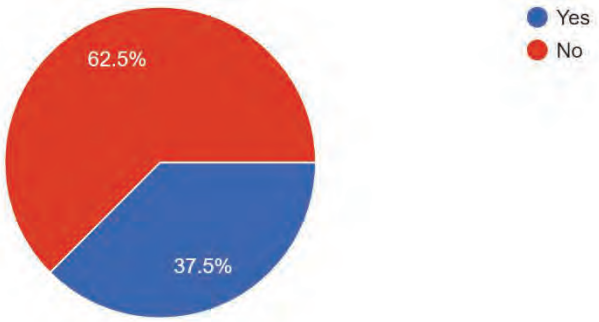
9. Are you aware of the Mathematics Tutoring Centre at the Namibia University of Science and Technology?

15 responses



10. Have you ever utilized the services of the Mathematics Tutoring Centre at the Namibia University of Science and Technology?

16 responses



11. If No, please state the reason(s) why 9 responses

Cant really say

I don't know about it.

A Regional Student

because its a big challenge for me to partake in services offered since iam staying far from where the centre. It is difficult to attend classes and i find it difficult to do the given assignments alone it requires to get assistance which is at times not possible. I have always had an issue or rather challenges with Mathematics since High school so This level the degree level that iam currently enrolled in also makes it difficult for me to pass Basic Maths. I have been struggling to really pass it . I would like it if in the future NUST can perhaps look at better ways we can be or rather distance students can be assited to be able to pass the subject as it is costly if one has to repeat it.

Distance student

I do not know about it

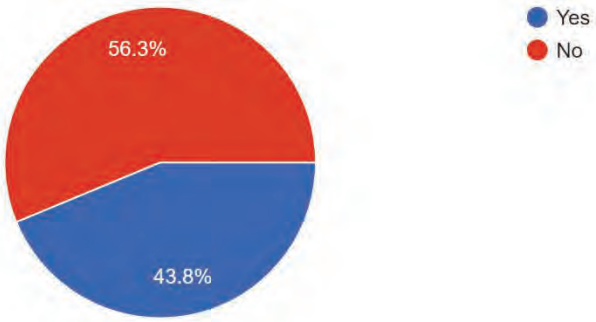
Pressure to understand things in short time

Didn't know about it

Because I'm doing it on distance and sometimes I find myself far from Windhoek

12. Do you think that the Namibia University of Science and Technology's Centre for Open and Lifelong Learning'... with mathematics-related subjects?

16 responses



13. If Yes or No, please explain your answer 16 responses

The tutoring they offer plus the Saturday classes

Because, last semester was the first semester in my whole a ademic year to get such a free spirited lecturer, someone who is willing to help and who understand the students. Most of the lecturers don't have time to explain.

The Tutor's at Nust can be contacted to assist with the assignments, the small town where no centres is available the University must make arrangement with Mathematics teachers to provide evening classes for the students to assist them. The students asked assistance from local teachers the are not willing to assist.

The tutor markers are flexible and always ready to help by going the extra mile.

Each regional centre have assigned a tutor

The time is not enough. one class in a week; on Saturday for two hours only.

Face to face classes is more important

Apart from the 2hours classes on weekends no extra effort is done. If you contact the tutors it takes awhile before they come back to you. Communication gap between marker tutors and regional lecturers.

They should personnlly find out from the students how NUST can assit distance students especially the ones experiencing problems

students are on their own, except the vacation school of one day

Had a bad experience with support offered.Unwillingness of assistance.

Because it offers weekend classes, however its not sufficient for students without mathematics background understanding

N/a

The weekend tutorial classes are not conducted according to a prescribed programmes. it is not followed according to a given course outline and that's why i stopped attending those classes

Because alot of students are still failling math and accounting

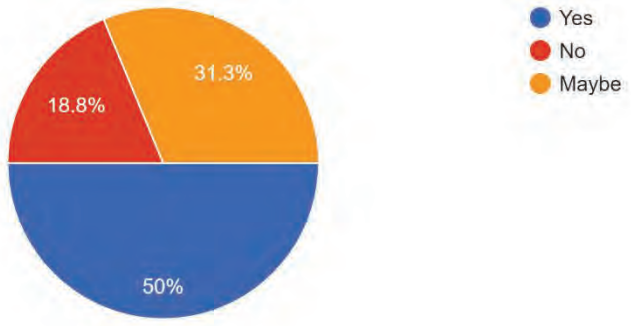
I'm not aware of that at all.

14. In your opinion, which additional support should be rendered to the distance education students in order to assist them with the challenges associated with doing mathematical-related subjects (for example Basic Mathematics)?16 responses

Test scopes nd exam scopes
Mathematics tutoring centre might help.
Moodle live stream classes for the distance students will also assist them.
More face-to-face classes
Tutor should be availed on a 24/7 basis
Increase the number of lessons for Basic Mathematics and minimize the contents to a level of distance students
Contact classes for slow students is needed
More class time,more additional resources of mathematical help. Open communication between regional lecturers and marker tutors.
EG NUST can Arrange weekly classes and arrange for test open book test and we should go through old questions papers with Tutors and they should bring down the passing marks from 50 perent to atleast 40
tutoring at regional centers, at least to prepare the students for exams
Willingness to assist.
They should at least introduce 3 to 4 mathematics lessons in a month
Maybe assignments and test could be done one unit at a time. Test should follow soon after assignments topic at a time.example. assignment one covers unit one only and test one should be the same and set shortly there after. Break it down in small chucks
Maybe change lecturers from the usual COLL lecturers. They are not motivating enough
The math they are teaching isnt basic and doesn't relate to my course
There must be additional lessons towards the final exams and scopes to be provided prior to the tests or exams day for satisfying results because distance students are busy people in terms of being employed and find it difficult to study the whole manual per test.

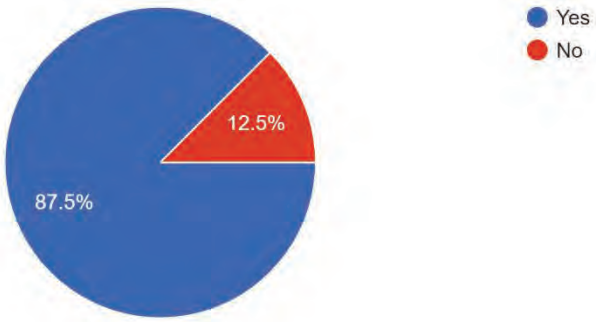
15. Do you think that you might need diagnostic testing for a specific learning difficulty such as Dyscalculia...y that is associated with Mathematics)

16 responses



16. Do you think students can benefit by volunteering to go for diagnostic testing for specific learning difficulties such as Dyscalculia?

16 responses



17. If Yes or No, please state your reasons why it might be beneficial for the Namibia University of Science and Technology's students to go for voluntary learning difficulty (for example Dyscalculia) testing at an early stage? 16 responses

So those with dificulties can be treated and taught differently

In my case I am doing media studies, i might need the test in my field of study, in languages perhaps, meaning that mathematics isn't important in every field of study.

It helps the learners not to repeat the subject many times and gives them a better understanding about the subject.

It will be beneficial because then the Namibia University of Science and Technology will be able to implement a programme to help students with Dyscalculia pass basic mathematics.

Perhaps the approach will be diffetent after diagnosis

In order to identify problems associated with high failure rate of students doing Basic mathematics

To find out the reason for studying difficult in mathematics

Then students don't need to suffer with Mathematics as a subject. Its disheartening doing mathematics for a number of years without any success. If one is diagnose with Dyscalculia one can seek immediate help and remedial processes can take place instead of suffering and feeling a sense of dejection. Some of us only have this subject left to graduate and its quite frustrating not passing it. Had I known of this learning difficulties I could have seek help and check myself out if I am suffering from this condition.

So that one can be assisted earlier and necessary diagnosis can be made and students can assisted to be able to pass the subjects without any problems

to assess and know as to whether special assistance is required for individual students

It would be much more easier to identify the problem at a early stage of learning

Because mathematics only need more time of facilitation especially to students without mathematics background

This may open up ways to deal with the problem

For students to know and be aware that they indeed have a problem in knowing and learning mathematics

Just to get to the root of the problem

Yes, in order to for the institution to know how many students are affected and needs more attention in math. To avoid having a lot of students failing this subject in future while it's not that they're lazy to study but its because of Dyscalculia effects. And for satisfying results in this specific subject as it's now acting as a brocking stone for many students to graduate upon the completion of their courses.

Appendix 8 –Telephonic Interview Transcripts

Appendix 8 – Telephonic Interview Transcripts

FGD interview 1 – 20 June 2019

Good evening. Good evening. Kindly note that this discussion will be used to support the findings of the online survey that was recently completed. Please note that this conversation is recorded, however all personal information of the participants will be kept strictly confidential. So our first question is what are your views on the academic performance of students in mathematic related subjects. It all depends on the capabilities to do the subject in itself the understanding and all that you find some who find it easy in some find it quite difficult. So the performance it's quite… I've had to deal with with some of my fellow students who find this very difficult and then they have to repeat the subject most times. So I can't really pinpoint that whether it's good or bad, but you find some challenges. Okay. Can I proceed on to question 2? Yeah. What do you think are the challenges faced by students with learning mathematics you briefly discussed some of them are struggling and some of them are not so good [at mathematics] what do you think are some of the challenges that our students are facing and why are they not able to pass the subject or repeated so many times? I think okay. Most of you probably don't know that there is this learning difficulty that there is so they just feel that mathematics is not for them. But they just don't understand the subject at all. I have also got the same thing to me that I don't understand mathematics at all. I never thought that maybe oh, I never knew that they could actually be a difficulty in itself. We hear about learning difficulties, but I didn't know that there's actually a mathematical difficulty with me. I will say that I've [not] got a difficulty because I'm good at remembering numbers. Yes, you can ask me about a number which I was dealing with like in my work environment. You don't necessarily need to tell me a name, but if you're in my work environment, I work with erf numbers because I work for electricity utility. Yes, ma'am.

Yes remember it so I can't really say that whether really I have a difficulty. So but I all I know is that maybe it's because I don't grasp the formulas. The formulas maybe they they they they can really get to me or the it's quite difficult for me to remember all of them. But I don't have any difficulty in knowing how to multiply how to go to divide things. All of those things. I can do but not those ones. Yes. Yeah. Yes. So what is common with the mathematical anxiety? Is that sometimes our fear when we hear the word Maths then our brain sometimes blocks out certain aspects when it comes to the applications of mathematical Concepts. Yeah, so my study relates to whether it's more related to mathematical anxiety or does some students actually have the learning the difficulty associated with mathematics, which is called Dyscalculia. No, I think it's more anxiety. Especially I have a problem. What I'm supposed to do Maths. I don't know what I'm supposed. Do we have this Y or the X totally throws me out. So do you think it's safe to say that certain students when it comes to the mathematics face common difficulties and maybe if so, maybe you can name two for me. We mentioned one with the X and the Y now, for example, what is in your experience? What do you think? If you look at your peers what common difficulties have you observed amongst them within our mathematics classes? What I have picked up is more of the the the rules in itself. We don't really know when to apply the root of what I have experienced is that when we first started with a mathematic some of us when we went to school most of us didn't really had that Foundation. Yes. Yes. It wasn't set in high school for us already. Some only we went up to standard 10. And then you come to the university and then you are asked to do mathematics you sometimes after [already] working for like almost six years or so. It's been [to] go back and then you find yourself with mathematics you forgotten all the rules you forgotten the formula, but you know, it's not in that advanced age as where you are because some of us only did yes, and nobody did extended [level of Mathematics at school] or on the higher grade

[level of Mathematics at school]. Yes, so you find it quite difficult. If they I would say that if they can at least give a background on all the rules before we start with just handing in assignments and writing the tests and going for the examination. This is a background. I think it's more on the rules. Yes, what you don't know what you have to do with the Xs and the Y's because some of us don't understand what I'm going to do with the X&Y, but that is just to test your logic how you think about it? Yes, and then again it is got to do that you have know.

To find out [what is] the board problems this is something which is tricky. Now. You don't know whether you are dealing with this type of thing or you have to do it this type of way. So I think those are the common things that we have. So it's basically just to recap the basics when students enter University again and not for lecturers to be of the Assumption probably which we sometimes are that our students are at a certain level and we expect them to perform at that level which we assume they are on. Yeah. Okay. That's it. It's quite difficult. I'm not doing anything why understand anything come? Mean time now you are running around trying to understand the stuff you are asking questions and still you only grasp at little bit and then come the examination. You see this paper and then you think yes. Hmm. Okay, so that is actually what my next question we like to do. But I think you already answered some of it the next question actually related to how can the difficulty stated in question for which we will related to the common difficulties being managed at University. And we mentioned some of the groundwork just a refresher course in that before the actual subject is being dealt with by the lecturer if you can maybe think of other learning support strategies, which we haven't discussed it. You are welcome to also add. I think also. What would what also makes it difficult is that we are sitting with the study guides and some of the things are not so in depth you sitting with the study guide but there isn't an in-depth into it you have to do extra research. Yes. Now not all of us are fortunate to have computers or you just don't know where to go to to look further for this information. Yes. Now you are stranded. Some of us don't have handbooks or this handbook that you are having is so confusing. You are just not understanding it all. Yes. Yes. Oh and then and then there's a different way in you are not having your lecturer which is supposed to give you your classes and then you go for extra some way help with somebody else. Yes, and then this person is teaching you in another way and this one is teaching another way. So it's two or three people who I help you each one with a different style of teaching. Yes. That's also do yes good point that you are right and that is often. Happens without distances education students, they seek tutoring assistance from somewhere else. And what happens is that the teaching methodology is misaligned or like you say the way one teachers is not the one that the other one teaches you you end up being more confused than you were before some tasks. Our last question relates to the support services that you would like to see implemented in order to assist our students that might experience either mathematical anxiety or dyscalculia provided that it has actually been diagnosed. So for this point in time, we only observe the mathematical anxiety aspect. So what services do you maybe recommend apart from us having the mathematics tutoring center? What else can we offer to our students in order to address this? Mmm. So it is only when we go for the vacation school that we can actually [practice Maths] exercise especially if you're coming from the Region's there isn't the facility here where we can go. Yes, we do have the the tutors here that helps us. You only have that contact with the tutor for the two hours after then the person is not interested in teaching any further. If you have to ask then they also demand that you pay for reimbursement for their time that they're spending with you. Yes. Oh indeed this there is quite a lot of support for most of the regional students really. Hmm and then what I have also experienced it that sometimes okay with a WhatsApp groups that are set up you and your tutor would have your your WhatsApp group and then the marker tutor will also have their WhatsApp groups, then sometimes you would ask them to put you on those groups and then they just don't because they now don't know who you are because you are a regional student. So they mostly they

will ignore you. They won't put you on that WhatsApp group, but I think if the markers can put everybody on those WhatsApp groups or give those facilities for of all of the students, even if they're giving the full time students whatever they're doing with a full-time student. They can give those lessons that they give to those ones also to the regional or the district students and also to the distance students it was help much then we at least know where they are standing even the test then one we can also we can also maybe just write this test and see how where we are going wrong. Mmm-hmm. It's not adequate. I've been suffering with mathematics for the whole time. It's the only subject I have left. And I just can't seem to graduate and I'm like if I don't finish it this year and it's all over I have to start all over again and I'm sitting with a problem. It's frustrating me because it's not that I don't understand it. It's just because I don't have that background of the rules and all of that in time is so so little there isn't a really little time there isn't a lot of time for you to do all that work. Yes, and then you know with them not coming and asking. Why are you having this problem? There's no question from you know, the institution itself asking us. Why do you keep on failing what is your problem? Yes, they could identify. I mean this is a trend that you guys are already seeing you could have the already see that this person probably has got some sort of like that learning difficulty that there is yes. Yes, then you'd rather let the person go for a test and see whether it's believer in situ that they have. Yes, I've been meaning to Difficulty then immediately when you know that there is a learning difficulty at least somebody can do something about it. Then it's not out of their own if there is some defect which is there if it means that there's still some remedial things that we can do to curb this anxiety. Yes, because it's the most people you go there, you know exactly what you do. Then you see this question paper and this time is not enough. Is that why you've been studying the whole night sleeping and you know, exactly. Yeah. Thank you so much ma'am. Your input is really valuable to me. This interview is [conducted] to support what the online survey actually showed so that is just to strengthen that and to really show that our students are having a serious problem that we need to address asap. And as you know as academics, you know, they want to see conconcrete evidence. They want to see research-based things and not just someone's opinion about something. So this will enable me at least to somehow if not raise awareness at least to start addressing the problem and to offer paid the student support to our especially our adult students that are doing distance education, then hopefully you will we will make it one step at a time and not eliminate the sphere which is sometimes a generation of here that our parents had this fear. Now, we have this fear with mathematics, you know. Yes. Yes. No, it's quite you know you like for me it's quite frustrating. It's just I can't handle it anymore. If I have to do mathematics, then I'm like, yeah, I had that pressure goes up. I definitely agree with you. Thank you so much. It was approximately 15 minutes that we spoke. So I keep to my side of the promise. I don't want to delay you any further. Thank you so much. I hope you learned something from the study as well and because through this research and the surveys and what I'm also trying to make the students alert. On our side we should also look out for this type of thing. Unknown to me. It was a wow moment. Oh, okay, and then when you do such a thing the challenges associated with mathematics that can actually be clinically proven. Thank you, ma'am. Have a nice evening. Thank you.

FGD Interview 2 – 23 June 2019

Good evening ma'am explained this is a follow-up to the into the online survey that we've recently completed some of the questions also pertain to the academic performance and support services that could be offered by the university I would like you to speak freely and openly this will be anonymous and Strictly Confidential your details will not be disclosed at any stage of my research pre-trial or post can I proceed with a question ok number 1 what are your views on the academic performance of students in mathematics related subjects are the percent of the students in mathematics

sometimes you think like in your mind or in your head is I don't like to do the subject . There are some common difficulties you briefly mentioned your perception to the subject for example you don't like the subject and what do you think are the common difficulties that you've may be observed amongst your peers that are sitting in the same class with regard to mathematics.

The last time you did Mathematics was in grade 12 and then you go to university where it is compulsory to have it [Mathematics]. That is a very good point. Our next question relates to how do you think that the university can manage these challenges that adult learners in particular are facing with regard to mathematics? I think the difference in all the different regions have regional centres and even support the students.

When you try it on your own you were only doing like YouTube or whatever. Llastly can you maybe name other support services that are not currently offered by the university that I could possibly look in that can support our distance education students were doing mathematics other individuals? Maybe there's our attitude and I think they can try to do support the mathematics students more. Thank you so much. Thank you ma'am for your valuable time we've come to the end of our interview I appreciate your time and valuable feedback have a blessed week ahead goodnight.

FGD Interview 3 – 23 June 2019

Good evening sir thank you for agreeing to partake in our discussion please note that this recording is going be transcribed so it's recording what you say word-for-word and then I'm just going to copy and paste this information again no personal details will be displayed I'm not going to mention your name or surname or student number and it's not going to be reflected anywhere on the transcription I would please like you to answer the questions openly and to speak freely and since the input was going to be very valuable to support my survey with regards to the challenges that distance students face with mathematics can I proceed to the questions thank you sir. Number 1 relates to your views on the academic performance of students in mathematics related subjects. Students attend full-time classes maybe benefit more [than distance education students]. Can I proceed to the next question number 2. To what do you think are the challenges faced by students with learning difficulties in mathematics. Centre with weekend classes are being held and sometimes the closest [centre] allocated near you is far and is only two hours [duration] for the weekend classes.

Transport for attending classes also is a challenge and some [students] drops out due to this. This is a valuable points thank you. Question 3 we've discussed the common difficulties now question four what are the difficulties stated in question three the challenges that we've just discussed and how can I do you think the university can manage these challenges you've mentioned that sometimes the the distance for to travel to your face-to-face classes a challenge in itself the time allocated for that class is another challenge so how do you think the university can possibly address these challenges in order to meet our distance education students halfway like right now in the north we only have one regional centre in Ongwediva and some students live outside town.

My next question is what other support services do you think the university can introduce you've mentioned that for the University to possibly look into getting a regional center Eenhana which is available can you maybe suggest any other support services that we haven't yet thought about but something that is critical in order to support our students. Normally lecturers provide notes which need to be uploaded on their learning system so that maybe student access. That is another valuable point thank you so much sir I appreciate your time and input we have come to the end of our verbal interview thank you so much have a blessed evening goodbye.

FGD interview 4- 24 June 2019

Good afternoon. Good afternoon, as earlier stated the discussion will not last very long. However, I would like you to please speak openly and freely because the information that you give me hear will support the study that I'm doing. Can I proceed with question 1? Okay question one, what are your views on the academic performance of students in mathematics related subjects. My views on the performance of the academic performance of the student when it comes to mathematics. I think it's not ok. The reason why I'm saying this is because a lot of different students have been complaining about mathematics from different departments. And you see that one has completed all the modules that we are even in your final diploma like for the ones as was doing VET , but we are still struggling with mathematics. So I would say that this. Thank you very much. Question 2. What do you think of the challenges apart from the fact that some students are only having one subject before they can graduate what other challenges might they also face when it comes to mathematics. What other ones do you also think they have that they struggle with when it comes to mathematics. I think (inaudible)…

There's nothing like a formula that people teach you that this is a formula on what you're going to get into that question. There are always those questions but there's no formula. So that is also a thing of having classes on a Saturday like some of us will go to church on Saturday and cannot attend class. How can the university deal with the challenges you've mentioned especially for the Seventh-day Adventists. They should have an alternative method of dealing with the weekend classes as opposed to only offering it on a Saturday. Okay, then our last question. Can you maybe suggest other Support Services, which the university doesn't already have that they might have not think about but which is critical in order to support our mathematics students that are enrolled for the subject on distance. I think got it. Extra support for adult students like having those classes only Mm like me when I was in grade ten I last did mathematics. So all these days I did not do mathematics. Then I come into contact with mathematics. So when someone will be able to tell some of the features then they'll be able to tell that no this one's and not that that one. Let me also add another explanation and say some tutors might be too fast on teaching mathematics while there might be another some students on another level instead of just being faster than the ones who are not so fast with mathematics. Who knows. So I think if they can also look into issues where by sometimes they changed tutors maybe that'll benefit and also the other thing the the issue of having tests. Some tests are out of sixty while assignments are out of forty. It's obvious in the assignment you can be you can get better marks just because they do better in the assignment because I said means they're calculated out of 40 instead of 60 like in other universities It's not like the other subject. So if they can just iterate to be like other subjects, I think so. It might be better. Otherwise you end up just having a lot of those people who do not pass mathematics? And they're not even graduate. They're not even get there. Imagine. Everything is finishing but you're not even having your higher certificate or your advanced certificate. Basically what I see basically what I was saying is that they should look at the assessment criteria that is attached to mathematics that one also and also to try and be as it may be to try and change. So they see, maybe ways or another tutor who can assist one another maybe one might be able to explain to others too who are struggling from the low stage. I would say we are having such people who are lacking foundational skills and need to be assisted. Thank you so much. We've come to the end of our interview. I appreciate your time and input. Have a good day. Bye. Okay. Thank you.

FGD Interview 5 - 25 JUNE 2019

Good evening, sir. As I've explained to you previously the follow-up questions relates to the online questionnaire that was recently circulated. Thank you for your input. Please feel free to speak openly no [personal] information will be disclosed. No personal information like your student names or student number nothing like that will be displayed as part of the data that is collected. This is strictly Anonymous. So pleased do speak freely. Okay. Can I proceed with question 1?

Question 1 what are your views on the academic performance of students in mathematics related subjects? It is poor They are actually failing especially they [the lecturers] don't care [about us since] we are doing distance now. And then why do I say so in the beginning of the year when we start we are so many and then there are only some who qualified for exams based on the criteria actually set out before having an exam. You need to take some tests. Then you need to qualify for an exam. If you failed the test, then you don't qualify. So when we take final exams, I always see that the numbers have decreased according to the previous number of students. The performance is really not that actually good.

Okay, I think you briefly touched on some of the challenges is there any other challenge that you would like to add that the students are also facing when it comes to mathematics. You've briefly mentioned that some of the students do not qualify to write examinations and that might be considered a challenge. So is there may be any other challenge that you could also think of when it comes to mathematics? I would say we don't actually have enough classes. I left mathematic long time that is in grade 10 when I was or 11 and 12 so and it had been a long time that I completed school and now deal with Mathematics again. To attend classes, which is only one day a week. It's going to be a challenge actually for me to cope especially if it is only two hours. Yes. It is not like you just need to read and understand the things that you need to understands the rules that you need to follow and then all these is not well explained. You may have your book and all the materials that they can get you not actually pass. Yes. Yeah, okay. We may not actually manage but at least if they said four hours [of face to face classes] then it would be better on Saturday. So it was going to be much better. Yes. Yeah, thank you.

Okay, some of the challenges that we've mentioned previously. I think you've also addressed by giving advice on how the university can address that for example to have longer classes. Is there any other support services that you would like to see from the University apart from us already having a mathematics tutoring center and weekend sessions. More regional centres needed. Now that vacation classes that we always take. Oh I would say they can always also arrange that with we can come visit the office for a week. They need to provide for us the letter that we need to attach one our study leave. They always do it actually for other modules like when we come for classes the technical exam so I can they also do that. They just need to arrange it for the week that we can come over to the main campus and we have classes like throughout the day or week. Yes. Yes, okay.

Thank you so much, sir for your input. We've come to the end of the interview. Thank you for making the time. I appreciate it. Yes, sir? You know. Yes, and then I ended up having a personal tutor that I could pay myself. Hmm, and I collected some previous material. Yes [and I told] him just to go through but I've discovered that out of surprise. Of course, he is qualified lecturers telling me that this basic mathematics that you guys are talking about it is basically a combination of the things that we had been doing on a [Mathematics] higher level. Okay, according to his opinion. Why do we have other things which are regarded for higher-level [Mathematics] people. Thank you so much, sir for adding that point. It is a valuable point also, so I will well included as well. Thank you, sir. Have a good evening. Thank you. Bye.

FGD Interview 6 -25 JUNE 2019

Good evening, ma'am. Good evening, as I've explained this interview as a follow-up to the online questionnaire that I've recently circulated. Please note the information in now information will be disclosed at any stage. It will strictly be an anonymous interview. I will be using a transcribe app. Can I proceed with the questions? You may.

Question number one? What are your views on the academic performance of students in mathematics related subjects. I find that the performance of students in mathematics based subjects is generally poor. Students find it difficult. Can I proceed with question two what do you think are some of the common challenges? I think most common challenge is linked to fear because students generally fear mathematics and thus they end up not having an understanding of it. And yes, that's what leads to poor performance. Okay. How do you think the university can manage these difficulties that you've just explained? I think they can Implement more tutoring services. Students go to tutoring services with different tutors, then they might explain it in a different manner than the lecturer which ends up confusing students even more. Hmm and secondly they can the lecturer can try implementing different methods or teaching styles to cater to the different types of students because some students might be slower than others. Thus most students don't process information as fast as others and thus people perform poor compared to their classmates. Hmm. You briefly touched on the aspect of support services that can also be offered now some of the supports are services that are currently being offered by the University's the mathematics tutoring center and we can face to face classes. Do you think that the university can Implement any other support services? Like I mentioned before maybe they can implement services that allow students to request for one-on-one Services one-on-one sessions rather because some students might feel that they do not want to participate in a classroom setting with other students in order to pay to understand and also they can try like I said different methods of Teaching styles, so maybe make it more interactive for students that are more Hands-On introduce more colors into the slides for students that have no visual or videos or things like that to keep the to the different types of students. That's a very good point that you have raised I think you I will consider including that as part of my findings. We've come to the end of our interview. Thank you for your time and input have a lovely evening. Goodbye. Thank you. Goodbye.

FGD Interview 7 – 25 JUNE 2019

Good evening, ma'am. Good evening. As I've explained. This interview is a follow-up on the online survey that I've recently conducted. Okay, please speak freely. And openly please also note that this will be an anonymous interview. Now personal details will be disclosed no names and I'm a student number will be reflecting on the data at any stage. Okay. Thank you.

Can I proceed with question 1 you may. Question 1 what are your views on the academic performance of students in mathematics related subjects. Performance is average to poor. Okay, when you say average to pour maybe you can just elaborate a little bit on the aspect of it being regarded as not that good. Students generally struggle a lot with math and math based subjects, like mathematics or accounting. Okay. So what do you think are some of the challenges that they might be facing that attributes to this average to poor performance in mathematics? Well A lot of the distant students do not always attended classes maybe because of transport or being too busy to attend classes.

Okay. So how do you think the university can manage these challenges? You also briefly picked on some difficulties may be in terms of not having transport or not not having time. How do you think the university can might be able to address those challenges and difficulties? I think maybe they [the university] can maybe offer an online solution maybe if they have sort of a web-based tutoring session for example, in case some of these students are not able to attend. This aspects also relates to my next question in terms of the support services at the moment NUST has a mathematics tutoring center and the sessions that they offer over the weekends to our students called the face-to-face sessions. Can you maybe think of any other support service that you think the in the University can also have a look at? As I stated earlier something of online support would be greatly beneficial because not everyone can always come physically to attend the classes. Yes. Yes. Thank you, ma'am. We've come to the end of our interview. Thank you for your time and your input. Have a good evening. Goodbye.

Appendix 9 – Proof of Editing

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7 July 2019

TO WHOM IT MAY CONCERN

I hereby confirm that I have proofread and edited the following thesis using the Windows 'Tracking' system to reflect my comments and suggested corrections for the student to action:

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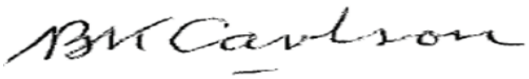

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Disclaimer: Although I have made comments and suggested corrections, the responsibility for the quality of the final document lies with the student in the first instance and not with myself as the editor.