Exploring Foundation Phase Mathematics teachers 'use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa.

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Submitted in fulfilment of the requirements for the degree

MASTERS OF EDUCATION

In
CURRICULUM AND INSTRUCTIONAL STUDIES

In the

COLLEGE OF EDUCATION

At the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: DR. AS. MAWELA
2019

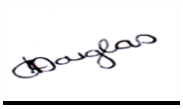
ABSTRACT

This study focused on the teaching of Mathematics to Grade 3 learners and learner underperformance in Mathematics in South Africa and worldwide. A theoretical framework examined the value of social constructivism, behaviourism and connectivism to Mathematics teaching. A comparison was made with Mathematics teaching in primary schools in South Africa, Bangladesh and Mozambique according to the literature. Against this background a qualitative inquiry was conducted in three selected primary schools with a purposeful, convenient sample of five Grade 3 Mathematics teachers in Daniëlskuil town, North West Province, South Africa Data were gathered by semi-structured individual interviews, non-participatory classroom observation and document analysis to explore theoretical knowledge and teaching approaches of participants, establish strategies to enhance teacher proficiency, identify successes and challenges in teaching Grade 3 Mathematics and factors that impede Mathematics teaching in the selected primary schools. Findings indicated challenges created by lack of physical classroom resources such as stationery, textbooks and learning aids, poor school infrastructure, overcrowded classrooms, discipline problems, teachers' inability to meet the needs of learners with barriers to learning, language barriers, learners' social problems, teachers' lack of Pedagogical Content Knowledge, lack of developmental teacher training and limited stakeholder support from the Department and parents. Successes related to Mathematics intervention programmes, study groups after school and math's clubs. Based on the literature and empirical inquiry, recommendations were made for implementation by Department of Basic Education, schools and teachers improve the learner performance outcomes in Grade 3 Mathematics in primary schools in South Africa.

Keywords: Learner performance, underperformance, primary school, Foundation Phase, social constructivism, behaviourism, connectivism, teaching approaches and methods, successes, developmental training, proficiencies, strategies, barriers to learning.

DECLARATION

I, Katherine Anne Douglas, do hereby declare that this dissertation “Exploring Foundation Phase Mathematics teachers ‘use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa” is purely the researcher's own work and that I have not submitted it for any other degree or to any other university.



November 2019

K.A. Douglas **Date**

DEDICATION

To the researcher's late Father, T.G Baldwin, and ever-present Mother. I.M. Baldwin for giving me the tools I needed to strive for success and encouraging me to be courageous and strive to be the best version of myself that I could be. Their unselfish love and utmost belief in my abilities has always been my driving force and without their sterling example, devotion and dedication, I would not be where I am today.

I would also like to dedicate this thesis to the teachers that live and breathe for the children that they teach. To those of you who so selflessly go that extra mile, and do so without a voice or a complaint, I salute you.

ACKNOWLEDGEMENTS

Due to the fact that no man or woman can honestly say that they have achieved success without the support and assistance from others, I have a long list of people to thank for assisting me with the completion of this thesis. Without their valuable contributions regardless of their magnitude, their time, patience and guidance I would never have achieved success.

My supervisor Dr. A.S. Mawela who taught me many lifelong lessons on this journey, the most valuable being that only you stand in your own way of success. Thank you for possessing the patience of Job and for your guidance, motivation and direction. It was sometimes a difficult journey, but for the most part I enjoyed the ride;

UNISA for providing me with financial assistance;

The Grade 3 teachers that participated in this research study;

My fiancée, Guy, for being my rock throughout this process. Your patience, love, devotion and emotional support sustained me and kept me going;

My daughter, Brittany, for being my number one fan and believing in me when I forgot to believe in myself;

The Education Department of the Northern Cape for allowing me to conduct this research study;
My mother, Ingrid and siblings, Julie and Lance, for their encouragement, love and support;

My principal and SMT for allowing me to conduct this research and allowing me time off when I required it;

My fellow M and D student, Vhulahani Patrick Tshivhase for lending an ear when I needed it, not laughing at my ignorance and assisting me when I was all, but ready to throw in the towel;

Last but not least, My Heavenly Father for carrying me through this process and giving me strength when I needed it the most. Your mercy and grace is sufficient for me.

It is with a grateful heart that I thank you all for your valuable contributions, without you, it would never have been possible.

LIST OF ACRONYMS.

ANA	ANNUAL NATIONAL ASSESSMENT
CAPS	CURRICULUM AND ASSESSMENT POLICY STATEMENT
DBE	DEPARTMENT OF BASIC EDUCATION
DOE	DEPARTMENT OF EDUCATION
FAL	FIRST ADDITIONAL LANGUAGE
HoD	HEAD OF DEPARTMENT
HL	HOME LANGUAGE
LOLT	LANGUAGE OF TEACHING AND LEARNING
NCS	NATIONAL CURRICULUM STATEMENT
OBE	OUTCOMES BASED EDUCATION
RNCS	REVISED NATIONAL CURRICULUM STATEMENT
SASA	SOUTH AFRICAN SCHOOLS ACT
SGB	SCHOOL GOVERNING BODY
SMT	SCHOOL MANAGEMENT TEAM
TRS	TOWARDS THE REALISATION OF SCHOOLING 2025
UNESCO	UNITED NATIONS EDUCATIONAL,SCIENTIFIC AND CULTURAL ORGANISATION.
UNICEF	UNITED NATIONS INTERNATIONAL CHILDREN'S EDUCATIONAL FUN

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CHAPTER 1
INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

In South Africa and in other parts of the world, the teaching of Mathematics poses a serious challenge to teachers. In South Africa in the Foundation Phase, mathematical teaching is conducted in various Home Languages. This invariably depends on the location of the school and the endorsed language policy that is enforced by the specific school's School Governing Body (SGB) as is stipulated in the South African School Act (SASA, 1996) while First Additional Language is only employed as from the Intermediate Phase. The teaching of learners using their home language in the Foundation Phase gives them an added advantage to be able to understand Mathematics better than when First Additional Language is used as a medium of teaching and learning. Studies conducted by UNESCO indicate that it is also imperative that teachers should be able to understand the learners' home languages and their culture in order to improve their learning. However, in many countries, learners are taught and assessed in languages that they do not speak at home and this has a major influence on their learning, understanding and performance (UNESCO, 2014).

The importance of teaching learners Mathematics in the Foundation Phase cannot be overemphasized. However, in South Africa for many years, the focus on learner performance has predominately been on Grade 12 and not the lower grades. The introduction of the Annual National Assessment (ANA, 2011) therefore identified a need to improve the performance of learners from grass root level upwards, in order to improve the overall performance level of Grade 12 learners. This specifically included Grade 3, 6 and 9 in Mathematics (Department of Basic Education [DBE], 2012).Towards this realization of improving learner's performance, it is articulated in towards the realization of schooling (TRS) 2025 goals that there should be an increase of Grade 3 learners' competency in numeracy (DBE, 2012). Despite the change in the curriculum in South Africa since 1994 from outcomes based education (OBE) to the National Curriculum Statement (NCS), Revised National Curriculum

Statement (RNCS) and lastly to the Curriculum Assessment Policy Statement (CAPS), there has been a minimal change in learner's performance, particularly in Mathematics as indicated in Annual National Assessment (ANA) statistics (DBE, 2014).

In previously conducted research, various factors, besides the changing of the curriculum, contributed to the challenges that exist in the teaching and learning of Mathematics, particularly in the Foundation and Intermediate Phase (Saritas and Akdemir, 2009). Govender (2009); Ganasi (2010) and Mitasha (2013) suggest that, in striving towards the effective quality of teaching and learning of Mathematics, the DBE in South Africa should invest in the professional development of teachers, the development of materials to teach Mathematics and address the issues of learner-teacher ratio in classrooms, admission versus home language and barriers to learning issues. The view of the researcher, as an experienced Mathematics teacher in a primary school, is that despite the observable awareness by the DBE on poor performance of learners in Mathematics as a subject, very little is being done to equip teachers with relevant and effective teaching approaches, and hence poor performance of learners in Mathematics prevails, and continues to exist. This view is supported by Prinsloo (2009) who indicated that South African progress in comparison with the international Mathematics competency in Mathematics assessments, is still poor, when being compared to other countries.

This study intends to exploring Foundation Phase Mathematics teachers 'use of different teach-ing strategies in Grade 3, in Daniëlskuil, in South Africa, teaching approaches that teachers use in teaching Mathematics to Grade 3 learners in primary schools and to suggest Mathematical teaching approaches that will empower them to be more proficient with regard to the teaching of Mathematics. The next section will discuss the theoretical framework that the researcher will use in order to conduct this study.

1.2 THEORETICAL FRAMEWORK OF THE STUDY

Social constructivism (Erikson, 2016), behaviourism (Skinner, 2011) and connectivism (Downes, 2010) are some of the learning theories that are imperative with regard to the effective teaching and learning of Mathematics. Although these learning theories differ in their perspectives, they are not mutually exclusive. The researcher intends to use these theories in conjunction with each other in order to meet the aims and objectives of this study.

In the context of teaching and learning Mathematics, the social constructivism theory implies that both teachers and learners should be able to understand the social world that places meaning-making, constructing and reconstructing at the center teaching and learning (Erikson, 2016). In the researcher's opinion, this theory is essential when teaching Mathematics to young learners as it is based on the knowledge that they obtain, and allows the learners to expand their understanding by actively constructing and reconstructing mental frameworks. These learners cannot obtain knowledge in a passive way but need to be actively involved in the process; this enables the learners to construct new knowledge by forming their own representations of the content, select this content and in turn interpret what they have learnt. Young learners need to be guided through this process, but should not be told what to learn. This can be obtained when a teacher acts as a mere facilitator during the learning experience but does not try to control the learning experience.

The next theory that is important in the teaching and learning of Mathematics in the Foundation Phase is the theory of behaviourism. This theory can be seen as a theory in which the behaviour of the teacher reflects on how well the learners are learning. This theory is implemented through positive and negative reinforcement and requires a teacher to adopt an authoritative and direct role in the teaching and learning process of Mathematics (Skinner, 2011). The researcher is of the belief that the behaviour of the teacher with regard to the teaching and learning of Mathematics plays an important role in the rate of success or failure that young learners will experience in a Mathematics class. Recent studies have found evidence that teachers can affect

behaviours and mindsets beyond the students' core academic knowledge and skills (Chetty, 2011: Jackson, 2012: Ruzek, 2014).

The third important and relevant theory that is needed to teach and learn Mathematics effectively is the theory of connectivism. According to AlDahdouh, Osorio and Caires, (2015), the theory of connectivism is based upon the current world phenomena known as the digital age. It aims at tackling complex learning in a world that is constantly changing. Connectivism emphasizes cultural and social factors in the learning context and it works through patterning and sees learning as a network. Connectivism focuses on connecting specialized information sets which allows us to learn more than our current state of knowing (Siemens, 2009).In the opinion of the researcher, connectivism is an important theory because it helps learners to continually acquire new information, connect specialized information sources and gives them the ability to connect various fields, ideas and mathematical concepts. Besides that, it is essential when teaching Mathematics, particularly in Foundation Phase, to nurture and maintain learner's ways of learning different concepts in Mathematics.

The theory that underpins this study is the social constructivist theory. This theory is seen as the most relevant theory and most commonly used for the teaching and learning of Mathematics. This study thus intends to explore teacher's views regarding teaching of Mathematics in Grade 3 in Daniëlskuil primary schools, and teaching approaches that teachers use in teaching Mathematics to Grade 3 learners in primary schools and to suggest Mathematical teaching approaches that will empower them to be more proficient with regard to the teaching of Mathematics. The next section will discuss the background and purpose on which this research proposal is founded.

1.3 BACKGROUND AND PURPOSE OF THE STUDY

The context and background for this research, is based on the fact that teaching and learning consists of a collection of diverse applications and disciplines and requires rigorous understanding of a variety of theories, vast knowledge and experience from teachers (Blum, 2007; Ojose, 2008; Hoong, 2015; Caprioara, 2014; Sullivan, 2011; Halai and Clarkson, 2011). In Daniëlskuil town, the teaching of Mathematics as a

subject often poses a serious challenge to teachers. This challenge was exposed by the introduction of the Mathematics ANA in South Africa in Grade 3, 6 and 9 which was mainly implemented to improve the teaching and learning of Mathematics. The results, however, as outlined in ANA statistics in 2011, 2012, 2013 and 2014, unfortunately, show no drastic change, and clearly indicate that a lot more has to be done to achieve academic success in this subject particularly in Daniëlskuil town.
This challenge was also exposed in other countries such as Mozambique and Bangladesh.

In Mozambique for instance the World Bank conducted studies that showed a substantial deterioation in Mathematics results in primary schools between 2007-2011 (World Bank,2017) and after conducting a survey of ten respective African Countries found the Mathematic Knowledge of teachers to be extremely weak (World Bank,2014). According to Wilson (2017) National Student Assessment Studies have concluded that only 3 out of 10 grade 3 learrners are able to complete basic addition sums and 92 out of 100 learners are unable to do division . Wilson (2017) also stated that thousands of children in Northern Mozambique failed to acquire the basic skills in Mathematics in primary school ,despite having spent 7 years in school.

In Bangladesh the same senario is presented claiming that 70% of children can't perform basic Mathematics calculations after five years of schooling (Abu Afsarul Haider,2015). This was also echoed by a report by the World Bank which stated that students in Bangladesh were failing to master the basic competencies in Mathematics (Daily Star,May 10,2014). This was further confirmed by the National Student Assessment of grade 3 and 5 learners that was conducted by the Bangladesh Ministry of Primary and Mass Education (2017) which stated that in 2013 , 43% of grade 3 learners performed below accepted levels in Mathematics. In 2014, 59% and in 2017, 59% of grade 3 learners performed below the accepted levels.

The status quo of Mathematics performance in Grade 3, 6 and 9 has been of serious concern to the DBE in South Africa. Various researchers indicate that there is no isolated reason for the poor teaching and learning of Mathematics, but a combination of diverse elements that cause this problem. Among other reasons, lack of planning,

ineffective subject knowledge and poor teaching approaches are some of the contributing factors towards poor learner performance (Brown and Gordon, 2009; Erden, 2010). According to Lombard (2010), learners' poor performance in Mathematics, particularly in South Africa, is a result of the curriculum that does not address inequality, ethnicity, economic status and learners' disabilities. It is the researcher's opinion, as a Grade 3 teacher, that the curriculum cannot be viewed as a 'one size fits all', and although previous research findings have merit, often circumstances that are out of the teacher's control determine the success or failure of the learners. The researcher therefore, would like to investigate if learner performance and the teaching of Mathematics approaches in Daniëlskuil primary schools are also influenced by factors such as learner's socio-economic status, learner's language usage, learner's disabilities, availability of resources and learner-teacher ratio in classrooms.

1.3.1 The views of teachers regarding Mathematics teaching approaches

In South Africa at present, teachers are currently using CAPS to teach Mathematics. In the researchers' view, most teachers are in favour of using the learner-centered approach as a method of teaching and learning Mathematics. Drawing from the researcher's teaching experience and observation, most primary teachers are influenced by social constructivism and connectivism in their endeavor to teach Mathematics. The teacher in this process is seen as the supervisor, monitor, and assessor for a learner to achieve specific aims and objectives in the learning of Mathematics (CAPS, 2012).

As a result of changes in the curriculum since 1994, research has indicated that most South African Mathematics teachers are no longer on the same level of understanding in terms of their teaching approaches. Teachers were pressured because not only did they have to focus on changing the content knowledge, but also had to focus on changing their educational knowledge (Van der Nest, 2012). With the introduction of CAPS in 2012 as a new curriculum, teachers had to shift from their traditional Mathematics teaching approach, which was a teacher-centered approach to a modelling approach. Mathematical modelling is a process of looking at a problem,

finding a Mathematical core, working within the core, and coming back to see what Mathematics tells us about the original problem (Paulson, 2009). As a result of the introduction of the new curriculum (CAPS), teachers had to change from their old familiar ways of teaching to a new way of teaching Mathematics. Boris and Herrington (2003) concur that changing the curriculum often poses a problem to teachers and leaves them feeling unfamiliar with the content change as they do not know how to align to a new way of teaching. The changing of the curriculum may often lead teachers to revert back to the old traditional ways of teaching Mathematics, or familiar ways that they are comfortable with and used frequently in the past. It therefore is essential that, before a new curriculum is presented, teachers should be familiarized with the content knowledge and relevant teaching approaches. This view is echoed by Berkovich (2011) and Winkler (2009) who state that teachers are not sure of the new content that they are expected to teach, and thus fall back on past teaching habits.

The theory that underpins this study is the theory of social constructivism, which promotes the learner-centered approach. However, according to Cavanagh (2010), practical concerns like time constraints, lack of lesson preparation time, difficulties in maintaining order in classrooms when using concrete materials or working in groups, and the need for exam preparation leads teachers to raise barriers towards learner-centered teaching approach of Mathematics. Weber (2008) and Hargreaves (2007) agreed that teachers often work under pressure to complete the syllabus in a certain time, and basically just cover the work without teaching Mathematics to the learners effectively or with understanding and this results in learners' poor performance. Learners should learn Mathematics through scaffolding, modelling and problem-solving in order to enhance learner performance (Schwartz & Sadler, 2007).

In the view of the researcher, teachers in South Africa, particularly in Daniëlskuil town often teach Mathematics by using the old traditional method of rote and repetition. Although it essential for teachers to abandon their old systems of teaching Mathematics, such as the use of rote, passive and repetition of numbers, most Mathematics teachers in primary schools are still caught up in the chalkboard and talk teaching approach (De Corte, 2004 & Cavanagh, 2010). On the other hand,

Cavanagh (2010) states that the learner-centered approach was born out of a desire to maintain the type of classroom environment where learners sat quietly and generally worked on their own. Contrary to the old system, wherein teachers use rote, passive and repetition of numbers when teaching Mathematics, the researcher views the learner-centred approach as beneficial to learners since they have the opportunity to learn on their own. The fear of failure to use new teaching approaches experienced by most teachers in Daniëlskuil town, may deny the learners the opportunity to learn in a different way which could be beneficial in mastery of Mathematics.

Although the learner-centered approach is regarded as a more essential Mathematics teaching approach than the teacher-centered approach, in countries such as Mozambique, teachers are ill-equipped to use this method. Passos (2009) points out that learners in Mozambique have an almost totally passive role in teaching and learning process, which often promotes memorization and mechanized procedures rather than challenging the learners to demonstrate all their skills and abilities. In addition, Guro (2009) states that very little group work is done in class and teachers often use the chalkboard method as their preferred approach to teaching and learning. The researcher's view is that teachers in Mozambique are aware of different Mathematics teaching approaches, but are reluctant to apply the learner-centered approach, which may be due to their own lack of knowledge.

On the other hand, in countries such as Bangladesh, the teaching of Mathematics is more associated with the memorization of numbers than understanding how to solve mathematical problems (UNICEF, 2010). Although it is important that the teaching of Mathematics should be linked with stimulating discussions and analytical thinking, learners are often deprived of this opportunity, since teaching and learning have become more teacher-centered than learner-centered. UNICEF (2010) found that teachers in Bangladesh often expect learners to memorize a huge amount of data and regurgitate it during exams. Consequently, learners perform poorly in Mathematics and spend nine instead of five years at the primary level. The use of drill and rote learning denies learners the opportunity to understand mathematical content, logical thinking, discussion and analytical thinking.

In the researcher's view, mathematical learning and teaching cannot occur by using drill or rote memorization, but by exposing the learners to various activities that test their abilities to problem solve, think logically, explore and use reasoning. Learners need to understand what they are learning not just regurgitate information that has been drilled into them. By examining Bangladesh, Mozambique and South Africa it is evident that Mathematics is not always taught by using a learner-centred approach. It is therefore imperative that teachers should promote a high level of learner participation, and promote learning through understanding in order to discover and develop the learner's confidence and potential in Mathematics (Protheroe, 2007). This next section will discuss the various challenges that teachers experience when teaching Mathematics in the primary school.

1.3.2 Challenges of teaching Mathematics in primary schools

The lack of Mathematics content knowledge contributes to poor learner performance particularly in South Africa (Daro, 2006). Despite the change in the curriculum since 1994 with the intention of improving learner performance in Mathematics, little has been achieved with regard to how teachers should teach Mathematics. This view was supported by Carl (2009) who indicates that teachers still require Mathematics pedagogical skills for them to improve Mathematics teaching. Many Mathematics teachers lack technical expertise and approaches that will enable them to transfer problem-solving knowledge to learners (Scott & Dixon, 2008). Nkopodi and Sunday (2013) echo that most of the Mathematics teachers are unable to select relevant teaching methods and activities that can motivate learners to develop abstract thinking skills in order to achieve the learning outcomes and to create a classroom environment that promotes the active participation of learners. Most teachers are also unable to plan a variety of assessment activities that allow learners to achieve results according to their own individual abilities. Wiggins (2008) concurs that assessment is an integral part of instruction, is vital in determining the extent of goal achievement and forms a vital part of teaching and learning. According to Jansen (2013), lack of content knowledge, teacher competency and complacency hinder the effective teaching Mathematics in primary schools.

Mdutshane (2007) indicates that sufficient resources allocation contributes to effective teaching and learning of Mathematics in schools. This view was also supported by Moore (2007) who stated that the shortages of textbooks and small classroom sizes hamper the teaching of Mathematics. From the researcher's experience as a Mathematics Grade 3 teacher, teaching Mathematics without adequate resources such as textbooks, overcrowded classrooms, and libraries is a formidable problem. In addition, the importance of training teachers on how to teach Mathematics using different teaching methods and approaches is essential. Mond, Meerah, Halim, Rahman, Abdullah, Hussan and Ismail (2010) agree that in order to ensure effective curriculum implementation, teachers need to be well trained, highly motivated, and dedicated. The training of teachers to teach Mathematics should not be a once off, but an ongoing process (Meyer & Warnich, 2010). Badugela (2012) concurs with the above researchers by indicating that, resources such as textbooks, overcrowded classes and training funds should be made available to teachers for effective teaching and learning of Mathematics. According to Dube (2016), the unsuccessful teaching and learning of Mathematics occurs as a result of a lack of teacher confidence. Lessing and De Witt (2007) state that most teachers are not familiar with how to teach learners with barriers to learning. Therefore, teachers find it awkward to find correct teaching method to teach Mathematics to them.

Despite the lack of Pedagogical Content Knowledge, teaching methods and approaches, resources, training to address learners with barriers, teachers particularly in South Africa are overwhelmed by administrative jobs and an uneven distribution of workload (Lessing and De Witt, 2007; Olivier, 2015). The sudden change of language of teaching and learning (LoLT) from Grade 3 to 4 is regarded as one of the major challenges to Grade 4 Mathematics teachers. Grade 3 learners are taught Mathematics in their mother tongue also known as a home language (HL) and after promotion to Grade 4, the LoLT becomes the First Additional language (FAL) which is English (DBE, 2011; Evans, 2007). The poor performance in Mathematics can be attributed to the lack of understanding of the language of instruction. Unfortunately, teachers are not always equipped to deal with these language barriers in linguistically diverse Mathematics classrooms as they lack the skills needed to address such problems. (Pascoe, 2017)

For effective teaching and learning of Mathematics, the teacher should be able to manage his or her class and maintain discipline in all learners. Pineda and Frodden (2008) agreed that teachers often encounter the difficulties in classroom management which disrupts the teaching and learning process. Van der Nest (2012) adds that, for effective classroom management, the learner-teacher ratio should be taken into consideration, since overcrowding often contributes to poor classroom management. It is also important for the teacher to plan on what to teach and what to assess. UNESCO (2014) indicates that most teachers in Mozambique are unqualified, and not trained to implement better strategies or methods to deal with large classes. Brown and Gordan (2009) maintain that daily activities help teachers to be objective, have relevant teaching methods, assessment and set time frames.

In countries such as Mozambique lack of teacher training result in teachers using irrelevant and ineffective teaching methods and approaches to teach Mathematics (Passos, 2009). According to UNESCO (2014), the training that teachers received in Mathematics was insufficient and very little monitoring and pedagogical support was offered. Teachers in Mozambique remain unmotivated and lack essential skills especially with regard to the effective teaching and learning of Mathematics, which results in the decline in quality of education. UNESCO (2014) also pointed out that most teachers do not qualify to be Mathematics teachers, and are not trained to implement better strategies or methods to deal with large classes. Another cause for concern was the teacher-learner ratio in Mozambique. UNESCO (2012) reported that the ratio was 63 learners to one teacher. In Mozambique; the lack of resources, classrooms and learning materials are also seen as a reason for the low-performance rate in schools (Afrimap, 2012).

In Bangladesh, the qualifications of teachers are presently questionable. Research indicates that teachers at primary level are under qualified, mostly secondary school graduates sporting third divisions (Rabbi, 2008). Most teachers lack any sort of training and, unsuitable as teachers and mentors of the minds of future generations. In many cases, teachers are more interested in private tutoring rather than mentoring and teaching in regular classes and because of this, learners suffer greatly both

academically and financially. This can be attributed extremely poor salaries paid primary school teachers by government and their status that is the lowest among all government employees. (Rabbi, 2008; UNICEF, 2008). In the researcher's view, the government should realize that this self-defeating policy is reflected in the quality and commitment of teachers. Lack of proper school infrastructure and basic facilities such as chairs, tables, water, electricity and even toilets also hinder quality teaching and learning in schools.

Absiye, Hassan and Ahmed (2013) indicate that lack of teaching and learning resources and teacher's level of motivation affect the implementation of quality education. Learner-teacher ratio also contributes to poor academic achievement; effective teaching cannot take place if the ratio exceeds 40:1. The lack of preparation, lesson plans, resources and teaching and learning materials are often seen as the reason for poor academic achievement. Teachers also seemed to blame their workload for this problem (Absiye, Hassan & Ahmed, 2013). I will use the next section to discuss the strategies that are used in teaching Mathematics in primary schools.

1.3.3 Strategies in teaching Mathematics in primary schools

Emanating from own experience as a Mathematics teacher in a primary school, the social constructivist theory is relevant in teaching Mathematics as it gives the learners the opportunity to actively participate in a lesson, construct new ideas and derive meaning from their ideas (Sydney Education, 2011). According to Paulson (2009), learner's prior knowledge and learning environment are important elements in the learning process. It is therefore essential that teachers should strategically actualize learner's prior knowledge as part of involving them and creating an active learning environment in the classroom. This learner-centered strategy promotes cognitive reasoning which also motivates learners to solve Mathematical problems (Sydney Education, 2011). This requires that the teacher take the time to get to know the students in depth and to integrate what they learn about them into their instruction. The learner-centered approach is a principle of systematically recognizing learners' worldviews and experiences as well as prior learning in the development of curricula

that will allow learners to reach their learning objectives and aspirations (Paulson, 2009). In South Africa, teachers are criticized for not using social constructivism in their teaching and learning process of Mathematics (Amineh, 2015).

Various strategies can be used to teach Mathematics. In order for teachers to improve the mathematical skills of the learners and improve the quality of learning and teaching in Mathematics, a variety of strategies and approaches need to be used (Kodisang, 2015). Caprioara (2014) indicates that one of the most fundamental components in teaching Mathematics is the concept of problem-solving. Koblitz (2014) reiterates that one of the best strategies in teaching Mathematics is problem-solving, which can easily be done through the use of grouping learners in order to work together. Group work is very beneficial in the improving of mathematical skills, mathematical thinking processes, concept retention and ensures that meaningful learning takes place in the Mathematics classroom (Allen, 2012). Armour, Thomas and Curcio (2008) argue that Mathematics teachers should be able to support and interact with learners in various ways that will challenge and promote strategic thinking. Protheroe (2007) maintains that Mathematics teachers should demonstrate an acceptance of the learner's divergent ideas. In this regard, learners should be challenged by the teachers to think deeply about mathematical problems that they solve and be encouraged to reach beyond the solutions required for solving problems. Further, learners should be given the opportunity to be actively engaged and experience real-life situations in order to solve problems (Protheroe, 2007). Another strategy in teaching Mathematics is that of using scaffolding since it increases learners understanding of Mathematics problem-solving. Learners learn how to make connections between concepts, procedures and understanding (Education Alliance, 2006). In the researcher's view, the teacher who communicates well with learners in class enhances the level of learners to understand Mathematics. In a Mathematics classroom, learners should be presented with a variety of ways in which to communicate their mathematical ideas, using various manipulate and other tools to bridge gaps and allow learners to move from the concrete to abstract meaning in problem-solving (Allen, 2012).

Mozambique has a curriculum document that states that a learner-centered approach should be used in the teaching of young learners, but is not always followed as this approach is not value-neutral and that the indigenous knowledge is an alternative to learner-centered pedagogy (Tabulaw, 2003). Some of the strategies in teaching Mathematics in Bangladesh include the use of group work intervention and careful planning of mathematical activities to increase the learner's participation in Mathematics. The increase in the use of teaching resources and practical teaching aids and visual aids in teaching Mathematics are suggested as strategies that may improve learners understanding, participation and skills of problem-solving (Yeigh, Tony Jennifer, 2008; Abasiye, Hassan & Ahmed, 2013).

The use of social constructivism in teaching Mathematics is of great benefit to Mathematics learners and improvement can be viewed since the teaching of Mathematics has become more learner-centered than teacher-centered. However, the majority of teachers in South Africa are not using this teaching approach due to lack of Pedagogical Content Knowledge of Mathematics and failing to employ different strategies of teaching Mathematics, such as the use of scaffolding, group work, actively engaging learners in problem-solving, and actualizing learner prior knowledge. (Tabulaw, 2003; Allen, 2012 & Mdutshane,2007). Several challenges relating to the teaching of Mathematics such as teaching and learning resources, under-qualified teachers, lack of classroom management skills, learner discipline, and overcrowding have been identified locally and internationally. The next section will present the problem statement.

1.4 THE PROBLEM STATEMENT

Given the significance of teaching and learning of Mathematics in primary schools, it is therefore imperative that teachers should be qualified and have the necessary knowledge and skills in order to teach Mathematics (UNESCO, 2014). If teachers fail to produce learners who are capable of learning Mathematics, that will be falling to equip learners with the necessary skills to enable them to pursue scientific careers in order to meet the South African economic demands and to fulfil the South African

national educational goal which the production of learners who are capable of competing both locally and internationally in Mathematics.

Despite the CAPS, most teachers are exposed to challenges regarding both teaching and learning of Mathematics (Rabbi, 2008). Some issues that this study focuses on, include: the theories endorsed in the teaching and learning of Mathematics; the proficiency level of teachers in teaching Mathematics in Grade 3 ; the teacher's successes and challenges in teaching Mathematics in Grade 3 ; and strategies that can be employed in order to improve teachers' proficiency regarding teaching of Mathematics.

According to Cavanagh (2010), the teacher-centered approach is commonly used by Mathematics teachers as their traditional pedagogical practice. Contrary to that, CAPS (2012) advocates the learner-centered approach. It is also an ideal purpose of this study to look at the teacher's lack of training in the implementation of CAPS; lack of Mathematics teaching resources; learner-teacher ratio; classroom management; teacher's lack of planning, knowledge of Mathematics content; and assessment methods as factors contributing towards poor teaching and learning of Mathematics. Based on these reasons the researcher intended to explore teachers' views regarding the teaching of Mathematics in Grade 3 in Daniëlskuil primary schools in South Africa. This now brings me to the main research question that is broken up into sub-questions.

1.4.1 The Research Question

Against this background the research question is formulated as follows:

- To what extent are teachers in Grade 3 in Daniëlskuil in South Africa use different teaching approaches to teach Mathematics?

The following sub-questions were posed to explore the main research question further.

- What theories endorse the teaching and learning of Mathematics?
- What is the proficiency levels of teachers in teaching Mathematics in Grade 3?
- What are the teacher's successes and challenges in teaching Mathematics in Grade 3?
- What suggestions can be made to improve teacher's proficiency in teaching Mathematics?

By addressing the above research question and sub-questions, the aim of this study would be achieved.

1.8 AIM OF THE STUDY

This study aims to exploring Foundation Phase Mathematics teachers 'use of different teach-ing strategies in Grade 3, in Daniëlskuil, in South Africa. This study intends to establish the successes and challenges faced by Mathematics teachers in Grade 3 in Daniëlskuil, South Africa. The other reason is to determine what teachers believe are the factors that impede the teaching of Mathematics in primary schools. The importance of acquiring relevant information regarding this study may inform the DBE on implementing appropriate professional development for teaching Mathematics in primary schools. Collected data can also confirm what is needed for further research in teaching Mathematics in primary schools.

1.9 RESEARCH OBJECTIVES

The main objectives of this study are:

- To explore scholarly literature about teaching Mathematics and to ascertain theories that are foregrounding the teaching and learning of Mathematics in primary schools.
- To determine the views of primary teachers regarding teaching Mathematics in Grade 3 classes.
- To find out whether primary teachers in Daniëlskuil are empowered to teach Mathematics.

- To identify the successes and challenges regarding teaching Mathematics Grade 3 learners.
- To suggest strategies to improve teachers' proficiency in teaching Mathematics to Grade 3 learners.

1.10 THE SIGNIFICANCE OF THIS STUDY

The purpose of this study is to exploring Foundation Phase Mathematics teachers 'use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa. It seeks to investigate, describe and analyze the views of teacher's towards teaching Mathematics; the proficiency level of teachers in teaching Mathematics; the teacher's successes and challenges in teaching Mathematics; and the possible strategies that can be employed to improve the teaching of Mathematics in primary schools.

The significance of the research study is therefore directed at analyzing the research findings and making conclusions and recommendations to ensure proper teaching and learning of Mathematics in primary schools. It is further hoped that the research findings will be utilized in the professional development of teachers regarding teaching and learning of Mathematics subject in Grade 3 primary schools in South Africa.

An explanation of the research methodology and research design used to reach the aims follows.

1.8 RESEARCH METHODOLOGY

1.8.1 Research paradigm

Several research paradigms can be used in conducting research. Some of the commonly used paradigms include the positivist, interpretivism, feminist, post and critical science paradigms (Carson, Gilmore, Perry and Gronhaug, 2001). These paradigms represent the different ways of seeing the world in research. This study will employ the interpretive paradigm research.

According to Henning (2004), the interpretive paradigm is effective in probing daily experiences. In the view of the researcher, interpretive paradigm is seen to be suitable for this study, since it will allow the researcher to gain insight and understanding of the Grade 3 teacher's views, approaches and strategies used in the teaching of Mathematics. It will also enable the researcher to probe and gain a better understanding of teachers' behaviour and attitudes towards teaching Mathematics.

1.8.2 Research design

The research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby also ensuring the effective address of the research problem; it constitutes the blueprint for collection, measurement, and analysis of data (Williams, 2017 & Trochim, 2001). The aim or purpose of a research design is to provide a plan of study that permits accurate assessment of cause and effect relationships between independent and dependent variables (Pharm, 1980). In this study, the research design will mainly focus on reviewing literature, collecting and analyzing data with the intention of finding the coherent and logical ways to ensure effective teaching and learning particularly in Grade 3 and 6 learners.

There are various types of research designs: quantitative research designs, qualitative designs and mixed research designs. According to MacMillan and Schumacher (2001), quantitative research designs emphasize objectivity in measuring and describing phenomena. As a result, the research designs maximize objectivity by using numbers, statistics, structure, and control. Qualitative research designs use methods that are distinct from those used in quantitative designs. Emphasis is on gathering data on naturally occurring phenomena. Most data are in the form of words rather than numbers, and in general, the researcher should search and explore with a variety of methods until deep understanding is achieved (MacMillan & Schumacher, 2001). On the other hand, mixed method research designs take advantage of using multiple ways to explore a research problem (Biddix, 2004). According to Macmillan and Schumacher (2001), this mixed method research design combines quantitative and qualitative methods and is becoming increasingly

popular because the use of both approaches together can provide a more complete investigation.

However, in this case study, the qualitative approach was used to probe teacher's views in terms of teaching Mathematics in Grade 3 learners in primary schools. Creswell (2007) indicates that qualitative research is the type of educational research that relies on the participant's vision, gathers data consisting of words from the participants, expresses and considers these words for themes. The researcher collected data in the form of words which provided a detailed description and interpretation of the phenomenon. (MacMillan & Schumacher, 2001). It sought to investigate, describe and analyze the views of the teacher's towards teaching Mathematics; the proficiency level of teachers in teaching Mathematics; the teacher's successes and challenges in teaching Mathematics; and the possible strategies that can be employed to improve the teaching of Mathematics in primary schools

1.9 POPULATION SAMPLING

Population sampling is the taking of a section of units of a population as representative of the total population (Vos, 2011). It is also referred to as a selection of a group or individuals from whom data is collected and which represents a total population (MacMillan & Schumacher, 2001). The population sampling of this study was teachers from three primary schools in the Daniëlskuil town. Convenient sampling technique was employed to sample five grade three teachers teaching Mathematics (n=5). The sampled participants were considered information rich regarding teaching Mathematics in primary schools.

1.10 RESEARCH SITE

This study was conducted in three primary schools in Daniëlskuil that have grade three classes which teach Mathematics. Two of the schools offer Afrikaans as the language of instruction and the second one offers Tswana as the language of instruction. English is the FAL in both of them. I chose this research site because I live in Daniëlskuil and these schools are close to where I work and travelling between

them was easy and inexpensive. They are also the only primary schools in Daniëlskuil.

1.11 DATA COLLECTION AND ANALYSIS

Data collection can be referred to as the gathering of information to form a complete picture by using a variety of sources. It is also referred to as the process of collecting information required by the researcher to solve the research problem (Rouse, 2017; Mae, 2013 & Study.com, 2003). Data analysis can be defined as organizing information derived from data. The researcher made use of semi-structured interviews, observation checklist and document analysis to gain a better insight into the teacher's views regarding the teaching of Mathematics in Grade 3 learners in Daniëlskuil primary schools.

1.12 ETHICAL CONSIDERATIONS AND TRUSTWORTHINESS OF DATA

The researcher is ethically responsible for protecting the rights and welfare of the subjects that participate in the study. Most studies require that informed consent is obtained from the students, their parents, or a relevant institution, and laws are in place to protect the confidentiality of the data and the privacy of the subjects (McMillan & Schumacher, 2001). The researcher informed all the participants about all the aspects of the research. Confidentiality and privacy were maintained at all times. The participants were informed about the interviews and the classroom observations that took place. Field notes and all documents analysis were discussed with the participants. Pseudonyms were used to protect the participants and the schools. The researcher intends to share the findings with the DBE and any confidential information will be discussed with the participants (Morrison, Cohen & Manion, 2011).

To ensure trustworthiness, participants were given enough time to articulate their views about the problem statement. Semi-structured interview questionnaires and observations checklists were made available to the teachers beforehand so that they were assured that the same ones were used in the research. This study ensured

reliability by developing friendly relations with the teachers since the researcher is also a teacher from the same community (Her & Nijlen, 1004).

1.13 RESEARCHER'S ASSUMPTIONS ABOUT THE STUDY

The researcher assumed that the participating schools had the CAPS which was used to learn and teach Mathematics in the classroom, and that these teachers had been adequately trained to implement this policy effectively. The researcher also assumed that all the teachers in the primary schools in Daniëlskuil town have the knowledge and skills that are required to teach Mathematics and are competent in lesson planning. It is also assumed that the teachers in the selected primary schools can speak the FAL fluently and have a good command of the LoLT.

1.14 DELIMITATIONS AND LIMITATIONS OF THE RESEARCH STUDY

The delimitations are characteristics that limit the scope and define the boundaries of the study (Simon, 2011). The following may form part of limitations of the study: teachers refusing to participate in the research study; schools that may refuse to allow teachers to be observed when teaching; dishonest answers from teachers; assumptions that the research project may not bear fruits towards improving their teaching and learning; and schools refusing to disclose their statistics of Mathematics ANA learner performance of Grade 3.

1.15 CHAPTERS OUTLINE

The dissertation is organized according to the following chapters:

CHAPTER 1: INTRODUCTION AND BACKGROUND TO STUDY.

This chapter served to present the reader with an introduction to the study as well as the background on which this study was founded. It gave the reader a theoretical basis for the study and provided essential information as to the problem explored.

Background information was also provided on the views of teachers in regard to teaching and learning Mathematics, the challenges that are experienced by primary school Mathematics teachers and strategies to effectively teach Mathematics.

This chapter also includes the theoretical framework on which the study was based, the purpose of the study and the statement of the problem that was investigated.

Some main focal points in this chapter were the main research question, the sub-questions that substantiate the main question, the aim of the study and the selected research methodology that the researcher chose to use to conduct the study.

Other focus points were the research objectives, the research design and paradigm, the selected population that formed part of the study, how the data was collected and analysed, assumptions connected to the study, limitations and important ethical considerations.

CHAPTER 2: THEORETICAL FRAMEWORK OF THE STUDY

This chapter outlines the theoretical framework that was used to formulate the study. It includes the relevant theories that influence the teaching and learning of Mathematics. These theories include social constructivism, behaviourism and connectivism. Each theory is discussed in detail and the existing and relevant principles are laid for each of them.

CHAPTER 3: THE LITERATURE REVIEW

This chapter contains literature that is consistent and relevant to the study. It is used to form a theoretical basis for the study, which is the views of Grade 3 Mathematics teachers in primary schools.

In this chapter the reader is presented with literature that guided the study to familiarize them with various concepts that have originated from the sub questions in the research question. This literature includes topics like the theories that endorse

the teaching and learning of Mathematics, the proficiency levels of Grade 3 teachers and suggestions that can improve teachers' proficiency in teaching Mathematics.

Theories that endorse the effective teaching of Mathematics, constructivism, social constructivism, behaviourism and connectivism are discussed in detail as well as professional development of teachers, their workload and strategies to develop Pedagogical Content Knowledge in Mathematics teachers in Grade 3.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

This chapter includes the methodology that was used to investigate, explore and gain understanding of the research study. It also includes the design that was used to carry out the research which includes the research paradigm, the type of research that was used relating to qualitative research and case studies, how the participants were sampled and the research site in which this research was conducted.

It also includes the way in which the data was collected and analyzed in the study including semi-structured face-to-face interviews and observation checklists. Lastly it discusses important ethnical considerations such as validity and reliability which relate to the study and delimitations and limitations that pertained to the research study presented.

CHAPTER 5: EMPIRICAL FINDINGS

This chapter pertains to how data that was collected were analyzed and interpreted. Its main focus is on analysing the interview questions and data obtained from the observation checklists of the Grade 3 primary school Mathematics teachers.

CHAPTER 6: DISCUSSIONS, RECOMMENDATIONS AND CONCLUSIONS

This last chapter houses the main findings that originated from the literature study and the empirical data that was collected and analysed with a view to addressing the research questions.

It serves as a summary of the research study and further provides recommendations that can be used for further research.

1.16 CONCLUSION

This chapter's main aim was to provide the reader with an introduction, a background, a theoretical framework on which the research is founded, a better understanding of concepts, an awareness of the problem statement and to inform the reader of the various aims and purpose of the research study.

It also includes the main research question and its sub-questions from which this research study emanated, the intended research objectives, the research paradigm chosen by the researcher and the design that was optimally used in the study. The way in which the population is sampled for this study is also discussed and the research site is also confirmed.

It serves to explore and investigate the methodology that was used in the study as well as the research methods and techniques which were chosen by the researcher in order to conduct the study. The chapter also gives insight into data collection by means of observation checklists and semi-structured interviews, data analysis of the various documents and the significance of the research study.

This chapter also discusses the ethical considerations that apply to this research study with regards to trustworthiness, reliability and confidentiality. The assumptions of the researcher are also reviewed, the limitations and delimitations of the study explored and various concepts are explained.

Lastly this chapter presents the organization of the dissertation per chapter and summarizes what each chapter contains.

In the next chapter the researcher will discuss the theoretical framework on which this study was founded and conducted.

CHAPTER 2
THEORETICAL FRAMEWORK OF THE STUDY

2.1 INTRODUCTION

When embarking on any research study it is imperative that the researcher should have theories, as these theories provide the framework for interpreting environmental observations, and thus act as a bridge between the current research and education (Schunk, 2012). These research findings can be organized and systematically linked to theories. Without theories, research findings would be viewed as a disorganized collection of data as the researcher would have no framework to which they could connect their data. In the context of teaching and learning Mathematics, it is imperative for teachers to understand and recognize that Mathematics consists of a collection of various diverse applications and disciplines (Sullivan, 2011) and therefore, requires teachers to have a good understanding of the theories (Caprioa, 2014) that facilitate the learning of Mathematics.

A good theory is valuable because it gives meaning to the challenges and phenomena that we often experience in teaching and enables teachers to use knowledge to understand, act and teach in more effective ways (Swanson, 2010). Theories are used in the educational context to create a better understanding of the way in which learners learn and to investigate how to improve learning and teaching (Torraco, 2010). According to Phakisi (2008), a theoretical framework is an important component of any research as it provides the researcher with a set path by which they need to conduct their research, and by which they build their case for the research problem, by offering support of the problem and by confirming the purpose of the intended study.

The theoretical framework in this research study involves the presentation of specific theories that are crucial to this study and contains empirical and conceptual work about these theories (Phakisi, 2008) functioning as the structure or scaffold for the study.

According to Asher (2013), a theoretical framework is a structure that holds the study together and describes various theories and explains why the research problem under study exists. It helps the researcher to demonstrate their understanding of various theories that arise in the study and to identify concepts that relate to broader areas of knowledge that still have to be researched and considered in the study (Trochim, 2017).

A theoretical framework (Machaba, 2013) can be viewed as a lens through which researchers view their study. It helps the researcher to formulate assumptions with regard to their study and see how their study connects to the real world. By reflecting the stance that has been adopted by the researcher, the theoretical framework frames the researcher's work, creating an anchor and facilitates a dialogue between the literature and the research. According to Rocco (2009), the theoretical framework of any study is very important as it synthesizes existing theories, related concepts, and empirical research in order to develop a foundation in which new theories may develop.

The framework for this study was constructed by using social constructivism as its underpinnings and by including other learning theories such as learning theory, behaviourism and connectivism, which are fundamentally imperative to the effective teaching and learning of Mathematics. In order for a person to use learning theory to teach Mathematics, a person should be clear on what the learning theory entails and how it facilitates learning (Schunk, 2012). This knowledge of learning theories and how they facilitate learning is imperative if a teacher is to deal with educational reform and change (Schunk 2008). A teacher needs to have a solid understanding of various theories that drive teaching, including ideas about how learners learn, should learn, and how teachers can enable learning (Schunk, 2012).

The theory of social constructivism prodiminately underpins this research study as it focuses on how grade 3 learners are taught Mathematics in a social context as they work in groups and interact with their peers. The main research question : "To what extent are teachers in grade 3 in Danielskuil, in South Africa making use of different

teaching approaches to teach Mathematics and what strategies can be suggested to empower their proficiency regarding the teaching of Mathematics? “ can be linked to social constructivism as this learning theory requires teachers to use various methods and approaches to teach Mathematics effectively. This includes group-work, providing learners with opportunities to develope problem-solving skills, allowing learners to discuss their work , share ideas and to construct their own meaning and knowledge.

Behaviourism is another theory that underpins the research study as it is the behaviour of the teachers that are observed in this and these behaviours will determine the proficiency levels of the grade 3 Mathematics teachers, answering one of the sub questions namely: “ What are the proficiency levels of the teachers teaching Mathematics in grade 3 ? By observing these behaviours the researcher will also be able to offer suggestions that will improve the proficiency levels of these teachers and to find out if grade 3 are empowered to teach Mathematics to grade 3 learners.

Connectivism is the last theory that underpins this research study. This learning theory is very instrumental in Mathematics teaching as it promotes group collabaration and discussion,allowing different views and perspectives to be used in problem-solving,decision making and assists learners to make sense of new information. It is linked to the main research question as by using Connectivism as a teaching approach or strategy can empower the proficiency levels of the grade 3 Mathematics teachers.

The next section will explain theories that influence the teaching and learning of Mathematics (Machaba, 2012).

2.2 LEARNING THEORY

According to Schunk (2012), a learning theory can be seen as a process that seeks to explain how humans and animals learn and thereby assists in creating an

understanding of the inherently complex process of learning (Richards, 2011) and have an extensive value to what we teach and learn.

Mawson and Haywood (2014) explain a learning theory as being a theory that explains the way in which humans learn in terms of gaining knowledge and through emotional work. A learning theory is useful to teachers as it can allow other methods of learning to be modified and create a discipline that can help learners and teachers to understand concepts better. According to Richards (2011), the intention behind learning theories is to provide both teachers and learners with a precise guide (Williams, 2012) and effectively arm teachers with methods that can meet the needs of all their learners, providing them with insight into the leaner's mindsets and backgrounds (Forrest, 2012). These learning theories provide guidance to teachers based on the learners own unique learning styles.

From an educational viewpoint, a teacher needs to have a good knowledge of multiple learning theories (Wilson, 2006). These theories may vary in quality and rigour, so teachers should be well-informed so they can interpret, adapt and combine all theories in practice. Learners need to be able to learn in multiple ways so teachers need to have a pedagogical repertoire that draws from the knowledge of various learning theories (Peterson 2007).

2.3 SOCIAL CONSTRUCTIVISM

According to Erikson (2016), social constructivism is a theory that is based on the knowledge that is obtained and understanding that is expanded through the construction and reconstruction of mental frameworks. Har (2011) argues that it is essential for learners to construct their own knowledge and meaning. This implies that the effective teaching and learning of Mathematics should allow learners to gain a better understanding of new knowledge as they are allowed to construct meaning by themselves.

Social constructivism as a learning theory (Bhattacharjee, 2015) does not view the learner as a sponge, an empty vessel, blank slate or passive observer in the learning

process. This view was supported by Har (2011) who indicates that learners should be at the foreground and be encouraged to be active participants in the learning process. According to Snowman, McCrown and Biehler (2011), using social constructivism enables learners to form their own representations, by selecting content and interpreting it (Erikson, 2016) and making sense of their own worlds as they construct knowledge through experiences.

Pritchard (2014) views social constructivism as a learning theory that moves away from seeing learners as individual scientists, who work on their own and make discoveries on their own (Snowman, McCrown and Biehler, 2011). In the teaching and learning of Mathematics, the researcher views it as a social process whereby learners acquire knowledge, not alone but through interaction with other learners, teachers and their environment. This learning theory thus has its origin within a social context (Berkeley, 2016) where learners construct new knowledge by interacting within a knowledge community. In supporting this Berkeley, Bay, Bagceci, Cetin (2012) state that learners acquire knowledge through peer interaction and meaningful, authentic experiences.

Social constructivism is a learning theory that is enhanced by social interaction (Bhattacharjee, 2015). It is the researcher's view that, the teachers and learners in classes should be able to interact while sharing knowledge and skills. In this theory, learning occurs socially as learners tend to rely on each other when they construct new knowledge (Reeves, 2007). Mckinley (2015) and (Cottone, 2012) indicate that learners' achievement tends to increase when they work in groups. In this setting knowledge and understanding are jointly developed (Amineh & Asl, 2015).

Social constructivism encourages cognitive growth on a social level as the learners make meaning of new knowledge through interaction with each other and their environments in which they live and learn (Amineh & Asl, 2015). It is the researcher's view that social constructivism acknowledges the uniqueness and complexity of all learners in classrooms, and that learners learn in their own unique way at their own individual pace. It encourages the learner's own version of the truth and takes into account that the learner's background, prior knowledge, and culture will influence how

they learn. It also stresses the importance of social interaction between the learners and other knowledgeable members of the community.

Social constructivism as a learning theory rests on the notion that all learners are unique and thus need to generate their own learning, knowledge, and meaning from their own life experience (Leed-Hurwitz, 2009). These experiences are triggered by dynamic interactions between the teacher, the learner and the task (Varney, 2005) and coordination with other humans and learning-rich environments (Amineh & Asl, 2015). In social constructivism learners take these meaningful learning experiences and deliberately construct a deeper meaning to what they already know and allow themselves to form valid connections between existing knowledge and new experiences (Pritchard, 2014).

Nawaz and Qureshi (2010) view social constructivism as a learning theory that emphasizes collective learning, where learning no longer rests solely on the shoulders of the teachers and the learners, but relies on the assistance of the learner's peers, parents and the community as a whole. In this way, teaching and learning can easily be undertaken as a social and community activity (Sasseville, 2007). It emphasizes the fact that learning should be active, contextual and social where the teacher acts merely as a facilitator and a guide and no longer just transfers knowledge to the learners, but also guides the learners learning processes (Qureshi, 2009).

In social constructivism the learners are allowed to follow self-designed, self-controlled and socially collaborative learning tracks (Phillips, 2008). This implies that learners should be able to construct their own knowledge by negotiating with others and harvesting their own learning processes. This learning theory promotes social interaction, group work and problem-solving to allow the learners to learn effectively, negotiate various meanings of a particular phenomenon, and arrive at a shared understanding and to construct knowledge in a fun and meaningful way (Kundi & Nawaz, 2010). According to Nawaz and Zubair, (2012), social constructivism is a learning theory that shifts its focus from instruction to construction and discovery and no longer focuses on the fact that all learners learn in the same way, but customizes

learning to suit the needs of the individual learner, creating a fun way of learning and thus promoting lifelong learning.

In the researcher's view as a Grade three Mathematics teacher, using the tenets of social constructivism to teach Mathematics is a very effective way of teaching as it appeals to the vast diversity of learners, as well as their individual styles of learning. Our classrooms are filled with learners who are at different levels of development, ability levels and who learn at different paces. These learners thus need to learn in a way that makes sense to them and learning methods should be tailored to meet their individual needs. By using social constructivism these learners can learn new information by connecting new knowledge to experiences that they are already familiar with and make sense of new concepts through discovery and investigation.

Social constructivism allows learners to actively participate in group work, problem-solve, interact socially, negotiate the meaning of a particular phenomenon, construct new knowledge and learn in a fun meaningful way. These learners can learn by doing and not just be told how to learn. In social constructivism the learners construct their own knowledge through social interaction with their teacher and peers. The learners get the opportunity to develop skills that are relevant to them and through personal experiences they gain a sense of ownership and value for the knowledge they have acquired. In the researcher's opinion, social constructivism allows every child in the class an equal opportunity to learn and reach their full academic potential. Even the slow learners can achieve success in a classroom that uses social constructivism to teach Mathematics. Often these children battle to answer test questions on their own but excel in group problem-solving activities. This is often due to the fact that their mental capabilities and speech are well developed, but lack reading and writing skills. They might also excel in group activities as they are not singled out, and feel confident and safe within the confines of a group. These learners learn from interacting with each other, exchanging ideas and sharing knowledge with each other. They are all placed at an advantage as they orally answer questions and are not required to write them down. These problem-solving activities provide the learners with authentic learning experiences, allow the learners to develop confidence and feel a better connection to their work. When the learners evolve in this way, they turn a normal

classroom into a learning community. In this learning community, the learners turn to each other to find solutions to problems and to negotiate conflict if it arises in the learning process.

The above theory stresses the importance of learning that is learner-centered and not teacher-centered. This view was supported by Ageeva (2015) who echoed that social constructivism theory is integrated with the process of reality construction, how people predict and interpret various events in their lives.

In this study, the researcher intends to explore how Mathematics teachers actively engage learners with the purpose of allowing them to construct knowledge. Social constructivism recognizes the discourse between the learner and the construction of their inner selves as they learn and gain knowledge and experience in their day to day lives. Below is a detail description of the behaviourist theory.

2.4 BEHAVIOURISM

According to Woollard (2010), behaviourism can be viewed as a theory that focuses on animal and human learning behaviour. In this study, the researcher intends to focus on learners and the change in behaviour that takes place (Mayer, 2011). Woollard (2010) asserts that all behaviour, no matter how complex, can be reduced to a simple stimulus-response association, and new behaviours can be taught through classical or operant conditioning or by modifying old behaviour through rewards and punishment.

Rewarding positive behaviour creates an incentive for learners to behave in a more appropriate way and this behaviour modification has a positive effect on their overall ability to learn. They become more focused and this improves their ability to concentrate and absorb new information. This is vitally important in a Mathematics classroom as good discipline is essential to teaching and learning. In the behaviourist learning theory, positive behaviour is reinforced by offering the learners rewards and this ensures that this positive behaviour is repeated (Malaysia, 2007); negative behaviour is illuminated by using negative reinforcement or punishment. In the

researcher's opinion, a learner's behaviour can be changed or modified if the teacher models behaviour that is positive especially with regard to the teaching of Mathematics. If the teacher has a positive attitude towards Mathematics, he/she teaches enthusiastically, plans effectively and makes his/her lessons fun, the learners will be well disciplines and behaves in a way that is conducive to learning. The attitude of the teacher, therefore, sets the pace of how and what the learners learn and a negative attitude will thus contribute to negative or inappropriate behaviour. This behaviour can also be modified or changed by the imitation of observed behaviour called modelling (Woollard, 2010).

In learning behaviourism is seen to occur when experience and practice causes a relatively permanent change in the learner's knowledge or behaviour (Rostami & Khadjooi, 2010) and focuses on repeated behaviour that eventually becomes a habit (Zhou & Brown, 2015) and can be changed consciously or unconsciously. In this study the researcher seeks to find out if the Grade three teacher's perceptions of Mathematics and their views on the subject have an influence on the teaching and learning of Mathematics in this Grade. By researching the approaches and methods that these teachers use to teach Mathematics and their attitudes towards the subject the researcher was able to determine if teaching practices could be responsible for lack of academic performance, and if so, could the modification of these practices attribute to the academic success of the Grade three learners. In this regard, the researcher was able to determine if behaviour can be modified or changed by modelling.

According to Macleod (2007), behaviourism is a psychological approach which emphasizes scientific and objective methods of investigation which is only concerned with observable stimulus-response (Phillips, 2011). Although the researcher supports the fact that observable stimulus–responses should be measured to determine the changes or modification of behaviour, the researcher is of the opinion that the emotions and the mind of the learners cannot be ignored when trying to determine how or why learning occurs. Behaviourists were of the opinion that the internal processes of the mind should be ignored and only outward behaviours should be measured, but thoughts lead to actions or certain behaviours thus the outward and

internal processes of the learner need to be considered in learning. In the researcher's opinion, the emotional state of the learners, as well as their thoughts will cause them to display positive or negative behaviour. First, they think, then they act. In the researcher's opinion, as a Foundation Phase teacher, the environment that the learners are placed in affects their knowledge acquisition. The richer the learning environment, the more likely it is for the learners to learn and retain the new knowledge they have acquired. If a classroom contains mathematical pictures and mathematical language, the learners are more interested in the subject as it is something that is familiar to them and not only used once in a while. They are familiar with the terminology that is used and understand better than a child that has never been exposed to mathematical language. A learner that is exposed to problem-solving and group work regularly, knows what to expect and behaves accordingly. Situations and the interactions that they have with their fellow learners also has an effect on how and what they learn.

These observable behaviours are controlled by the environment and the learner's prior learning and make use of experimental methods to allow the learners to draw inferences from cause and effect relationships between various variables (Sammons, 2008). Behaviourism (Hauser, 2017) places emphasis on outward observable behaviour, but in the researcher's opinion should also include the emotions and internal processes of the mind, as these things work in conjunction with each other and cannot exist on their own. How a learner feels is just as important as how the learner acts. Culatta (2015) indicates that behaviourism ignores the inner mental state or the working of the learner's brain. It thus assumed that knowing what stimulus elicits which response to which behaviour is enough without having to speculate about the internal mental processes of the learners (Sammons, 2008).

According to Crone-Todd (2013), behaviourism is a systematic approach to the understanding of behaviours of both humans and animals. It assumes that all behaviours are either reflexes produced by a response to certain stimuli in the environment, or a consequence of the individual's history, including reinforcement and punishment, together with the individuals current motivational state and controlling stimulus. In the researcher's experience, she has come to realize that a

child's background plays a valuable role in how a learner behaves and in their academic achievement. If a child comes from a home that values education and sees the importance in it and has parents that are supportive and play an active role in the child's formal education, the child is more likely to achieve academically. Learners tend to behave better if they know that the teacher and the parents are in constant contact with each other and that their progress is discussed regularly.

However, behaviourist theory aptly points out that incentives create certain responses and either a positive or a negative change in behaviour. In the researcher's Grade three class, reinforcements or rewards are great motivators for children to learn and punishment impacts on classroom discipline. Inherited genetic makeup also plays a role in how a child behaves. A tendency to certain character traits like aggression, emotional instability, intelligence, mental instability, alcoholism and depression may be transmitted from one generation to the next. In this regard, behaviourists made a contribution by claiming that inheritance can determine how learners behave in certain circumstances.

Madden (2013) states that behaviourism generally accepts the importance of inheritance in determining how learners will behave in certain circumstances and focuses on environmental factors which may lead to behavioural changes in the learners. The researcher concurs that environmental factors affect how children learn. If a child is placed in an environment that is not conducive to learning, they will find it difficult to concentrate, learn and to remember what they have learned. A classroom which is learner friendly, learner-centered, well-planned and disciplined produces better academic results than a classroom that is unplanned, undisciplined, unorganized and not learner friendly. In order to promote learning the classroom should be filled with activities that promote exploration, discovery and ways in which learners can construct their own knowledge.

Crone-Todd (2013) maintains that optimal learning can be achieved by changing external behaviour by using reinforcement and repetition (rote learning). As a Grade three teacher the researcher is in favour of using reinforcement, but does not hold that rote learning is beneficial, as basically the learners repeat what they learn without

having a proper understanding of what it is they have learnt. Parrot fashion repetition leads to the correct answers, but no understanding of the concept or how the answer was arrived at. Behaviourism, in the researcher's opinion, is useful in teaching and learning but ignores a part of the child's identity by ignoring the internal workings of the child's emotions and mind. It also rules out one of the most important tasks of a teacher: the holistic development of the child. How can any teacher develop a child properly if they ignore the feelings of the child?

Behaviourism is based on the assumption that external change in behaviour is the most important factor in the learning process and ignores the internal processes of learning that lead to behaviour change; no consideration is given to the emotional state of the learner (Madden, 2013). The mind of the learner is viewed as a blank slate from birth and is shaped through social conditioning throughout life (Webster, 2010). Social conditioning impacts how a learner learns throughout their lives, but it is not the only way in which a child learns or makes sense of their worlds. Learners construct their own knowledge through social interactions, social processes, exploration and discovery. They become lifelong learners and continuously build new knowledge on their existing knowledge.

According to Weegar (2012), behaviourism is a learning theory which focuses on observing measurable outward behaviours of both animals and humans and how behaviour can be altered or affected by environmental changes. Behaviourism was first tested on numerous animals and because it was so successful, behaviourists decided to use human subjects. Experimentation with animals did not concern emotions or the internal workings of the mind, as the food incentive caused the intended results. Experimentation with humans is not so cut and dried. Animals have very few needs, most are only physical not emotional. A child, on the other hand, is multi-faceted and requires more than just physical elements to allow them to learn. The introduction of positive reinforcement like rewards and punishment for inappropriate behaviour alters behaviour, but learning does not only occur with behaviour change.

It is concluded that behaviourism is a useful theory for studying the outward behaviour of learners and how the main stimuli of behaviour come from the environment in which they live but is ineffective with regard to determining how a child feels and thinks, processes thought patterns and constructs knowledge. The internal processes of the mind are in the researcher's opinion of more importance than the outward observable behaviour of the learners. Often a teacher has to dig deeper and look for clues that are not obviously observed but are kept hidden within the learner. The outward behaviour often manifests due to the inner working of the learner and we will never know what this entails if we ignore human thought or cognition. It is a theory that provides a direction for social science research that allows the measurement of all relevant variables by ignoring human thought or cognition, not interested in the working of the mind, but focuses on behavioural responses. This in itself is like working with a robot, the body moves and acts in a certain way, but gives no indication as to how or why it moves. Much of what a person does is based on how they think and feel about a given situation. Behaviourism thus assumes that feelings, intentions, mental processes have no bearing on what children learn, but learning is affected by behaviour (Weegar, 2012).

Thorndike (1922) states that Mathematics students need to use drill and practice activities and use the correct procedures and facts to strengthen their mental bonds. It is thus imperative that mental processes cannot be ignored when teaching Mathematics. Zhou and Brown (2015) explain behaviourism as a learning theory that focuses on how people respond to external stimuli and how behaviour can be altered by including rewards and punishment. The behaviourist methods of using reinforcement can be effective in creating positive behaviour in almost any learning environment. In the researcher's opinion, these methods have a positive effect on the learner’s performances, but often the behaviour change is short-lived. Unfortunately, this good behaviour only lasts as long as the reward itself.

This learning theory to primarily concerned with observable and measurable aspects of human behaviour and emphasizes that changes in behaviour are directed by stimuli (Zhou & Brown, 2015). According to Zhou and Brown (2015), individuals select one response instead of another because of prior conditioning and psychological

drives that exist at the moment of the action. In this learning, theory techniques are employed to promote behaviour that is desirable and discourage behaviour which is not by using contracts, consequences, reinforcement, and extinction and behaviour modification.

In this study, the researcher wishes to observe the behaviours of the selected teachers with regard to how they present mathematical lessons and apply various teaching approaches and strategies. The researcher wishes to determine if the behaviour that the teacher's model is appropriate; if not, could the teacher's behaviour be modified to have a positive effect on the learner's Mathematics performance? According to Wollard (2010), behaviourism is a learning theory that is supported by empirical data and can only be obtained through careful and controlled observation and measurement of observable behaviour under laboratory conditions or within defined social environments (Zhou & Brown, 2015).

In this study, the researcher gathered empirical data by using semi-structured interviews and by observing various Grade three teachers while they present Mathematics lessons. This behaviour was observed in the social environment of the respective participating schools. Due to the fact that the views and perceptions of these teachers were explored, emotions have to be taken into account. Thus, the study cannot only be modelled on the principles of the behaviourism theory only but will also include other theories that are relevant in the teaching and learning of Mathematics. In this study the researcher collected data through using semi-structured interviews and observations and behaviours that are not directly observable will not be deemed worthy of study (Jacobs, Vakalisa & Gawe, 2016) or scientific inquiry (Bush, 2006). It is thus actions and behaviours that are legitimate objects of study and not thoughts, emotions, explanations of how the brain works that have substance in behaviourism (Pritchard, 2014). The researcher in this study listened to what the teachers said they did when teaching Mathematics and observed teacher behaviour also served as legitimate focus.

The behaviourist view of learning places the teacher incomplete control and allows the teacher to be the dominant person in the classroom (Madden, 2013). The learners

in a behaviourist classroom, are not given the chance to reflect or evaluate the learning process (Crone-Todd, 2013). They are just given the correct or incorrect answer without understanding how the teacher arrived at the answer. In respect to learning, the behaviourists believe that their focus should only be on the external changes in behaviour and if changes in behaviour occur, then in their opinion, learning has occurred. They are also of the belief that the emotional issues and internal workings of the learner have no effect on how learners learn or retain new information.

This needs more intensive investigation as in the researcher's opinion, learning can only take place when all the components that make up the learner, are at harmony with each other. A nervous or anxious learner will not be able to retain information as their mind is constantly wandering off. Their emotional issues hinder their total engagement in the classroom and what they learn is easily forgotten. What a child feels later manifests in either appropriate or disruptive behaviour, depending on how it is dealt with.

The one element of behaviourism that in the researcher's view is crucial to learning and behaviour modification is modelling. The attitude that the teacher exhibits and portrays to their learners can either have a negative or positive effect. This is especially true in a Mathematics classroom. If a teacher gives the impression that Mathematics is fun and anyone can do it, the learners will adopt the same attitude. If however, the teacher portrays Mathematics as a subject that is complex and gives the impression that only some people can do it, the learners will have a negative feeling towards the subject. This follows the belief that one behaviour tends to follow another (Peterson, 2006).

This learning theory does not give the learner the opportunity to reflect or evaluate in the learning process, but is simply told what is right and wrong (Crone-Todd, 2013) The way in which learning is determined rests purely on external changes in behaviour without taking into account that emotional issues and the internal working of the learner may also have an impact on learning (Crone-Todd, 2013). These two ele-

ments also impact how learners retain new information. One behaviour leads to another, so if the teacher acts in a certain way the students will act in the same way (Peterson, 2006).

The fact that one behaviour leads to another behaviour is relevant to this study, as the researcher through observation tried to determine if the views and opinions that are expressed by the teachers with regard to the teaching and learning of Mathematics, could affect how the learners learn and retain new formation. The researcher wished to determine if the learner's behaviour can be modified by changing certain approaches or methods that are applied by the Grade 3 Mathematics teachers. In the researcher's opinion, this kind of 'follow the leader' behaviour can have a negative or positive effect on what and how children learn. By modelling positive behaviour the teacher can modify inappropriate behaviour and replace it with behaviour that is conducive to effective learning and an increase in academic performance.

Although this learning theory has been criticized for only focusing on what a teacher can see on the outside of the learner, it can be effective in classrooms because of the amount of control that is exercised over the variables, the insistence on objectivity, the reliability of the studies and the scientific methods that are used to observe behaviour (Sammons, 2008). Behaviourism as a learning theory allows learners to learn from their own experiences and by observing others. The last theory that I will discuss is connectivism.

2.5 CONNECTIVISM

According to Van Wyk (2016) first behaviourism emerged, thereafter cognitivism became popular and then a new learning theory developed to meet technological change. This theory is called connectivism and it has been named the theory for the digital age. This theory was developed to replace older and inferior theories and to explain new ways of learning (Kop, 2008). Connectivism developed to keep up with the rapidly changing social world (Kop, 2008).

Connectivism (Baker, 2011) is a model of learning that acknowledges a tectonic shift in society where learning is no longer internal but has moved to an individual learning activity that has altered how learners think, learn and acquire new knowledge. In this study, the researchers wish to establish where the gap exists with regard to what is taught and how it is learnt. Through observation the researcher determined if the teaching approaches and methods used by the Grade three teachers cater to the individual's way of learning. Due to the rapid changes in the social world of the learners, teaching approaches and methods have to be adapted to help all learners to learn. The researcher wants to determine if in fact these adaptations have been made and if teaching approaches and methods have been amended to accommodate all learning styles and abilities in Grade three classrooms. In this study, the researcher wished to observe the teaching approaches and methods that are used by the Grade 3 teachers, to establish how the learners relate to these teaching methods and if the methods used help the learners to make the relevant Mathematics connections. These connections are important if a learner is to learn Mathematics.

Connectivism in Mathematics learning is a learning theory that helps learners to learn in a way that makes sense to them and helps these learners to access information easily and gain knowledge in ways that are connected to their everyday lives. According to Bateman (2008), connectivism is a learning theory that is based on the idea that knowledge exists in the world rather than simply in someone’s brain and emphasizes that knowing where to find knowledge is just as important as the knowledge itself. The learners need to realize that Mathematics is all around them and can be viewed not only in their Mathematics classroom but can be seen and used every day as they complete routine activities like buying a loaf of bread or sharing sweets with a friend. This study intended to establish if learners are being taught Mathematics in a way that helps them connect new information to what they already know or if new information is merely added without allowing these learners to make these important connections.

The researcher shares the core proposition that knowledge cannot be acquired as if it were an object but should be recognized as a set of connections that are formed due to the experiences and actions of humans (Downes, 2011). The researcher thus

used observation to determine if the methods and approaches that the Grade three teachers use promote the forming of connections by offering aesthetic experiences where learners get the opportunity to discover, explore, construct new knowledge and learn through social interaction. Group work is essential for making these connections and the researcher thus observed if the teaching methods and approaches that these Grade three teachers use, includes group work or if they only apply direct instruction to teach Mathematics.

In connectivism, learners learn by connecting nodes on networks, suggesting that knowledge cannot reside in only one location, but arises from multiple domains (Downes, 2008). This pertains especially when multiple individuals seek information that is related to a common interest, then share the knowledge by providing feedback to one another. According to Smith and Allen (2014), connectivism is a learning theory that helps learners link or connect previously learnt information to current information by incorporating technology. As a Grade three teacher I am aware of the value that technology can add to the teaching and learning of Mathematics, but feel that it should be applied correctly and used to build on the learners' prior knowledge not just to introduce them to new knowledge. If this technology is not administered correctly, it will be of no use to the learners.

If technology is administered correctly, it can help the learners to look beyond their own understanding and connect and understand new information and knowledge. In the world today knowledge is constantly changing and various influences and circumstances determine what and how learners learn (Elieson, 2013) so new and updated ways of learning have to be created to help learners find connections between previous and current understanding. In the researcher's opinion, professional development of Mathematics teachers will allow them to keep up with new and best practices and adapt their teaching methods and approaches to meet the learner's needs of the 21st century. Old and outdated teaching and learning methods no longer meet the educational needs of the learners in our classrooms, and teachers need to find more effective methods that promote learning in the diverse circumstances. As the world evolves so should teaching and learning, what seemed to work in the past is no longer effective, so an upgrade is needed in methods and approaches of teaching and learning.

This is especially relevant in Mathematics learning; as new methods must be found to enable the learners to make the relevant connections that they require to be successful in the subject.

It is common practice in today's society for children to have cell phones and computers and they have no problem operating these devices and learning new knowledge or making connections that are related to these devices, yet battle to learn at school. In the researcher's opinion, they are interested in this way of learning as it is high-tech and socially acceptable and they can relate to it. Teachers should thus be encouraged to find interesting ways to teach Mathematics and find methods that appeal to the learner's way of making connections and learning. According to Mchaney (2011), connectivism is a learning theory that has been developed to help learners learn in a way that does not clutter their brains but provides an easy way of learning and knowledge retention. My study wishes to determine if rote learning and repetition is an effective way of learning Mathematics or does it just give the learners information and facts without creating understanding. It also seeks to establish if the approaches and methods that are currently used to teach Mathematics in Grade three allow the learners to construct their own knowledge and understanding through experience and interaction.

Connectivism in this study can thus be used to identify ways to help the teachers to improve their teaching methods and approaches and find ways to teach in a simple way that does not rely only on the relaying of information, but how this knowledge is constructed and retained. These teaching methods and approaches will thus rely on evolving technology to help learners find new and easy ways to access information (Goldie, 2016). Downes (2012) explains connectivism as a semantic condition that describes the efficient and effective functioning of networks to achieve knowledge, create development and growth and to help learners to form connections within themselves. In the researcher's opinion, learners cannot learn new concepts if they are unable to establish a connection between what is being taught now and what they have already learnt. These connections or patterns allow them to link related concepts together and group objects defined by specific attributes like colour, shape and size. Sequences or patterns help a child to understand concepts and without forming

connections a child will not be able to grasp new knowledge or understand it. It is important in Mathematical learning to use networks and connections in order to impart new knowledge on the learners. Using connectivism helps the learners to make connections between various newfound knowledge and facts, and discern what information is relevant, share knowledge about cultural biases, personal experiences and incorporate opinions into stories, learning, and memory (Downes, 2012). In Grade three all the above mentioned are critical to learning and knowledge construction.

Connectivism helps teachers to incorporate new strategies to meet the learner's expectations (Marquis, 2012) and to keep up with physical changes that technology places on the young mind and incorporates new data, knowledge, and concepts into the learner's worldview (Underwood, 2016). Since the world around us is changing at such a rapid pace and the way in which learners make connections and learn is by using technology, for teachers to ignore its benefits would be counterproductive. Incorporating teaching methods and approaches that appeal to the learner's interests and things they can relate is beneficial in the teaching and learning of Mathematics. In order to allow the learners of the 21st century to learn, it should be determined how they form connections and make sense of the world around them. Teaching methods and approaches must be upgraded to keep up with the times. As the world evolves and progresses so should education. New methods and approaches become available to teachers and therefore this leaves no excuse for teachers to still use old methods or approaches to teach Mathematics.

In connectivism learners are encouraged to grasp new information, maintain old connections to previously learned knowledge and to cultivate their own fields in technology in order to be able to break down traditional academic fields. The learners are also encouraged to use the information that is freely available to them, to find how to process information and apply it when needed, rather than just memorizing information and later regurgitating facts (Mattar, 2017). According to Siemens (2009), connectivism be a learning act or recognizing patterns that are shaped by complex internal and external neural networks that help learners to adapt to the world around them. In the researcher's opinion, there is great benefit in teaching Mathematics by using

networks and connections as these connections allow the learners to see how concepts are related to each other or how they differ. They can use these connections to group things together or identify which objects do not fit into a group. Connectivism in a Mathematics classroom can help the learners see connections between various ideas, subjects, and concepts and thus provide learners with choices and decisions as to what and how to learn. In this study, the researcher wishes to determine if the approaches and methods that are used in the teaching and learning of Mathematics assist the learners to make the connections they need to be able and link previous knowledge with new knowledge or whether new facts are introduced in isolation. It can be likened to a dot to dot activity. When the learners connect the dots, they see the bigger picture. Teachers thus have to help the learners to connect the dots so that the bigger picture of Mathematics concepts will become clear to the learners. Without being taught how to connect concepts, the learners will not be able to learn effectively. By nurturing and maintaining these connections and networks, a Mathematics teacher will assist the learner to construct new information to what the learner already knows and will help the learner to facilitate continual learning (Siemens, 2011).

Kop and Hill (2008) explain that connectivism is a network theory of learning that draws on a diverse set of theories from learning, education, philosophy of knowledge and knowledge management. It is situated within the discourse of change in education and is related to the transformative possibilities that are offered to learners by emerging technologies (Bell, 2010). In this study, the researcher used the principles connected to connectivism to assess whether teaching and learning methods have transformed to meet the current needs of the individual learners in the Grade 3 Mathematics classrooms, or if methods and approaches are outdated and in need of adaptation. Connectivism contributes to the development of new pedagogies (Kop & Hill, 2008) and inspires to learn in diverse contexts. Bateman (2008) explains that connectivism has an added advantage to teaching and learning as it allows the teacher and learner to form a partnership and to develop learning strategies to meet the learning needs to the new generation. In connectivism learning strategies are constantly being updated to keep up with new learning technologies and learners are

encouraged to use their prior learning experiences to develop new learning experiences. This learning theory of the digital age helps learners to make connections faster, fosters creativity and advocates collaborative group work to ensure that learners work towards a shared goal. Nurturing and maintaining these connections and networks help the learner to facilitate continual learning (Siemens, 2011). The main aim of connectivism is to ensure long-term and full learning activities (Mattar, 2017) that allow the learners to make connections (Siemens, 2011) between ideas, concepts, new information, patterns and themselves and to grow and develop themselves and society in certain connected ways (Downe, 2007). This study will thus be used to make connections between the way in which concepts are taught and the way in which learners receive this information in order to make their own connections and learn. The researcher will determine where the gap lays between what is taught and what is learnt, for example, connections between underperformance and the factors that are responsible for this.

Through interviewing the Grade three teachers and observing their teaching methods and approaches, the researcher wished to determine if participating teachers were aware of the theories required in the teaching and learning of Mathematics. The researcher also wanted to establish if these teachers understood the principles of these theories and the importance of using the correct theory to teach a concept. Thus, the researcher would be enabled to establish if the lack of theoretical knowledge can impact on the way that Mathematics is taught and learnt in Grade three.
The next chapter covers the literature review that relates to this study.

CHAPTER 3
THE LITERATURE REVIEW

3.1 INTRODUCTION

Chapter 2 discussed the theoretical framework that was used by the researcher to conduct this research study and how the researcher used this specific framework to build a case for the research problem, offer support for the problem and confirm the purpose of the study (Phakisi, 2008). The theoretical framework presented thereunder including specific theories that were crucial to the study and served as a scaffold structure on which the study was founded. Chapter 2 was also presented to the reader to enable them to link various research findings to these theories.

According to Sullivan (2011), without these theories research findings would just be a disorganized collection of data and there would be no framework to connect the data with. Chapter 2 thus explained the various theories that are needed to be able to learn and teach Mathematics to learners effectively. It also explained the value of theories with regards to the teaching of Grade 3 Mathematics, expressing the utmost importance for teachers to upgrade their knowledge of these theories to ensure that Mathematics is taught correctly to Grade 3 learners.

The relevant theories that were discussed with regards to the teaching and learning of Mathematics in Grade 3 were the social constructivism, behaviourism and constructivism. All are imperative to the teaching and learning of Mathematics effectively and therefore should be understood and used in Mathematics classroom.

Chapter 3 reviews relevant literature pertaining to how Mathematics should be taught and learned in Grade 3 classrooms. Its main aim is to discuss the proficiency levels of Grade 3 teachers, their successes and challenges in teaching Grade 3 Mathematics and to recommend strategies and suggestions that may in fact improve their proficiency levels with regard to teaching Grade 3 Mathematics. It discusses the concept

of Mathematics as seen by various other scholars and explores reasons why unsatisfactory results or underachievement exists in this subject, especially in Grade 3. Mathematics is one of the most important subjects at school level and thus should be taught effectively using methods and approaches that are conducive to learning. The DBE has produced the CAPS documents that form the basis for why and how Mathematics should be taught in Grade 3. This study will later also explore the Grade 3 teachers' views on the teaching and learning of Grade 3 Mathematics. The teachers in this process should ensure that the CAPS implementation for Grade 3 Mathematics is effective and that what and how they teach produces the required results that are prescribed by the DBE.

The literature that the researcher reviewed focused on the teaching and learning of Mathematics in the Foundation Phase, the current problems experienced in this regard and what precautionary measures can be used to improve teaching and learning in this subject. The researcher used this literature as a conceptual framework in which to position their study.

The ensuing section elaborates on the proficiency levels of Grade 3 Mathematics teachers.

3.2 MATHEMATICS TEACHERS' PROFICIENCY LEVEL

In order to understand what proficiency in Mathematics entails, a person should know what proficiency is and what skills a person should possess in order to be deemed proficient. According to the American Heritage Dictionary (2016), proficiency is the state or quality of being proficient or displaying competence. Mathematical proficiency refers to a teacher developing a profound understanding in Mathematics (Garg, 2017) and is a key factor in developing a strong mathematical community (Tucker, 2013). Mathematically proficient people exhibit certain behaviors and dispositions when doing Mathematics. If they are truly proficient in Mathematics, they will be able to exhibit five important strands of proficiency (Garg, 2017) which are certain behaviours or dispositions which a teacher should exhibit while doing Mathematics. These profi-

ciency strands are designed to assist teachers with how they teach Mathematics content

strands and how they should engage their learners in thinking, doing and investigating in a mathematical context (Sansome, 2016).

Kilpatrick, Swafford, and Findell (2001) describe mathematical proficiency as having five intertwining strands which consist of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Conceptual understanding in Mathematics refers to the understanding of concepts, operations and relations. This conceptual understanding helps students to make connections between interrelated facts and find similarities between these facts; students do this with comprehension and understanding (Garg, 2017). Procedural fluency is also required if a learner is to succeed in Mathematics. This procedural fluency thus refers to a person's ability to be able to flexibly, accurately and efficiently implement appropriate mathematical procedures (Weyer, 2015). Skills that occur in proficiency include having the knowledge to be able to depict when and how to use these procedures. This also includes efficiency and accuracy in basic computations when doing Mathematics (Tucker, 2013). It also includes having a vast knowledge of the symbolism that is used to represent mathematical concepts (Garg, 2017).

Much research has been conducted on procedural proficiency and it has been a common finding that conceptual understanding should be present if procedural proficiency is to develop (Garg, 2017). According to Johnson (2007). Relational understanding can only exist if a learner or teacher has a deep conceptual and procedural understanding. Strategic competence refers to a person's ability to formulate, represent and solve mathematical problems (Tucker, 2013). This strategic competence in a sense is similar to problem-solving and goes hand in hand with conceptual understanding and procedural fluency. The value of this strand of proficiency is a very valuable one to learners and teachers as problem-solving is not only essential in the Mathematics classroom, but also in everyday life experiences that one encounters (Weyer, 2015). An example of demonstrating mathematical competence is, for example, when a learner applies one strategy, sees it does not work and then applies an

alternative strategy in order to solve the problem.

Adaptive reasoning refers to a person's ability or capacity to think logically about concepts and various conceptual relationships (Tucker, 2013). It demands that a person should have reasoning skills to be able to navigate their way through various procedures, facts, and concepts and allows a person to arrive at a solution for a problem. An example of this in a mathematical classroom is when a learner arrives at an answer and wonders if they are correct and then in turn tries to convince their peers that their answer is indeed correct. Another example is when they write something down and realize that the path they are taking is not working and thus should find another way of solving the problem. This capacity to reflect on one's work, evaluate it and later adapt it is essential in adaptive reasoning (Garg, 2017).

Productive disposition refers to the positive perceptions that a person possesses about Mathematics (Tucker, 2013). It develops as learners and teachers gain a deeper understanding of Mathematics and realize that they are capable of doing Mathematics (Domino, 2009). Mathematical disposition in Mathematics includes the confidence that a learner possesses to be able to do Mathematics, their perseverance to keep trying to solve problems and their invested interest in Mathematics as an essential subject (Domino, 2009).

These intertwined strands should be possessed by all Mathematics teachers if they are to teach Mathematics to their learners effectively. In South Africa, Mozambique and Bangladesh it is noted that a trend exists wherein not all Mathematics teachers possess all the strands or competencies that are required to teach Mathematics. In a survey that was conducted by the World Bank (2014) it stated that only 1% of primary school teachers in Mozambique had the minimum level of knowledge that is required to teach mathematics and only 1 in 4 could do two-digit subtraction sums. This report also stated that 39% could not subtract decimals. SDI Report (2015) also stated that 65% could not calculate correctly. In this case it is obvious that Mathematics teachers lack the strand of procedural fluency and basic computation (Tucker,2013).

In order to be proficient in Mathematics, teachers need to have a clear vision of the goals of instruction and know what being proficient means to the specific content they are teaching, know the horizons of Mathematics (where it can lead and where learners are heading with it) and need to be able to use their mathematical knowledge flexibly in practice (Tucker, 2012). In this respect, teachers need to possess skills that are required to adapt instructional material, represent content in accessible ways, plan instruction and assess how much the learners are actually learning in their Mathematics classroom (Tucker, 2012).

According to Killen (2014), it is vitally important in a Mathematics classroom that a teacher is equipped with the necessary skills and knowledge that will enable them to assist Mathematics learners to integrate their learning. This will thus allow the learner to view Mathematics as a whole and not just to see it as an isolated collection of ideas. Teachers, therefore, should possess various kinds of mathematical knowledge and a deep understanding of what they are. Without this level of understanding in Mathematics (Jacobbe, 2008) they will not be able to provide accurate or detailed explanations or meet cognitive levels of the learners in their classrooms. Ball (2008) identifies two forms of knowledge that are required in order for a person to effectively be able to teach Mathematics: subject knowledge and Pedagogical Content Knowledge. Ball (2008) explains the subject matter consists of three categories which include common content knowledge, the knowledge of mathematical horizons and specialized content knowledge.

Common content knowledge is mathematical knowledge that is used daily in a learners' life. It includes various aspects such as a learner's ability to judge whether an answer is correct or incorrect and to be able to determine why it is this way. It also includes a learner's ability to be able to understand concepts that are connected to various operations that are used in Mathematics (Ball and Hill, 2009). This knowledge of mathematical horizons as explained by Ball and Bass (2009) refers to a vision that a learner possesses to be able to position themselves within mathematical concepts.

These concepts exist on a mathematical horizon and give understanding as to how various concepts will impact at a certain stage and thus give way to broader mathematical structures, ideas, and principles. Included in this is the understanding of functions like addition and place value. In a broader sense specialized content knowledge (Ball and Bass, 2009) refers to a type of detailed knowledge that professional people use in their daily lives or in their selected occupations. Examples of such specialized content knowledge in Mathematics are presentations, relationships between symbols and picture representations. It can also relate to the teachers' ability to know how to give mathematical explanations to the learners and to be able to provide the learners with reasonable solutions to problems. Another type of knowledge that a teacher needs to possess is the knowledge of the content of Mathematics and the knowledge of the learners they teach. This knowledge is required so that a Mathematics teacher will be able to identify the typical mistakes that are so often made by learners in Mathematics and to be able to identify how individual learners construct knowledge at a certain age (Chikiwa, 2017).

In the African context of teaching Mathematics, a Mathematics teacher needs to possess a vast knowledge of the curriculum (Ball, 2008). This curriculum knowledge refers to the educational aims that teachers need to work towards or pursue as well as curriculum policies established by the government in a specific country. In South Africa, the Curriculum Policy Document guides teachers on how and what to teach and is called the Curriculum Assessment Policy Statement or presently known as the CAPS document (DBE, 2012). Another type of knowledge that is imperative to mathematical teaching and learning is Pedagogical Content Knowledge. This term was first used by Lee Shulman in 1986. According to Shulman (1986), this knowledge expands well beyond just merely having subject knowledge that is needed for teaching. In Shulman's account of what Pedagogical Knowledge is, he includes useful forms of representations of ideas that tend to exist in a given subject, powerful analogies, illustrations, examples, explanations and demonstrations (Tucker, 2012). All of these elements are used to make a subject like Mathematics comprehensible to others who are just learning it.

Shulman (1986) explains that Pedagogical Content Knowledge includes being able to determine if a topic will be easy or too difficult for a child to learn and understand. It is an essential component for teaching and learning of Mathematics, as this knowledge includes conceptions and preconceptions that a learner of different age groups will bring with them to the mathematical classroom. Learners often have pre-conceptions that may be incorrect and for this very reason, teachers need to possess the knowledge strategies and skills to be able to reorganize a learner's understanding (Tucker, 2012). This is essential in a subject like Mathematics. Unfortunately, ongoing research on academic achievement in Mathematics in South Africa implies that teachers lack the basic content knowledge and skills that are connected to Pedagogical Content Knowledge (Spaull, 2015). Mathematics is one of the areas in South Africa where major deficiencies exist in teaching practices (Spaull, 2015). These South African teachers are seen to only being capable of getting learners to the basic levels of proficiency, but because of limited mathematical knowledge, they fail to take these learners beyond this point of learning and understanding (Spaull, 2015).

This type of research in Mathematics has also been conducted in Mozambique and Bangladesh, and in both countries, it has been established that varies deficiencies in Mathematics also exist (The World Bank, Maputo, 2015; Absiye, Hassan Ahmed, 2013). According to Beutel (2011), this underachievement in Mathematics is due to the fact that Mozambican teachers are untrained and lack content knowledge and Pedagogical Content Knowledge. These teachers have a limited knowledge of their discipline and do not know enough about what they are teaching (Beutel, 2011). In Bangladesh, the same situation has been identified as Mathematics teachers lack the subject knowledge, subject related pedagogical knowledge and skills to be able to teach Mathematics effectively. According to UNICEF, in Mozambique (2016) it is a shocking reality that only 1% of Mozambique primary Mathematics teachers have the minimum amount of knowledge that they are expected to have to be competent to teach Mathematics.

According to Tucker (2012) teachers today have some knowledge of what they are expected to teach, are aware of the facts and procedures that are needed to teach their subject, but their conceptual basis for knowledge is extremely weak. Teachers

who find themselves in this predicament are in a position where they have a limited capacity to explain and represent content in a way that makes sense to their learners (Baumert, 2010). Nell (2007) also supports this opinion by commenting on the fact that teachers are not fully grounded in the mathematical content and pedagogy of their discipline. The opinion was thus enforced that because of this deficit the teachers are neither confident nor competent in what they teach.

Carnoy (2011) points out that the situation is exacerbated when teachers do not know enough about the subject that they aim to teaching and are unaware of what their learners need to learn in the subject. This is a reason why learners do not achieve good results in Mathematics. Pournara (2015) concurs that weak knowledge of teachers is responsible for the poor mathematical performance in South Africa. This equates to the sad realization that a person cannot possibly teach what they themselves do not know or understand (Carnoy, 2007). Often it is this very lack of knowledge that can make the explanation of mathematical content to the learners extremely difficult.

This may pertain to the fact that for the most part teachers tend to impart knowledge in a way that they understand it (Gervasoni & Lindenskov, 2011). Unfortunately, without sufficient knowledge, the explanation that a teacher gives may lead to great confusion and may result in the fact that a learner is unable to understand or grasp the concept that the teacher is trying to explain. Mathematics teachers are not only required to have a good grasp of the methodology of Mathematics but should also have a high level of content knowledge (DBE and DHET, 2011) and possess well developed pedagogical skills. Mathematics teachers need to be able to draw on this knowledge and from this make valid inferences about their teaching practices, make informed decisions and have a deep and structured understanding of their discipline (Bertram Christiansen, 2012). These teachers also need to have in-depth knowledge of the procedures that need to be followed in order to generate knowledge in Maths (Bertram Christiansen, 2012).

Teacher performance is a concept that has undergone constant scrutiny and has been named as a critical factor accounting for school functionality and achievement

(Chisholm, 2011). The quality of teaching has thus been linked to what teachers know, their ability to convey complex concepts and ideas and motivation to teaching with content and Pedagogical Content Knowledge (Chisholm, 2011). According to Chisholm (2011) when teachers lack these various types of knowledge, they tend to be unconfident and unsure of what to teach and how to go about it. In these cases, teachers are not likely to teach effectively and often avoid teaching the parts of the curriculum that they find difficult, often even finding ways to spend less time in their classrooms (Canoy, 2011). These pedagogical practices and low proficiency skills are a reason for concern (Taylor &and Taylor, 2013) and often lead to underachievement in Mathematics.

According to Askew (2008), underachievement in Mathematics can be attributed to the fact that some teachers who are proficient in Mathematics choose not to teach Mathematics. This then leaves a gap that has to be filled by teachers of other subjects, with little or no mathematical knowledge or pedagogical skills, resulting in low proficiency levels in Mathematics. In light of observing the competency and proficiency levels of teachers and the teaching that they provide to learners to ensure Mathematics mastery, South Africa participated in a number of local educational studies (Chikiwa, 2017). From these studies, it was deduced that South African learners and teachers are not doing very well (Spaull, 2013). Spaull confirmed that as far as educational outcomes go, South Africa had the worst educational outcomes out of all the middle-income countries that participated in the cross-national assessments.

Since this study focuses on Grade 3 learners, the proficiency levels in Mathematics are examined by reviewing the ANA that was introduced in 2011. This was a way for the DBE to track the learner performance and to identify problems that manifest in the learning of Mathematics. The ANA showed that Grade 3 achieved a Grade average of 44, 5%. These results were retrieved from a report that was compiled by Robertson and Gaven (2015) as follows:

FIGURE 3.1: ANA results from 2011-2015

Grade	2011	2012	2013	2014	2015
1	63%	68%	60%	68%	64,75

2	55%	57%	59%	62%	58,25%
3	28%	41%	53%	56%	44,5%
4	28%	37%	37%	37%	34,75%
5	28%	30%	33%	37%	32%
6	30%	27%	39%	43%	34,75%

According to Gaven (2016), a deficit exists in primary schools in South Africa and as the learners move up the ladder their performance seems to diminish due to poor teaching and learning in the lower grades (Spaull, 2013; NEEDU, 2013). Spaull (2013) also deduced that because of this deficit South African learners will be two years behind by the time they reach Grade 4.

Although a slight improvement over the three-year period, the achievement level is still relatively low in comparison to other countries (Spaull, 2013). Chikiwa (2017) also looked for reasons for this lack of academic achievement in Mathematics that occurs in the Foundation Phase and concluded that this was due to the fact that teachers did not develop number sense properly in the lower grades. This then spilled over into the higher grades as the learners were placed at a disadvantage as they did not possess the proficiencies or skills that are required to enable them to learn easily and thus be promoted to the next grade (cf. also Hoadley, 2012).

The proficiency levels of Grade 6 teachers have also become a cause for concern. According to Spaull and Simkins (2013), data collected in 2007 revealed that in Grade 6 in South Africa, most teachers could not answer a simple Mathematics question that they expected their learners to be able to answer. This is most disturbing and reinforces the fact that teachers cannot teach what they do not know. In the described study SACMEQ II researchers tested Grade 6 teacher's mathematical knowledge (Spaull & Venkatakrishnan, 2014). These data were analyzed by Spaull and Venkatakrishnan and the findings were that 79% of these teachers faired below the rate that was recommended for a Grade 6 to achieve in order to pass. The Recent National School Effectiveness study (NSES) displayed the same dismal levels of knowledge and proficiency in teachers (Taylor, 2013).

According to Magari (2014), classroom practices will urgently have to be addressed. He states the quality of teaching and learning will remain a mere phantom unless teacher education is developed and if teacher competencies and proficiencies are not refreshed.

This now brings the researcher to their next sub-question of this research question: the challenges and successes encountered by Grade 3 Mathematics teachers. Firstly, challenges are discussed and thereafter, the successes that Grade 3 teachers have experienced in mathematical teaching and learning.

3.2.1 Teachers' lack of Pedagogical content knowledge in Mathematics

Teachers' lack vital Pedagogical Content Knowledge which enables them to teach Mathematics effectively (Makeleni, 2014). According to Park and Oliver (2008), this Pedagogical Content Knowledge refers to a teacher's understanding and their enactment as to how they should assist learners with specific subject matter and understanding. They should be able to apply multiple instructional strategies, work with representations and assessments effectively and work within contextual cultural and social limitations in a learning environment.

South African teachers of Mathematics possess a very limited repertoire of Pedagogical Content Knowledge (Nason, Chalmers & Yeh, 2012) and their teaching experience alone is not sufficient to teach Mathematics (Kleickman, 2013) but needs to be combined with thoughtful reflection to enable them to teach Mathematics effectively. Research in Mozambique and Bangladesh has also confirmed that teachers from these countries also fall short of the requirements of competent Mathematics teaching, as these teachers also lack pedagogical knowledge and cannot embed their knowledge into their teaching practices (Sir Peter Williams 2008; UNICEF, 2016).

Silverman and Thompson (2008) stated that in order to teach Mathematics effectively a teacher needs a deep and organized Pedagogical Content Knowledge that they can easily revisit while teaching mathematic. They also require Pedagogical Content Knowledge to create awareness of elements that lack in their pedagogical practices and allows them to develop this knowledge. The advantage of this gain in knowledge

will enable these teachers to create meaningful connections in Mathematics while they are busy teaching in their respective classrooms.

If a teacher is lacking in Pedagogical Content Knowledge, they will not be able to teach effectively as they exhibit weaknesses in their teaching practices and exhibit the lack of deep conceptual understanding that is imperative in the teaching and learning of Mathematics (Hill, 2008). Numerous studies support the fact that a lack of Pedagogical Content Knowledge will invariably lead to a lack of confidence in teachers and have a negative impact on their behaviour and overall teaching practices.

When a teacher lacks mathematical knowledge, they tend to enforce the premise that learners should just blindly follow the procedures that they have memorized to get to the required answer. However, by only teaching these procedures the learners do not gain conceptual understanding and tend to ignore vital mathematical connections that are imperative to learning Mathematics (Landsberg, Kruger & Swart, 2016). Teaching Mathematics with understanding pertains to more than just blindly following procedures and teachers need to have a sound Pedagogical Content Knowledge to venture beyond subject knowledge (Shulman, 1986).

It is vitally important that teachers be made aware and understand why pedagogical knowledge is so essential when one has to teach in ways that will enhance and guide learning in an appropriate way (Killen, 2013). According to Killen (2013), Pedagogical Content Knowledge will never exist in a teacher if they do not have a deep understanding of the content they teach, learning theories that are connected with the learning and teaching of Mathematics and general pedagogy. This is a general characteristic that relates to all teachers regardless of what they teach.

Possessing Pedagogical Content Knowledge is important especially when a teacher is faced with various wrong answers that are supplied by their learners. By drawing on this knowledge teacher will be able to determine reasons why these mistakes occur and help the teacher to reteach the content using alternative methods and approaches; later these learners can be assessed to see if what has been retaught was

done in an effective way (Woolfolk,2013). According to Woolfolk (2013), the importance of a teacher possessing Pedagogical Content Knowledge can never be downplayed or ignored. Pedagogical Content Knowledge is a unique kind of teacher knowledge that combines the mastery of academic content, knowing how to teach the content successfully and the ability to match quality teaching to the various student differences.

This great importance was highlighted when Ball, Hill, and Rowan (2005) were asked to research teachers of Grade 1-3 learners in the United States (US). This was done in order to establish if there is a link between a teacher's pedagogical knowledge and Mathematics achievement. Their studies confirmed that there was a direct correlation between teachers who had increased pedagogical content levels and high achieving Mathematics students. The more the teachers knew about the subject they were teaching, the more students were able to learn and understand.

In Germany similar studies were conducted and it was concluded that teachers who had a better Pedagogical Content Knowledge were more inclined to engage their learners in activities that developed their cognitive levels of learning, used qualitative methods of teaching instruction and thus enjoyed higher levels of student achievement (Boument, 2010).

Woolfolk (2013) echoed this sentiment by explaining that teachers with higher Pedagogical Content Knowledge seem to make clearer presentations and recognize where learners experience difficulties more quickly than teachers who do not have this extensive knowledge. With this type of knowledge, teachers are well prepared to answer any questions that their mathematical learners may have in their classrooms. These teachers are never vague in their responses to learners and mirror an air of competence and confidence (Woolfolk, 2013). This will then ensure that learners are not placed under false pretenses; learners cannot be expected to know the answer if their teachers do not know the answer.

If teachers possess this kind of knowledge, they will use more effective teaching methods and not opt to use ways that do not promote conceptual learning (Woolfolk,

2013). Thus, academic achievement in Mathematics will occur and the deficiency of underachievement will be a thing of the past, not something that will leave its negative mark on South Africa for years to come (Chikiwa, 2017).

3.2.2 Teachers' methods and or approaches to teaching Mathematics

According to Ali (2016), the main reason why teachers seem to fail to teach Mathematics is the way in which they choose to teach. Ali explains by saying that these teachers tend to use disconnected ways of teaching without giving the learners a proper understanding as to why or how learning will occur. These teachers tend to refrain from practical teaching and their lessons seem to be boring lacking any element of excitement or fun. They are a mundane rush to get through the syllabus on time with little time for anything else. Ali (2016) adds that their teaching seems to lack the intent to develop the learner's conceptual understanding in Mathematics.

Brown and Gordan (2009) add that many teachers battle with teaching Mathematics because of their lack of effective teaching and learning methods. These teachers lack teaching skills (Moalosi & Malwane, 2010) and because of this tend to lack confidence which results in them not using alternative methods for teaching Mathematics.

According to Wagner (2008), effective teaching methods do not only rely on the teacher but on an obvious interaction between the teacher, their subject matter and their teaching skills. Faull (2009) explains that teachers do not always teach in a way that would score highly on an objective measure of teaching. This is because these teachers are not able to make sense of other teaching methods that are not their own, regardless if these teaching methods are more effective than their own. The cure for this will be to give teachers opportunities where they can unpack mathematical ideas with their colleagues and develop better alternative methods of teaching (Ball, 2008). Teachers need to realize that often other teachers have over the years developed teaching methods that work and accepting assistance will not deem them incompetent but develop their own methods of teaching Mathematics.

Kessel (2009) argues that teachers of Mathematics need to know how to teach, what to teach and what methods to use in order to gain mathematical success. Implementing the CAPS curriculum has been difficult for many Mathematics teachers as they are so familiar with the old methods that they use to teach the subject that they find it difficult to implement new methods of teaching and learning (Furguson, 2010). These teachers were taught with traditional teaching methods, so they teach in that way. These veteran teachers appear unwilling to change their teaching methods even if this change will mean increased academic achievement in Mathematics (Spaull, 2013).

According to Beutel (2011), Mathematics teachers in Mozambique also find it difficult to teach the current Mathematics curriculum as they feel that it is inappropriate and designed in the global context and not suited to the country itself. It is their view that the curriculum is too difficult for the teachers to teach and rush to finish the syllabus without teaching with understanding what they are teaching or if learning in occurring in their Mathematics classrooms. The teaching approaches applied in these Mathematics classrooms are ineffective and rote and surface learning dominate classrooms including chorus, copywriting and memorization of large amounts of facts (Atweh, 2014). This is neither interactive nor encouraging and does little to promote thinking, reasoning or problem-solving skills.

In Bangladesh teachers use inappropriate teaching methods and approaches to teach Mathematics and refuse to adjust their teaching techniques to include problem solving that occurs outside of the prescribed textbooks and totally disregard the benefits of group work and allowing their learners to construct their own knowledge (Latif, 2006). According to Latif (2006), these teachers cling to old traditional methods of teaching and rely heavily on rote and memorization to instruct their learners. These teachers also read what they want children to know from textbooks and the learners blindly quote the work word for word without understanding the purpose of what they are studying (Pradhan, 2016).

According to Pradhan (2016), the curriculum that is currently being followed in Bangladesh poses a problem to the teaching and learning of Mathematics, as is it is not

unified and a great disparity exists in the curricula and the standards of schooling. Often teachers lower their standards to accommodate weak learners and this hampers learners who have a stronger mathematical background.

According to Spaull (2013), these teachers have become complacent and cling to old traditional methods because they find these methods comfortable. They are of the belief that their methods of teaching are the only methods that work, as they have done it for years (Spaull, 2013). They work on the premise that if something is not broken, you should not try and fix it. This unrealistic assessment of their competence (NEEDU, 2013) leads to incorrect teaching methods being used in Mathematics classrooms.

Ghaye (2011) comments that experience, or years of teaching are insufficient indicators of proficiency and by reflecting on their teaching practices, these teachers will be provided with insight that will be able to improve their teaching methods. These teachers need to focus on their strengths not only on the elements that they find difficult (Ghaye, 2011). Landsberg et al. (2016) mention that these old traditional teaching methods are linked to a very authoritarian way of teaching and learning. They explain that in traditional teaching the teacher just explains a concept to learners, tells them how to solve the problem and gets the correct answer. This way of teaching Mathematics is a follow-the-rules, computation-driven, answer-orientated way of learning and allows learners to believe that they cannot solve a problem without being told the solution beforehand (Landsberg et al., 2016). This stereotypical traditional approach to the learning of Mathematics promotes the view that learners should solve routine problems with teachers simply telling them what to do and how to do it. The learners listen and apply what they have been told to do. This leads little or no time for learners to reason, think or solve problems on their own, a problem if effective learning in Mathematics is to occur (Spaull, 2013).

According to Damodharan, Regarajan, and Aicwa (2012), teachers who use traditional methods tend to use the chalk and talk method to deliver their instruction. This chalk and talk method only accommodate one-way flow of information where the teacher talks, and the learners just listen. Children in this type of classroom get little

chance to respond and the feedback that they obtain from the teacher is limited or non-existent. Teachers who teach in this way rely heavily on drill and rote memory rules rather than enforcing the fact that Mathematics needs to be taught with understanding and reasoning (Vilardi & Rice, 2014).

Learners in this type of classroom setting often complain that they do not feel part of the teaching or learning process because they are not given enough opportunities in which to be able to debate problem solutions or to discuss how they arrived at the answer (Villard & Rice, 2014). Ferguson (2014) describes the fact that traditional Mathematics teaching works only in the short term, but because students do not retain mathematical knowledge, they cannot always remember what a teacher did at a certain step or understand why a teacher used a certain procedure.

Furguson (2010) elaborates that learners who are traditionally taught are used to memorizing facts and then just simply apply them to the problems without understanding why they are performing these actions. They merely become content with doing routine problems but have no idea of the principles that are behind the Mathematics that they are doing (Furguson, 2010). This fails to develop understanding or problem-solving skills. White-Clark (2008) adds to this statement by saying that veteran teachers believe that their role is just to impart information to learners and hope that with any luck they may retain it for future use. By just merely listening to how a teacher says a problem should be solved, learners ignore their own reasoning and blindly follow rules that the teacher imparts for solving the problem (Holaelan, Ilam & Iran, 2015). This is detrimental to the learning of Mathematics as reasoning, thinking and problem-solving is an important part of Mathematics (Landsberg et al., 2016).

This method of teaching is characterized as being teacher centered, content-driven, examination focused, and transmission based (Mhlolo, 2013). It relies on teaching through the memorizing of facts which students regurgitate and relay back to the teacher. This type of teaching emphasizes the memorizing of formulas and applying mathematical concepts before a child has had the opportunity to experience the concepts on their own (Marshall, 2006). It also focuses on procedures and algorithms (Molefe & Brodie, 2006) and the teaching of lists rather than mathematical principles (Fisher, 2011). In countries like Mozambique and Bangladesh where classes are

overcrowded, teachers opt to use the teacher-centered approach simply because they feel that this method allows them to manage the learners more effectively and active participation from learners will only make their jobs more difficult (Beutel, 2011). These teachers also lack the ability and skills to manage ability groups so allow the learners to simply sit quietly and become passive recipients of what the teachers provide (Taylor, 2014).

This form of teaching Mathematics is ineffective as it focuses more on the theory of Mathematics while avoiding the practical and real-life situations (Killen, 2013). This teaching style ignores problem-solving and group work which is detrimental for mathematical learning as problem-solving lies at the heart of a genuine mathematical activity (Mann, 2006). The knowledge that is not linked to practice is of no use at all.

Most reasons for low achievement in Mathematics has been narrowed down to poor teaching practices. Although many skills a learner needs for learning are learned in everyday contents, the development of most mathematical skills depends heavily on formal intentional teaching. Unfortunately, in South Africa, formal teaching of Mathematics is not always what it should be (Ensor, 2009). There is often an emphasis on drill and accuracy rather than on understanding guided discovery and students work with mathematical processes as principles as opposed to right or wrong answers. Many students have difficulties in Mathematics simply as a result of such poor teaching (Donald, Lazarus & Moolla, 2014).

From the above discussion, it can clearly be seen that traditional teaching methods that are teacher centered are ineffective in the teaching and learning of Mathematics. They exclude the development of understanding and do not promote the use of problem-solving, which in itself is essential for developing mathematical reasoning (Ngaumwe, 2004). According to Bansilal (2017) if achievement in Mathematics is to improve, teachers will have to extensively examine their teaching practices and constantly update them to ensure the effective teaching and learning of Mathematics.

3.2.3 Learners' anxiety to learn Mathematics

Mathematical anxiety has been explained as more than just negative emotions that interfere with a learner's ability to solve mathematical problems (Blazer, 2011). Sparks (2011) explains that mathematical anxiety is more than just disliking Mathematics, but rather a serious condition that leads to a learner avoiding mathematical classes or situations where Mathematics is deemed necessary. This condition exists when learners' working memory becomes blocked and they fail to access facts even when they are given enough time to think about a problem. As their stress levels increase so their confidence levels decrease, and anxiety sets in. An illusion now exists in the mind of the learner that if they cannot complete a task quickly, they are not good at Mathematics (Landsberg et al., 2016). This slow pace of completion leaves these learners feeling inadequate, a failure that will never be able to do Mathematics. The premise now exists that, why should they try if they are just going to fail?

This level of anxiety that exists in the learners may very well be caused by the teacher. Teachers may cause anxiety because they are not able to explain a mathematical concept effectively to their learners (Landsberg et al., 2016). These teachers place their faith in the textbook explanations and cause the learners to aimlessly copy work that they write on the board, with no understanding of what they are writing (Landsberg et al., 2016). This serves to fill up the learner's books but contributes nothing to learning.

Boaler (2015) explains that when a teacher finds themselves in a situation where they cannot explain effectively to their learners, they become impatient, make derogatory comments to the learners and tend to lack enthusiasm towards Mathematics. Teachers tend to teach things that they themselves understand and are interested in. The teacher's approach of teaching Mathematics may cause anxiety and make the learner avoid it at all costs, just because they believe they are not capable of doing it (Landsberg et al., 2016). Attempting the unknown is always a daunting task.

According to Vilardi and Rice (2014), teachers can cause mathematical anxiety in their learners by placing too much emphasis on memorizing formulas, learning Math-

ematics through drill and rote memory rules and by setting work out in the old traditional way rather than promoting understanding and reasoning. According to Landsberg (2016), often learners develop anxiety as a result of the fact that they are being taught by teachers who are anxious themselves about their abilities in certain areas. Teachers thus need to help their learners to avoid anxiety when they are dealing with Mathematics problems (Vilardi & Rice, 2014). Learners who are afraid will fail to deliver their best work, and this will result in poor mathematical performance. So rather than being forced to remember excessive amounts of mathematical rules, learners should rather be encouraged to develop their ability to analyze, question, test and find their own solutions to various mathematical problems. They need to be allowed to apply their own procedures to a situation, not be told what to do (Ufuktepe & Ozel, 2011). Teachers should make it their utmost goal to teach towards understanding and develop vital problem-solving skills (Spaull, 2012).

3.2.4 Teacher and learner absenteeism

Mathematics is a subject that relies on a learner to be able to build on their previously learned knowledge and skills (Landsberg et al., 2016). When learners are consistently absent, they need to find a way to catch up and this is something that is not done. Work that is lost remains lost. This is because teachers are placed under tremendous pressure to keep up with the curriculum and because of this cannot go back and address the backlog that has occurred due to a learner being absent (Spaull, 2014). Thus, work that is lost is lost forever and learners never catch it up (Carnoy, 2008).

According to Coelho, Fisher, McKnight, Matterson and Swarts (2015), one element that is crucial for a learner's success in Mathematics is attendance. This is particularly important in the Foundation Phase as attendance is vital for the development of skills in Mathematics that a learner will carry with them to a higher grade.

According to Coelho et al. (2015) learners from low-income households are more prone to being absent. This high level of absenteeism of learners has been noted in studies conducted in Mozambique, Bangladesh and South Africa (Hossain, 2016; Beutel, 2011; Gani, 2017). This absenteeism may be due to many different reasons;

household work, lack of interest in education, peer influences, the distance they live from schools, illness or disease, loss of parents or family members or poverty (Komakech & Osuu, 2014). Balfanz and Burnes (2012) attribute this absenteeism to lack of parental support, poor teaching styles used by teachers, boring lessons, teacher's attitudes, bullying at school, drug abuse, and a lack of having the correct clothing to be able to attend school. Sometimes these learners are forced to stay at home to provide day-care for younger siblings as the parents are incapable of doing so or at work (Wadesango, 2011). Cognitive ability in Mathematics may also be a reason for children being absent from school. When a child struggles in a subject, they feel less connected and less likely to attend school (Basch, 2010).

Regardless of the reasons for absenteeism of learners in the Foundation Phase, it still is a huge concern to teachers (Brown, 2012). In the Foundation Phase the foundations for mathematical learning is laid (Coelho et al., 2015). Absenteeism causes a disturbance in a child's early mathematical learning, causing variable skills to be underdeveloped or lost and causes a definite ripple effect across their progress plane in higher grades (Coelho et al., 2015). Another factor that impacts on mathematical achievements is teacher absenteeism (Miller, 2012). In the South African context as well as in Mozambique and Bangladesh teacher absenteeism has been identified as one of the reasons that learners underachieve in Mathematics (Griffith, 2017; Absiye, Hassan Ahmed, 2013; Beutel, 2011). According to Taylor (2011), about 11% percent of teaching time is lost due to the absenteeism of teachers. This usually occurs on a Monday and Friday and tends to double at the end of the month. The repercussion of this is a lack of time on task teaching and this leads to underperformance in subjects like Mathematics. The teachers who are constantly absent fall behind in their work and this causes a backlog that can never be made up (Spaull, 2012).

Hanushek (2014) states that many research studies have been employed to determine the importance of the roles that teachers play in academic success. According to Miller (2012), the results of these studies have confirmed that teachers are the most important element of the school component, without them nothing would be taught, and no learning would occur. If they are absent from a school, it causes a chain reaction of chaos that filters out to all areas of the school, disrupting learning

(Denteh, 2011) and resulting in an undisciplined corps of learners. The message that constantly absent teachers send out about their attitude towards learning is not a positive one and thus has negative results on academic achievement (Bradley, 2007). Learners often find themselves asking the question: if my teacher is never at school, then why I should be at school?

Absenteeism of teachers also has an escalating monetary cost to the DBE and to schools in general as qualified substitutes when available expect to be paid for their services (Porres, 2016). Unfortunately, often qualified substitutes cannot be recruited so classes remain unattended or become the burden of the teachers who are at school. According to Gani (2017), relief teachers have an extra burden to carry as they have to complete their own workloads as well as look after or accommodate pupils from classes that do not have teachers. In the researcher's experience as a Grade 3 teacher, when teachers are absent the teachers who are at school are left to deal with the children of that teacher. According to Griffith (2017), when teachers are absent, it disrupts the normal flow of operations and dividing learners up into other classes' places a undue burden on teachers who already teach in overcrowded classrooms Teaching effectively in these circumstances is very difficult or even non-existent as there is no space to move around. These learners generally have to sit on carpets so group work cannot be done on that day.

The learners who have come from other classes do not come with their books or other forms of work, so they land up disrupting teaching by fighting, making jokes or spilling papers around the classroom. The learners who originally belong in that classroom also start misbehaving because they want to show off in front of their peers. Maintaining discipline is very difficult and the noise level is often unbearable. Teaching in this type of classroom, even if it is only for a day leaves a teacher exhausted and stressed. According to Meador (2019) trying to maintain discipline in an overcrowded classroom is a daunting task as classrooms that are overcrowded provide more opportunities for general disruptive behaviour and increased noise levels can lead to a teacher becoming overly stressed and exhausted.

3.2.5 Teaching learners with barriers to learning

One of the biggest challenges to date is the teaching of learners who have barriers to learning in a mainstream classroom (Dreyer, 2017). These learners with highly intensive support needs are placed in under-resourced mainstream classrooms and are supposed to be taught by these teachers who do not feel competent or qualified to provide for these educational and support needs (Nel & Tlale, 2015).

This puts a great amount of strain on teachers who were traditionally not expected to cope with these learners with barriers to learning, but now have to take responsibility for all learners in their classrooms (Donald, Lazarus & Lolwana, 2010). These teachers are expected to work flexibly, and use differentiated teaching materials, methodologies and techniques that cater to the diverse needs that exist in the classroom (Salend, 2011). Teachers in such mainstream classrooms are not confident to teach these learners as they do not feel that they possess the specialized skills that are required for the effective teaching of such learners. These teachers feel intimidated because they feel that they lack the kind of knowledge, skills, and expertise that is needed to teach Mathematics to these learners and at the same time support these learners who have high-intensive support needs (Engelbrecht, 2015).

Teaching in classrooms with learners who have very diverse needs often leaves Mathematics teachers feeling despondent. This is generally because these learners do not seem to achieve mathematical success regardless of the efforts that they put into teaching and learning (Dreyer, 2017). Stress then mounts in these teachers as they are expected to do more in less time, with limited resources, while teaching in overcrowded classrooms (NUT Guide, 2012) and being expected to gain improvement in Mathematics although the learners do not seem to be progressing in the subject. Often teachers are unqualified to deal with these barriers of learning and lack the skills they need to make a difference in these learners' mathematical abilities (Mauvso, 2013).

When inclusive education was in its infancy in South Africa, it seemed like a good idea when written on paper, but became more difficult in practice (Mauvoso, 2013).

In the beginning, teachers thought that they would be able to teach under these extreme conditions, but failed to achieve positive results (Dreyer, 2017) which left teachers feeling unconfident and incompetent. This was compounded by contextual factors that prohibit them from providing quality and support to all learners.

According to Landsberg et al. (2012), there are various forms of barriers to learning. The most prevalent in the researcher's Mathematics classroom are attention deficit-related difficulties, hyperactivity, and impulsivity, difficulties with physical skills and foetal alcohol syndrome. In an inclusive mathematical classroom, children who have attention deficit, hyperactivity and impulsivity have difficulties in learning Mathematics as they have a short attention span and thus cannot sit still during a lesson and are easily distracted. Due to the fact that these learners are easily distracted, they often walk around, fidget or interfere with other learners who are trying to do their work. Landsberg (2012) indicates that these learners do not achieve success in Mathematics as they often do not follow all the steps involved in problem-solving; they just leave the problem totally untouched and incomplete. These learners are also easily distracted and repeatedly ask the teacher to repeat the question as they do not understand what has been asked of them. According to Landsberg et al. (2016), these learners are often careless and make numerous mistakes when completing mathematical problems. They also tend to make unnecessary errors in calculations and shout out answers without carefully thinking about the answer. Unfortunately, due to the fact that these learners possess these barriers to learning, they get lost in the mainstream classroom and drift along aimlessly from grade to grade (Dreyer, 2017).

In Mozambique one of the biggest barriers to learning is albinism (Human Rights Watch, 2019). This condition causes learners to have very poor vision because of a melanin deficit. These learners find it difficult to learn and teachers do not adapt their teaching practices or their classrooms to assist these learners. Worksheets should be enlarged for these learners and their desks should be placed in the front of the class, but teachers ignore this and refuse to make reasonable adjustments in their classrooms. These children are widely discriminated against and find it difficult to attend school or achieve success, especially in Mathematics. In Bangladesh, many children are physically disabled and find learning in a mainstream school very difficult. According to Ahmed (2016) this is due to the fact that specialized materials for core

development and learning are not available to these learners. The overall environment is not adapted to the special needs of these learners and teachers discriminate and deal with these children in an unfriendly manner (Hossain, 2018). These children then find it very difficult to learn and achieve academic success.

Teachers also experience extensive challenges because of language barriers that exist in the mainstream classroom. This often occurs because teachers who teach Mathematics are not proficient in the LoLT and do not know what or how to teach the intended content (Taylor, 2012). According to NEEDU (2013), teachers in mathematical classrooms are not achieving the desired outcomes as they lack the proficiency and language skills that are required to explain Mathematics in a way that learners will easily be able to understand.

Primary language and reading difficulties also contribute to children not being able to learn Mathematics (Donald, Lazarus & Moolla, 2014). Even in the early stages of learning, Mathematics relies on a range of complex linguistic concepts (e.g., greater than, less than, equal to, element, set, and function) that primarily require good language skills. Later when workbooks are used, reading skills become essential to both understanding and performing mathematical tasks (Donald et al., 2014). If reading difficulties are sorted out, the problem with doing Math's is improved.
According to Hugo and Nieman (2010), a critical issue that hinders Mathematics learning is that teachers who are proficient in African home languages, are expected to teach this subject in Afrikaans or English, languages that they are not proficient in, since it is their second or sometimes third language. These teachers are not fluent in this language of instruction, therefore, communication between the teacher and the learner is limited and this often leads to misunderstandings (Evans, 2013). In an instructional context where intentional meaning should be made, this could have a destructive impact on learning (De Jager & Evans, 2013).

Often teachers feel uncomfortable teaching a language that they are not proficient in, so they tend to use questions that have set answers and avoid using questions that require reasoned thinking (Donald et al., 2014). This is not conducive to Mathematics learning as reasoned thinking and prerequisite for mathematical learning (Spaull,

2013). These teachers often must revert to traditional methods of teaching that they are comfortable with, repetition and memorization, and refrain from verifying learners understanding. In this case, the classroom becomes teacher centered (Graham, 2011) not the type of environment that promotes effective learning.

Needu (2012) states that research has also established that teachers who teach Mathematics prefer to teach in English rather than in the learner's home language since subject-specific terminologies are easier to pronounce in English. This has detrimental effects on the teaching of Mathematics because the use of the learner's mother tongue in the early years is vitally important (DBE, 2011a). According to the Zener Foundation (2007), poor language skills among teachers is one of the causes of underperformance in Mathematics. In Mozambique children also seem to battle to learn Mathematics because they do not understand the language of instruction, which is Portuguese (Zachmann, 2013). These learners speak local languages at home and when the lessons are presented in Portuguese, they struggle to understand what the teacher is saying or what they should in fact be learning (Jeronimo, 2018).

These teachers lack linguistic skills that are important for interpreting and understanding word problems (Donald et al., 2014). Nsamba (2008) explains that learners often develop problems in mathematical learning as they are taught in their home language in Grade 1-3 and they are instructed in English in Grade 4. Nsamba further explains that this late introduction of English into schools causes learners to experience confusion and thus become unable to understand what is expected of them with regards to learning.

According to the DBE (2011), language is important to learning because it is infused in all forms of learning. This also includes language that is mathematical, statistical or where scientific processes are involved. Language is the main tool that humans use for thought and communication and when it is effectively used, it enables learners to acquire knowledge, express their identities, feelings, ideas, interact with others and manage their worlds. From this statement one can conclude how important effective, easily understood examination language is in the teaching and learning of Mathematics (Donald et al., 2014).

3.2.6 Mathematics teachers' professional development workshops and training

According to Spaull (2015) because teachers of Mathematics lack content knowledge, Pedagogical Content Knowledge, skills and proficiencies that enable them to teach the subjects they teach, these teachers need to be continuously trained and encouraged to partake in professional development. Spaull (2015) explains that in order for teachers to improve their content knowledge and teaching skills they must undergo forms of development which would also serve to develop their competencies and confidence levels. This form of professional development will be instrumental in lifting the quality of teaching, especially in regard to the teaching and learning of Mathematics.

This sentiment was echoed by the Mathematics in Africa Summary Report (2014) which emphasized the fact that low mathematical performance can be attributed to a huge scarcity of skilled Mathematics teachers in South Africa. Van der Walt and Posthuma (2015) also elaborated on this situation and noted that although teachers understand the critical underachievement levels of Mathematics in the Foundation Phase, they do not have the valuable skills that are needed for intervention. The development would thus be needed to improve the teachers' understanding of Mathematics and assist to improve the teaching methods that they use to teach Mathematics in their classrooms. According to Umuginaneza and Bansilal (2017), in order for teachers to develop their existing teaching methods, develop a sound understanding of Mathematics and create new innovative approaches to teaching Mathematics, teachers need to continuously update what they know and the ways in which they teach. This can be achieved by orientation and training (Moodley, 2013).

Unfortunately, in South Africa, Mozambique and Bangladesh, Mathematics teachers feel that one of the reasons why they are not achieving success in the teaching of Mathematics is due to the fact that they have received little training in this regard (Moalosi & Molwane, 2012; Prodhan, 2016; Beutel, 2011). In South Africa, due to this lack of in-service training, many teachers feel that they are not competent to teach

parts of the mathematical curriculum and tend to only teach what they are comfortable with (Makeleni & Sethusha, 2014). Professional development or in-service training that was implemented before and after CAPS was provided in the form of workshops (Dreyer, 2017). These workshops were short courses that lasted for 3-5 days. These courses were designed to improve the teacher's knowledge and their teaching methods and give them a better idea as to what and how they were expected to teach. Unfortunately, many teachers felt that these courses were too short and had little or no impact on them (Armstrong, 2011).

According to Mamosa (2010), these workshops have been cited as being brief, fragmented, incoherent encounters that are decontextualized and isolated from real classroom situations. Often traditional approaches that are used to present the content at workshops (lectures read in a boring way) are not effective and have little impact on the teachers who attend the workshops. These workshops also lacked advice and guidance as to how teachers were expected to teach Mathematics to learners who have barriers to learning and require special needs support (Nel & Thale, 2015). According to Armstrong (2010), these workshops were unplanned and left teachers more confused than what they were before attending the workshops. Singh (2011) adds training sessions were not effective as insufficient time was allocated to these workshops; in order to complete them, they were rushed. Further, presenters were not familiar with the content that they were supposed to present, so they were unable to answer the questions that the teachers had.

According to Mata (2012), the facilitators were not forthcoming with ideas and failed to explain how the intended teaching practices were practically going to be implemented in classrooms. Singh (2011) also maintained that the training that was received was not continuous. Training must be intensive and continuous to develop a teacher's knowledge and skills (Armstrong, 2011). In order for this training to be effective, it needs to be for an extended period of time and not just for 3-5 days at a time. Taylor (2011) was also of the opinion that short-in-service courses do not seem to be very effective and teachers felt as if they needed to be presented with follow up workshops after the initial training sessions. These follow up workshops would ensure that the teachers were making progress and enable them to discuss the problems

that they were experiencing (Umalusi, 2014). Dada (2009) also expressed the fact that educators felt that they were not provided with enough support and they needed clarity on various aspects of the curriculum that they found confusing. Unfortunately, after being workshopped, they had even less clarity on planning, preparing and teaching.

Ongoing professional development is essential for the teaching and learning of Mathematics as it provides teachers with the opportunity to evaluate, modernize and broaden their responsibilities as transformation managers in teaching (Mkhwanazi, 2007). According to Mkhwanazi, this professional development helps teachers to expand their knowledge, skills, attitudes, and values with regards to the teaching and learning of Mathematics. This needs to be an ongoing change that will enhance teachers' learning so that they will, in turn, be able to teach learners more effectively.

Teachers feel that the DBE does not support them enough when it comes to finding solutions to the teaching of Mathematics in diverse classrooms. According to Bernstein (2015), the DBE cannot always offer relevant support to teachers, as they have limited funds and advisers in some of the districts. Financial constraints and limited staff mean that the Department is unable to provide the relevant amounts of support and monitoring that teacher's need in schools today. Issues have also been raised as to how officials at district levels go about ensuring the accountability of schools and teachers and ensuring development (Plowright, 2007). According to Mbeshu (2010), support in teaching is vitally important as a lack of support can hinder effective co-operation in assessing teachers' work. When teachers feel that they are fully supported in their endeavors, they work harder and produce the results that are expected of them.

3.2.7 Mathematics teacher's workload

The current workload of teachers has vastly increased in recent years as not only are they now expected to teach formal lessons, but also have to help children with the basics (homework, reading, additional Mathematics, writing, projects, home visits,

taking children to the clinics, social workers and police stations) which should be the responsibility of the parents (Bantwini, 2010).

Moreover, much more time is needed for planning and preparation (Erden, 2010). This often leads to teachers having to work long hours after they have finished with the actual school day. According to the AN Nut Guide (2012), paperwork has become a burden to many teachers. They spend excessive amounts of time on paperwork and administration tasks which consumes non-teaching time, weekends and holidays.

Wood (2007) highlights how extensive these workloads of teachers have become by emphasizing what teachers' jobs entail. Woods (2007) found working days for teachers include normal teaching of lessons, financial responsibilities (collecting money and keeping record of it), completing registers, filling in documents and compiling files, fundraising, planning and preparing lessons, belonging to various committees, extra co-curricular activities, assessments, setting tests and examinations, marking of books and implementing intervention programmes. They are then expected to attend meetings and workshops after hours and often in the holidays. Mauvso (2013) explains that teacher's workloads have increased due to the increased pressure that is placed on them to do more in less time and be responsive to a greater range of demands from external sources to meet a range of targets that are driven by deadlines. This, unfortunately, leads to teachers having less control of their planning, decision making, and classroom management. This is often compounded by the fact that the teachers have to deliver positive results irrespective of the environment, lack of suitable space and limited resources.

Often this increase in workload leaves teachers questioning why they have to engage in so many unnecessary tasks that do nothing to support or improve learning (Mauvso, 2013; Dada, 2009). Duplication of various administration tasks often leads to the teachers being frustrated; they cannot see the logic behind repeating certain activities over and over, especially tasks that have no bearing on mathematical teaching and learning.

3.2.8 Overcrowded classrooms: How does this impact on the teaching and learning of Mathematics?

Overcrowding in classrooms often leads to serious discipline problems. This is very prevalent in learner-centered Mathematics classrooms when discussions need to take place to ensure that effective learning takes place. Often this overcrowding of learners into a classroom leads to learners lacking concentration during instruction (Bak, Behardien, Marrow & Pendleburg, 2017) and administrating tests without learners copying is virtually impossible.

According to Bak et al., (2017), these learners do not think or reason to arrive at an answer, they simply ask the person next to them or just look at their answers. This is not conducive to mathematical learning as thinking and reasoning is an important part of mathematical learning (Donald et al., 2014). Often these teachers in overcrowded classrooms tend to avoid using group activities for problem-solving (Bak et al., 2017) due to limited space, the intense noise level and disciplinary problems. This is detrimental to mathematical learning as problem solving is at the heart of understanding Mathematics (Landsberg et al., 2016).

The noise level in such a classroom may cause learners to withdraw or not to pay attention. Group work is constantly disrupted when a teacher pays individual attention to a learner who is struggling, and the rest of the group is supposed to continue working on a problem on their own (Bak et al., 2017). In such classroom's teachers find it impossible to give all the learners individual attention. In overcrowded classroom the biggest problem is maintaining discipline. So, when things get out of hand, inexperienced teachers resort to using methods where children remain passive in a lesson (Mtika, 2010). This is not conducive to teaching Mathematics in a constructivist manner as active engagement and participation is a prerequisite for allowing learners to construct their own knowledge and understanding (Erikson, 2016).

The biggest problem in most cases with maintaining discipline is that teachers do not possess the necessary skills or are unqualified to deal with large numbers in a class (Treu, 2010). Teachers who have disciplinary problems feel that they are being overpowered by their learners (Treu, 2010) and left despondent and unmotivated. Disciplinary problems have intensified (Naong, 2008) due to the abolishment of corporal punishment. Learners perceive that they are now able to do as they please as they are not afraid and disrespect authority (Naong, 2008).

The biggest problem for Mathematics teachers in the Foundation Phase is that learning is expected to occur by using group activities, but using groups is often impossible because of space (Mulaudzi, 2009). Constructive teaching is often avoided as the noise level is often unbearable in overcrowded classrooms (Dixon, 2008). Violence in overcrowded classrooms also disrupts teaching and learning (Thompson, 2012) as learners become distracted and look for ways to keep themselves busy; this may include walking around, hitting each other and taking things that belong to others. Another problem that emerges from overcrowding is that there is a limited interaction between the teacher and each individual in the class (Baruth, 2009) and children who are battling to understand concepts in Mathematics do not get the support or assistance that they require.

3.2.9 Lack of resources and teaching materials

A lack of resources and teaching materials is a formidable challenge faced by teachers in South Africa and a cause of underperformance in Mathematics (Van der Berg, 2008). This problem is also prevalent in other countries such as Mozambique and Bangladesh (Prodhan, 2016, Beutel, 2011). Moore (2007) mentions that the resources lacking in classrooms are textbooks, stationery and paper and of sufficient classrooms. According to Peter (2014) teachers are dependent on instructional material to bridge the gap between theory that they teach and how this theory is put into practice. Unfortunately, teachers are not provided with sufficient teaching materials or resources and these teachers then have to create their own instructional materials from improvisation (Nyawira, 2015). Having adequate, relevant instructional materials in classrooms leads to more effective teaching and learning.

In the researcher's view and experience, teachers are not provided with the resources they need to improve teaching and learning. Often the teachers are not provided with pencils, paper, laminating sleeves, plastic, charts, crayons or other supplies that are needed to improve teaching practices or to allow the learners to be able to complete activities. This lack of school-provided resources leads to teachers purchasing these items, as without them teachers cannot do their jobs effectively. Making resources from improvisation can often be done by using recycled products, but it often requires a teacher to purchase some items that are needed (Peter, 2014). Even if the learners are asked to bring some items from home or to buy certain stationery items, the parents refuse to do so.

Other resources that lack at schools are ink for the printers, ink for the Duplo copiers and toner for the Photostat machines. Often these machines are not working and fixing them takes a long time. Teachers complain that time constraints prevent them from making resources to use in their mathematical classes (Long Dunne, 2014). Teachers also complain that they do not know how to make mathematical resources as they have not received training in this regard (Badugela, 2012).

The supplying of textbooks and workbooks is also a big problem in mathematical classrooms. These books arrive late, are not enough for all the learners in the class or do not arrive at all. According to Moodley (2013), this should not be the case as the President in 2011 stated in his address of the nation's speech stated that each learner should have a textbook on time. According to SAID (2011), the ratio of textbooks to learners in a Mathematics classroom is 1:2. This means not all learners o have a textbook that they can take home to practice activities out of or prepare for tests or exams, resulting in underperformance in Mathematics.

According to Van der Nest (2012), schools in South Africa also lack adequate facilities like toilets, sports fields, libraries and sufficient classrooms. Blignaut (2007) found that some schools in South Africa have no doors, windows, chairs, desks, sanitation or running water. This lack of resources leads to frustration for teachers and learners alike (De Waal, 2004). Baruth (2009) found that teachers are not keen to work in poor

teaching conditions as it generally leads to stress. Panthi and Belbase (2017) explained that schools not only lack resources, but also lack teaching aid material and technological tools for the teaching and learning of Mathematics and are in dire need of more textbooks and workbooks. This is detrimental to mathematical learners, who are visual learners as they learn by seeing (Landsberg et al. 2016).

In order to be able to address these deficits in resources and teaching materials, all the stakeholders in mathematical teaching and learning need to pay careful attention to possible solutions that may resolve these challenges that teachers face (Panthi & Belbase, 2017). These stakeholders should ensure that schools are adequately supplied with financial resources, good physical structures and access to utilities and services (Bethell, 2016). Educational stakeholders need to ensure that there is adequate teaching and learning materials and qualified, well trained, motivated teachers. Unfortunately, this form of quality will not be accomplished overnight (Bethell, 2016) and the government should sustain its efforts over the long-term as there is no quick fix in terms of improving current situations in schools. This now brings the researcher to the successes that have been achieved in mathematical learning by Grade 3 teachers.

3.3 SUCCESSES IN TEACHING MATHEMATICS

In this section the researcher will discuss the learner's performance in Mathematics, intervention programmes that improve the teaching and learning of Mathematics, workshops that improve teaching approaches and methods for Mathematics teachers, professional development for Mathematics teachers in Grade 3 in the form of training and workshops and ways of developing of a teacher's Pedagogical Content Knowledge.

3.3.1 Learner performance in Mathematics

The ANA results indicate t slight improvements in Mathematics over the three-year period, but unfortunately these results have been questioned due to validity and reliability issues (NEEDU, 2013; Spaull, 2013). These results whether reliable or not

(Zenex Foundation, 2014) have caused the government to shift their focus to intervention programmes for numeracy in primary schools.

3.3.2 Intervention programmes to improve Mathematics teaching and learning which assist to improve the teaching and learning of Mathematics

According to UNESCO (2012; 2014) in order to improve mathematical instruction in a developing country like South Africa, a definite shift would have to be made towards newer Mathematics programme designs. Lake (2007) and Fleish (2014) indicate that the main focus for change in mathematical improvement needs to be instructional change, thus many programmes have been launched in South Africa to improve Mathematics improvement (UNESCO, 2012).

One of the interventional strategies that has been implemented to improve numeracy is the Numeracy Inquiry Community Of Leader Educators (NICLE) Program ((Piper, Ralaingita, Akach & King, 2016).This is a SANC project that is hosted after school in Mathematics clubs, in order to support Mathematics development and primarily focuses on Grade 3 and Grade 4 learners (Piper et al., 2016).These after school projects are effective in Mathematics achievement as they move away from using workbooks and other factors that constrain remediating of learning of Mathematics in classrooms. The SANC projects work with teachers in NICLE to develop foundational numeracy in primary schools. These groups have been successful in academic achievement in Mathematics because they are conducted in open spaces and not in classes that are overcrowded with little space to move between desks, individual attention can be given to learners because of the small groups that attend these classes. An improvement in Mathematics can also be achieved as these classes are devoid of disturbances that occur during school hours. Specific learner needs, competence levels and learner disposition are important focal points in these clubs.

3.3.3 Workshops that improve teaching approaches and methods for Mathematics teachers

NICLE have also introduced workshops that explain to teachers how to teach Mathematics in new, exciting and innovative ways, test theories, test out new activities, and discuss frameworks and assessment and ways of recovering early numeracy concepts (Piper et al., 2016). According to Stott (2014), these workshops form a safe place where teachers can try out pedagogical approaches. These clubs have become very important as they provide empirical fields for future studies (Stott, 2014). S.T.E.M. projects have also recently introduced in South Africa (Knight, 2018) which boost science, technology, engineering and Mathematics. These subjects have to be developed if South African learners are to realize their full potential in the competitive global market that is shaped by technology (Bethell, 2016). In South Africa another strategy that has been implemented to improve mathematical teaching and learning is 1+4 teacher development plan (SAID, 2011). This plan ensures that Mathematics teachers meet regularly to discuss strategies and teaching methods that work.

In the school that the researcher is currently teaching at in Daniëlskuil town, together with five other schools, has formed a Mathematics league for Grade 4-8 learners. These learners compete against each other by writing mathematical tests which teachers prepare in advance. The learners who do the best in each grade receive a cash prize that is sponsored by the mines in the area. A school in this research study established a School Improvement Plan, which is an after-school homework group where teachers from different grades supervise and assist learners especially with Mathematics homework. These intervention programs have had an impact on mathematical improvement (Prichett, 2012) and without these extensive and sustained interventions across all phases of education, the gap or deficit that occurs in Mathematics will never be narrowed.

3.3.4 Professional development for Mathematics teachers in Grade 3 in the form of training and workshops

The professional development of Mathematics teachers in South Africa is currently not very effective as it is not continuous and does not allow teachers to improve their

Pedagogical Content Knowledge, competencies and new skills to teach the group of diverse learners in their classrooms (Teacher Education, 2010). According to Teacher Education (2010), in most cases teachers leave these workshops with no new knowledge or skills as the sessions are extremely rushed and leave little or no time for asking questions or practical demonstrations (Demonte, 2013). According to Ono and Ferreira (2010), these workshops were brief, fragmented, and incoherent and failed to address the realities and challenges that hinder the teaching and learning of Mathematics in their classrooms.

According to USAID (2011), the reform of initial training is vitally important and the existing work teaching force should not be neglected. This can be achieved by strengthening existing in-service teacher training programmes for Mathematics teachers (USAID, 2011). According to Walter and Biggs (2012), professional development is of utter importance to teachers because it is concrete and classroom-based, brings expertise from outside the school, enables teachers to work collaboratively with their peers and provides teachers with opportunities to partake in mentoring and coaching activities. Walter and Biggs (2012) explain this type of development as being sustained over time and being supported by the school leadership.

Maintaining discipline in large classrooms is one of the challenges that teachers face when teaching Mathematics (Herzallah & Nesane, 2011) and teachers lack the skills they need to teach in such classrooms (Creemers, 2008). In order for teachers to be able to teach Mathematics in an effective way while maintaining discipline, interventions have to be put in place that will ensure that effective discipline will take place (Coetzee & Van Niekerk, 2015). Louw and Du Toit (2010) identify a number of key factors that will help a teacher to maintain effective discipline in a teacher's classroom. They are as follows:

- A teacher should be proactive in their management style in their classrooms, while at the same time creating a learner-centered classroom, which monitors learners at all times.
- The teacher should tell the learners beforehand what the learning objectives will be for each new learning experience and the lessons that the teacher uses should be carefully planned.

- The teacher should be prepared for each Mathematics lesson and know exactly what they are going to introduce at what time. Teachers who work according to a well-planned lesson are more confident in teaching and do not waste time by flipping through textbooks to find something to teach or by running out to make Photostat's (Reed & Michaud, 2010).
- The rules for discipline should be positive and be set through consultation; punishment should be in line with the school's code of conduct.
- Teachers need to deal with problems as they happen.
- A teacher should deal with all learners in a respectful way even when trying to enforce discipline.

According to Coetzee and Van Niekerk (2015), to maintain discipline in a Mathematics classroom, where there is a large number of learners, teachers should not sit down while they teach. They need to act as a facilitator, guide, and support to the learners as they construct knowledge and find solutions to various Mathematics problems (Bhattacharjee, 2015). The teacher also should have a set of rules that the learners should follow, consequences for breaking rules and a system to reward learners when they follow the rules (Coetzee & Van Niekerk, 2015). The teacher should not feel despondent when not being able to deal with discipline problems (Motseke, 2005) but should ask for assistance from the school management team (Louw & Du Toit, 2010). The parents should also be informed about the learner's transgressions.

3.3.5 Developing teachers' Pedagogical Content Knowledge

Teachers of Mathematics in South Africa lack Pedagogical Content Knowledge (NEEDU report, 2013) and to remedy this, these teachers need to attend workshops, seminars, conferences or courses (Ono & Ferreira, 2010). According to USAID (2011), professional development programmes are essential for developing a teacher's pedagogical skills that are essential to the teaching and learning of Mathematics. In South Africa, the importance of teachers possessing pedagogical knowledge in Mathematics cannot be ignored if teachers are to understand the levels of understanding that their learners may display (SAID, 2011).

Training and professional development (especially in Mathematics pedagogical knowledge) are vitally important for teachers, in order for skills improvement, teaching and the improvement of learner activities in Mathematics (Bantwini, 2010). This training should be continuous (Mamosa, 2012) so that knowledge that is gained can be practiced in classrooms (Singh, 2011) and taken back to training sessions to evaluate if what was learned had an effect on mathematical achievement. The professional development of Mathematics teachers will allow the teachers to teach more confidently as they will obtain the knowledge to implement the changes in the Mathematics curriculum effectively (Bantwini, 2010) and not feel obliged to teach only the parts of the curriculum that they are comfortable or familiar with (Meyer, 2010). The development of teacher's pedagogical knowledge will assist with improving the academic performance of mathematical learners in South Africa (Spaull, 2013).

This now brings the researcher to the last sub-question of the research study which is various strategies and suggestions that can be made to improve teacher's proficiency in teaching Mathematics.

3.4 STRATEGIES TO IMPROVE TEACHERS' PROFICIENCY IN TEACHING MATHEMATICS.

Current research on Mathematics teaching and learning suggests that it is critical that learners be able to build a deep understanding of Mathematics alongside procedural fluency which needs to be taught by using a variety of methods and techniques (Sarama, 2009). These techniques should focus on teaching Mathematics in a more collaborative, exploratory way (Walter & Briggs, 2012).

The teaching methods that a teacher chooses to use to teach Mathematics should push the learners to talk about Mathematics, use appropriate math's vocabulary and extend their learning (Sinay & Nahornick, 2010). Teachers in Mathematics classrooms need to encourage Math's talk and to foster Mathematics dialogue in their classrooms (Student Achievement Division, 2011). In Mathematics classrooms teachers need to promote the use of problems that have meaning for young learners, allow for the use of creativity in their classrooms, encourage, and support different

problem-solving methods and the use of scaffolding to help learners to make connections in Mathematics (Student Achievement Division, 2011). A teacher should always use a teaching strategy towards achieving conceptual understanding (Sinay & Nahornick, 2010).

3.4.1 Teaching towards conceptual understanding

According to Sinay and Nahornick (2010), a teacher needs to teach towards conceptual understanding in Mathematics classrooms. This is a prerequisite for the teaching and learning of Mathematics, but teachers in Mathematics classrooms often just focus on drills and procedural understanding (Protheroe,2007) even though the Mathematics curriculum has been designed to help students build a solid conceptual foundation in Mathematics that will enable them to apply knowledge and further learn successfully (Sinay & Nahornick, 2010). Thus, memorizing of Mathematics is not sufficient to developing understanding.

Teachers need to teach learners to understand the concepts behind the procedures in Mathematics. This can be achieved by asking students to connect procedures to underlying concepts (Wathall, 2016) and by asking the learners to justify the processes they use (Rittle-Johnson & Schneider, 2014). Learners also need to be allowed to work on interesting problems that will allow them to generate solutions (Lawson, 2016) and facilitate multiple representations through student interaction (Suurtamm, 2015). A teacher can teach conceptual understanding by encouraging learners to compare alternate solutions and methods (Schnieder, 2014) compare incorrect procedures (Rittle-Johnson and Schnieder, 2014) and be given enough time to work on unfamiliar problems. A teacher also must teach Mathematics by teaching reasoning skills to the learners.

3.4.2 Teaching reasoning skills in Mathematics

Teaching reasoning skills is an important element that a teacher should consider when choosing a teaching strategy for the teaching of Mathematics. According to Rittle-Johnson and Jordan (2016), by improving learners reasoning a teacher may improve a learner's mathematical abilities. Reasoning skills in Mathematics include a learner being able to identify similarities and differences, shape or size (Carlson, 2013).

3.4.3 Promoting problem-solving in Mathematics classrooms

Strategies that teachers choose to teach Mathematics should include problem-solving (Sinay & Nahornick, 2016). According to Suurtamm (2015), problem solving is the building block for the learning of Mathematics. Through problem-solving learners can be given numerous opportunities to connect mathematical ideas and develop conceptual understanding. Learners should be presented with work that is interesting, and rich in mathematical problems. It is important for teachers to present mathematical problems to learners that are complex, allows for multiple entry points, uses different approaches to find solutions to problems and provide scaffolding that engages learners without imposing procedural steps (Suurtamm,2015).

According to Suurtamm (2015), learners need to be given open-ended problems to solve that will present these learners with a variety of problem-solving methods and allow these learners to arrive at a variety of answers. Allowing learners to engage in activities that require critical thinking will help these learners to improve their sense-making skills because they are forced to work on unfamiliar situations. Students should be encouraged to create and solve their own problems (Barwell, 2011) and compare the way they solve problems with their peers (Rittle-Johnson & Jordan, 2016).

3.4.4 Use strategies in the Mathematics classroom that promote collaboration

Teachers in Mathematics classrooms need to support collaboration in Mathematics. Collaboration in Mathematics is an important way to foster Mathematics understanding and increase a learner's confidence in Mathematics (Wallace, 2009). According to Wallace (2009), to encourage collaboration in a Mathematical classroom a teacher needs to create an environment where learners feel comfortable to collaborate, share, explore, think mathematically and to improve their confidence in Mathematics (Suurtamm, 2015).

3.4.5 Use strategies that promote mental Mathematics activities

According to Sinay and Nahornick (2016), a teacher needs to include mental Mathematics in their teaching and learning of Mathematics daily. This should occur every day for 10-15 minutes and should include examples that are found in the everyday lives of learners.

3.4.6 Using cooperative learning and group learning to solve problems in Mathematics

A teaching strategy that can be applied to teach Mathematics is cooperative learning where group work is used to solve problems in Mathematics. According to Du Toit (2010), cooperative learning is a synthesis of work that is done by individuals and each learner is accountable for their own learning. Each member of the group is dependent on the other members of the group to accomplish specific tasks and this contributes to the overall success of the group. According to Killen (2014), cooperative learning is an effective way to help learners develop core skills that they will need in future. This may include the developing of a learner's research abilities, develop the learner's abilities to think creatively and assist learners to develop problem-solving skills collaboratively by working in groups.

According to Landsberg et al. (2016), these groups need to be structured in such a way that the group members can coordinate their own learning activities and in doing

so will facilitate one another's learning (Ballantine & Larres, 2007). These groups need to be specifically planned to be able to integrate the abilities, gender, and cultures of all the learners in the classroom (Louw & Du Toit, 2010). These groups encourage joint learning through social interaction, create a community of enquirers in a classroom, help foster respect between the learners and the teacher and provide opportunities for the learners to participate with each other (Louw & Du Toit, 2010).

Louw and Du Toit (2010) explain that these groups also need to be structured in such a way that allows learners to be in charge of their own learning, allows each learner to voice their opinions and improve their understanding, improve the learners 'listening and speaking skills, improve the learners' organizational skills and assist learners to improve their reasoning skills. Using group work to solve problems is an important part of mathematical teaching (Wilson, 2014).

3.4.7 Using groups to solve problems in Mathematics

According to Koblitz and Wilson (2014), solving problems in groups involves each learner in the group contributing to solving the Mathematics problem, by listening to each other and by reflecting on each other's ideas. All the learners should understand the work that is done in the group and the learners need to discuss the problem they are working on (Webel, 2013).

According to Webel (2013), effective group work involves the collaboration and sharing of mathematical ideas while the learners support each other. In group work, all the members in the group have to resolve disagreements together and collect ideas together. Members in the group assist other members who battle with concepts or find it difficult to find solutions to problems. Working in groups to solve mathematical problems can enhance high order thinking skills and improve the problem-solving skills of the learners (Allen, 2012).

According to Allen (2012), when learners work in a group and interact mathematically and socially, the learners get the opportunity to express their thinking, exhibit deeper understanding and improve their retention of concepts in Mathematics. Learners also

improve their own mathematical strategies by incorporating the ideas of their peers into their own problem-solving strategies. Working in groups teaches the learners to communicate with each other, use objective facts and function in a team environment. According to Killen (2014), group work also helps to shift the focus from learners being passive recipients of information to being active seekers of understanding. It assists with the retention of various concepts and enhances learner achievement (Willis, 2006). It is also a useful way to activate a learner's prior knowledge and help them reconstruct the meaning of the subject matter they are studying (Sousa, 2016). In this context, the subject matter refers to subject matter that pertains to the learning of Mathematics.

Group work is also beneficial to teachers in a Mathematics classroom as it allows a teacher to focus on the needs of a small group of learners while the other learners in the classroom are actively engaged. It allows the teacher to vary learning tasks for different groups of learners and thus allows the teacher to adapt the work according to the needs and abilities of the learners, without making the differences obvious to other learners in the classroom (Killen, 2014). Group work also allows the teacher to circulate and check the understanding of individuals in the class. Due to the fact that equipment is limited in most Mathematics classes, the use of rotation ensures that all learners will get a chance to use the equipment (Killen, 2014).

According to Killen (2014) group work in Mathematics classrooms is vitally important as it develops thinking and reasoning skills, helps learners to analyze situations, apply their existing knowledge to new situations and helps learners to be able to recognize the difference between facts and opinions. Group work can also encourage the learners to make objective judgements, make sense of the subject and develop higher levels of comprehension. Learners in these groups should talk about and evaluate their own understanding, identify flaws in their own thinking, develop interpersonal skills and keep natural curiosity alive.

Although strict rules are not applied during problem-solving sessions the lesson still should be well structured and the teacher should let all the learners know what is expected of them when they work together (Gonzalez, 2014). It is thus obvious from

the discussion above why problem-solving is deemed to be the building block of math's learning (Sinay & Nahornick, 2016).

3.4.8 Using groups to solve problems in Mathematics.

Discussion can also be used as a strategy to teach Mathematics (Bell & Pape, 2010). Discussion can be used to create opportunities for learners to incorporate their peer's reasoning into their own thinking and this can help to create a better understanding of Mathematics (Mueller, 2009). Discussing mathematical concepts and problems helps the learners to make mathematical connections and makes the learners aware that there are different ways in which a task can be completed. Learners use questions and the connections they form to gain a deeper understanding of Mathematics concepts and to make sense of mathematical ideas that occur within the context and abstractly (Common Core State Standards Initiative, 2010).

According to Stols (2008), discussion in a Mathematics class can be useful as it serves as a way in which learners can talk about alternative strategies with their teacher, observe alternative ways of examining a situation, learn through misconceptions that are made and allow the learners to interact meaningfully while they construct knowledge and form a deeper level of meaning.

According to Brookfield (2006), discussions help learners to solve problems and encourage them to explore open-ended issues. It also helps the learners to discover different approaches to solve problems and share their ideas as they work in groups. Discussion helps learners to master the general subject matter, develop problem-solving abilities and develops communication skills. Discussion is important in the teaching and learning of Mathematics as each learner should be able to verbalize his/her reasoning (Bell & Pape, 2010).

3.4.9 Using a learner-centred approach to teach Mathematics

The reform of the Mathematics curriculum demands a shift from the traditional teacher-centred approach to a learner-centred approach as it promotes Mathematics learning (Mhlolo, 2013). According to Armstrong (2012) in this approach, the teacher should be able to select the methods and the basis of a shared analysis of a learner's needs to use local and natural resources as an alternative or supplement to ready-made study materials and thus develop their own learner's creativity. A learner –centred approach demands a high degree of learner participation, contribution, and production. In learner-centred classrooms, the learners are the main focus in the teaching and learning process and are actively involved in their own construction of knowledge and learn by doing, engaging, interacting and exploration (Gupta, 2016). The learners should be guided and supported by the teachers.

A learner-centred approach maintains teachers have a holistic view of the learners, valuing the learner's life experience as the starting point for their studies. The Education Alliance (2006) states that in order to improve the teaching of Mathematics, teachers should use cooperative learning strategies to make real-life connections. Questions should be posed to the learners to justify their responses to problem-solving, emphasis should be placed on developing the learner's computation skills. Learning activities should not be teacher-centred but should focus on the learner and provide experiences that learners can build on their prior knowledge. Teachers should provide conceptual understanding to the learner and help develop the learner's procedural literacy that is essential in Mathematical education. Teaching strategies that improve Mathematical teaching and learning should provide the learners with challenges that stimulates their curiosity, promotes investigation and encourages learners to actively participate (Protheroe, 2007). In regard to Mathematics, these strategies can be improved by using group work in which students gain the opportunities to find solutions to problems that bear resemblance to their everyday lives (Allen, 2012).

3.5 TEACHERS NEED TO PREVENT ANXIETY IN A MATHEMATICS CLASSROOM IN ORDER FOR THE LEARNERS TO LEARN EFFECTIVELY

To enable for learners to learn Mathematics effectively, they should be anxiety free (Landsberg, Kruger & Swart, 2016). If learners are afraid, they lack confidence and fail to deliver their best work (Valardi & Rice, 2014). Teaching strategies should be used to reduce this anxiety (Blazer, 2011).

The researcher will now discuss a few teaching strategies that can be used to reduce math's anxiety (Blazer, 2011). Teachers can reduce Mathematics anxiety by relating Mathematics to real life situations in a learner's lives. These connections of everyday applications can help learners relate to Mathematics and assist them to realize that Mathematics skills can be used in real life situations. By encouraging critical thinking and not relying on memorization and rote repletion, instead of understanding, a teacher can reduce anxiety in Mathematics. When learners are taught with an emphasis on drill and practice and do not understand, they become confused and anxiety sets in. Teachers should present Mathematics as a thinking and decision-making tool and encourages learners to think critically (Geist, 2010).

To reduce stress and anxiety in a Mathematics classroom a teacher should encourage the learners to participate in active learning, accommodating the various learning style in their classrooms, modifying their teaching practices to ensure that all learners experience success in Mathematics, use visual aids, discussions, hands-on activities and technology. Teachers can avoid cause anxiety by allowing learners to solve problems by using their own strategies and not force them to complete their tasks in a rushed manner (Geist, 2010). Learners should also not be placed in situations where they will feel embarrassed or threatened. Lower-performing learners should not be asked to work out questions on the board or be singled out to answer questions in the class. The teacher needs to find alternative ways for these learners to participate in class until their confidence levels improve (Boaler, 2015).

Anxiety in Mathematics can be avoided by using cooperative groups. It these groups the learners are allowed to express their feelings, through ideas, ask questions freely, justify answers and debate processes in a non-threatening environment. A teacher needs to be patient, not use derogatory comments and offer support and encouragement. A teacher in a Mathematics classroom should also ensure that they have a

high level of Pedagogical Content Knowledge and well-developed skills as this will demonstrate confidence to the learners and make them feel more confident when dealing with Mathematics. A teacher that possesses a positive attitude in teaching Mathematics will have a positive effect on the learners in the class and this can lead to effective teaching and learning (NEEDU, 2013).

3.6 CONCLUSION

From the literature that has been reviewed, it is evident that many challenges exist in respect to the teaching and learning of Mathematics, and although interventions have been put in place to alleviate these challenges, much more will have to be done to narrow the gap in Mathematics performance (Prichett, 2012). These shortfalls in education will not be addressed without the active participation and engagement of all the perspective shareholders that form part of the education process in South Africa (Chisholm, 2011; Bethell, 2016).

In respect of teaching Mathematics, the reason for underperformance has been long debated and stakeholders have struggled to trace the causes for this underperformance (Doozie, 2015). The key shareholders in the educational sector are unsure who to blame but lean towards blaming the teachers or the learners in Mathematics classrooms (Doozie, 2015). This occurs at national and government levels and the teachers are often objects of the blame (Price, 2014). However, after critical analysis, it has been determined that everyone should take the blame (Doozie, 2015). Teachers should not be the sole focus of the blame as the failure of the education system cannot be placed on the shoulders of one group of individuals, but on the shoulders of all stakeholders (Price, 2014).

Evidence has been presented to show that the DBE is beginning to address the root causes of underperformance in Mathematics (Spaull, 2013) but many issues remain. These issues must be seriously addressed by the ruling administration and DBE regardless of the political or economic cost or existing patterns of underperformance and inequality will continue (Spaull, 2013). The underperformance of Mathematics in South Africa should

become the concern of all the respective shareholders in the education system who should accept accountability (Price, 2014). If each person does his/her part to improve the situation, the education system will improve.

In the next chapter the research design and methodology that was used in this research study will be presented.

CHAPTER 4
THE RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

This chapter provides a detailed explanation of the research process, design and methodology that was used to explore primary teacher's views regarding the teaching of Mathematics in Grade 3 in Daniëlskuil town in South Africa (Creswell, 2013). The chapter further gave a better understanding of how participants were sampled in order to collect data using semi-structured interviews, documents analysis, and non-participatory observations. This chapter outlined the delimitations, limitations, trustworthiness and ethical considerations of the study. The research paradigm is outlined in the ensuing section.

4.2 RESEARCH PARADIGM

According to Creswell (2010) a paradigm is a collection of what people believe or their assumptions of how they view reality and form a particular view of the world. It deals and confronts assumptions that have been formed on faith, beliefs about nature of reality (ontology) the relationship between what a person knows and the person themselves (epistemology) and the assumptions that are held about the methods that are used for research (Creswell, 2010). Schwartz and Ogilvy (1979) explain a paradigm to be a way which enables the researcher to tell a coherent story by perceiving the world to be meaningful, functional and culturally subjective. It serves as a lens by which principles are organized to interpret reality.

According to Guba (1990) research paradigms can be formed and characterised through ontology (What is real?) epistemology (How we know something) and methodology (How we go about finding something out). Chua (1986) highlights three types of research paradigms that are used in qualitative research namely the positivist, interpretive and critical theory paradigms.

According to the Leong (2008), the positivist paradigm asserts that real life events can be observed empirically and explained by using logical analysis of such events;

it predominates in science and posits that independent facts pertaining to a single reality can be quantitatively measured (Krauss, 2005). Data that are analyzed is value-free and do not change merely because they are being observed and in the process the researcher gets to view the world through a one-way mirror (Healy & Perry, 2000).

This paradigm supports the position that the goal of knowledge is simply to describe a certain phenomenon that someone experiences. Healy and Perry (2000) explain that a positivist sticks to only things that can be observed and measured and that knowledge that is acquired in any other form is simply impossible. Another viewpoint of a positivist is that they can detach themselves from the world they study and use scientific observations and measurements to depict what is happening in the social world, by simply finding regularities and casual relationships between constituent elements (Burrell & Morgan, 2000). According to Angen (2000), Creswell (1998) and Guba, (1994) a positivist paradigm uses general patterns of cause and effect as a means to control a natural phenomenon and relies on hypothesis generation and testing, using experimental and manipulative methods as well as numbers to conduct its research. In a positivist paradigm reliability of results can only be achieved by replicability (Cohen, 2003) and the consistency of the data results that have been achieved (Perry, 2005).

The second paradigm is critical theory. According to Nieuwenhuis (2010) critical researchers are of the opinion that social reality is only created historically and is later produced and reproduced by people. It is also assumed that this reality is created and shaped by social, political, cultural, economic, ethnic and gender-based forces which occur over time in various social structures (Angen, 2000, Creswell, 1998, Guba, 1994). The main aim of critical research is one of social critique which generally focuses on contest, conflict and contemporary society and attempts to get rid of alienation and domination that exists within society (Niewenhuis, 2010). Within this paradigm the researcher uses a lens to critically analyze a system from a subjective view point and observations that are made are not subjected to empirical verification (Niewenhuis, 2010) but are subjected to particular rules that occur in a historical period and thus decide what counts as scientific facts and which do not. In this type of

research, it is the role of the researcher to find hidden ideologies that exist in society and critique them.

Angen (2000) explains that critical theory aims at providing feedback to society, challenging the fact that the data which is gathered in research is neutral. This is often done without society being conscious of the fact that their needs and struggles are being disclosed. A critical researcher also follows the belief that our conceptual system and how society defines society is created through language (Niewenhuis, 2010) and how we use language influences and limits the observation process thus the stability of a language system will produce stability within a shared reality.

The last paradigm that warrants discussion is the interpretive paradigm. According to USC-Research Guides (2017), interpretive paradigm is an approach to studying people particularly in social sciences that starts from the position that the subject matter that is studied is inherently different from non-human subjects. According to Creswell (2016), interpretivism foregrounds the meaning that individuals or communities assign to their experiences, including intersubjective meanings that are crucial to achieving understanding and meaning. It also makes no distinction between the subject (the researcher) and the object (the event being studied); it recognizes the fact that behaviour is constituted by social conventions and needs interpretation as the facts do not always speak for themselves. Creswell (2016) explains that the interpretive paradigm takes into account the social context, conventions, norms and standards of the particular person or community as a crucial element in assessing and understanding human behaviour.

This study employed an interpretive paradigm since it seeks to explore primary school teachers' views regarding the teaching of Mathematics in Grade 3 in Daniëlskuil town in South Africa. The researcher viewed this interpretive paradigm as being suitable for this study since it allowed the researcher to gain better insight and understanding of the Grade 3 Mathematics teacher's views, approaches and strategies used in the teaching and learning of Mathematics. It also allowed the researcher to probe and gain a better understanding of the Grade 3 teacher's behaviours and attitude towards Mathematics, enabling the researcher to effectively answer the research question

through evidence (USC-Research Guides, (2017). This chosen strategy also enabled the researcher to gain a contextual understanding of the research topic and the data to be collected specifically from Grade 3 Mathematics teachers in primary schools in Daniëlskuil.

According to Creswell (2016), the interpretive perspective is based on the following assumptions: Human life can only be understood from within. Human life cannot be observed from some distant external reality but focuses on how a person constructs meaning of their social worlds by sharing their own individual meaning while interacting and relating with each other. Social life is a distinctively human product. By observing people in their social contexts, a better understanding is gained on the perceptions of their own activities. The human mind is the purposive source or origin of meaning. Through exploring the researcher can develop a deeper understanding of the meanings that are imparted by people to phenomena and their social context. By understanding how meanings are constructed the researcher gains insight into the meanings that are given and by doing this, improve our own comprehension of a given situation.

Human behaviour is affected by their knowledge of the social world. The interpretive paradigm proposes that there is more than one answer as to why a phenomenon occurs and realities differ across time and place. The researcher will thus gain a better understanding and knowledge as they construct realities. The social world does not exist independently of human knowledge. Researchers own knowledge and understanding of phenomena constantly influences the questions we ask and the way in which we ask them. Our knowledge and understanding are often limited to our own unique experiences, but as we progress through the research process, we gain a better understanding of the phenomena under investigation. It is imperative to view the experience through the eyes of the participants and view the experience independently. The ultimate aim thus of interpretive research is to offer a perspective of a situation and to provide insight into the way in which a particular group of people make sense of their situation and phenomena (Creswell, 2016).

This interpretive paradigm underpinned this research which sought understanding of Grade 3 primary school teachers' experiences of teaching and learning of Mathematics. The above view of Creswell (2016) applied to how this research gained a better understanding by viewing how these teachers made sense of their own social worlds with regards to the teaching and learning of Mathematics.

4.3 RESEARCH APPROACH

According to Chetty (2016) a research approach is a plan and procedure that consists of various meticulous steps varying from broad assumptions to precise data collection, analysis and interpretation. The type of approach that is chosen by the researcher will be based on the nature of the problem that the researcher wishes to address. The three types of research approaches that are recognized for the purpose of conducting research are qualitative, quantitative and mixed methods (Creswell, 2010).

According to Mertler (2002) in quantitative research the researcher predominately must rely on numerical data to test the relationships that exist between variables. In this type of research, the researcher must conduct tests about what is real and look for relationships that exist between cause and effect, using quantitative data to test hypotheses or answer questions. Variables are used to determine how strong these relationships are and just how frequently they occur. According to Creswell (2010), the goal of quantitative research is to describe or explain the relationships that occur between the variables, to measure them and formulate hypothesizes.

Chetty (2016) explains it as research in which statistical analysis is used to make a valid connection between what we know and what can further be learnt with research by using general perspectives to develop a theoretical framework to test a hypothesis and come to a specific conclusion. This specific conclusion is drawn logically from the premises (Soiferman, 2010). Coyle and Tickoo (2007) explain that quantitative research is deductive and makes use of tests and experiments, relies on statistical data and numbers to draw conclusions and the researcher obtains an objective distance from the subject of the study.

Qualitative research can be explained as the attempt that is made by a researcher to collect rich descriptive data to investigate a particular phenomenon or context, to develop an understanding of what is being studied or observed (Nieuwenhuis, 2010). The focus is on how individuals and groups view the world and construct meaning by looking at their experiences.

According to Nieuwenhuis (2010) this type of research approach concerns itself with understanding various processes within social and cultural contexts, behavioural patterns and is mostly associated with seeking an answer to (why?) questions. Holloway and Wheeler (1996) explain that it studies people or systems, by closely observing and interacting with selected participants in their natural surroundings. The researcher places little emphasis on producing statistically valid samples and does not measure variables to test hypotheses, or use numbers, but relies on words to understand phenomena as it naturally occurs. The understanding or meaning is gained by seeing the world as the participants see it, so the phenomena is described in terms of the meaning experienced by the respondents (Nieuwenhuis, 2010).

According to Ivankova and Creswell (2010), mixed methods research adds onto both quantitative and qualitative approaches to research. This type of research approach places more emphasis on finding answers to research questions than the process that is used allowing for contextual interpretations, using a variety of methods for researching, flexibly choosing a strategy to address the research question (Patton,2002). It combines both qualitative and quantitative strategies in one study, comprising of both numbers and text, using variables to analyse and find fitting questions and answers to the research question (Creswell, 2010).

According to Creswell (2008) mixed methods can be explained as a procedure for collecting, studying and mixing both quantitative and qualitative data at some time in the research process to be able to understand the research question more efficiently. This study used a qualitative approach.as the researcher explored the experiences of Grade 3 Mathematics teachers in Daniëlskuil, a small town in the Northern Cape. A special amount of interest was invested in discovering how Grade three teachers

in Daniëlskuil use various teaching approaches and methods, the theories that endorse the teaching and learning of Mathematics, the proficiency levels of the teachers and their successes and challenges that they face daily in their Mathematics classrooms. The aim of the intended study was also to come up with suggestions that would improve these Mathematics proficiencies. The methodology used in this research thus served as a strategic and manageable guide throughout the research (Hesse-Biber & Leavy, 2011) and allowed the researcher to come to a better understanding.

Qualitative research is concerned with the opinions, experiences, and feelings of individuals producing subjective data. It describes social phenomena as they occur naturally and understanding of a situation is gained through a holistic perspective. The researcher identifies, studies, and employs one or more traditions of inquiry. The researcher seeks to understand the problem and not a causal relationship of variables or a comparison of groups.

Qualitative studies include detailed methods, a rigorous approach to data collection, data analysis, and report writing. This means, too, that the researcher verifies the accuracy of the account using one of the many procedures for verification. Qualitative research places emphasis on understanding through looking closely at people's words, actions and records while the quantitative approach to research looks past these words, actions, and records to their mathematical significance and quantifies the results of these observations. The task of the qualitative researcher is to find patterns within those words (and actions) and to present those patterns for others to inspect while at the same time staying as close to the construction of the world as the participants originally experienced it. Qualitative research is perspectival and subjective unlike quantitative which hold objective views. Qualitative research is exploratory and seeks to discover and interpret data while quantitative research relies on proof.

The goal of qualitative research is to discover patterns which emerge after close observation, careful documentation, and thoughtful analysis of the research topic. What can be discovered by qualitative research is not sweeping generalizations, but contextual findings grounded in the in the data. Qualitative designs are naturalistic as

research takes place in real-world settings and the researcher does not attempt to manipulate the phenomenon of interest. The phenomenon of interest unfolds naturally because it has no predetermined course established by and for the researcher such as would occur in experimental quantitative studies. Qualitative research is exploratory and descriptive in focus, it has an emergent design and not a fixed one which gives the researcher greater flexibility. Data collection takes place in the natural setting with the researcher being an instrument of data collection, the inductive analysis is always ongoing. The task of the qualitative researcher is to find patterns within those words (and actions) and to present those patterns for others to inspect while at the same time staying as close to the construction of the world as the participants originally experienced it. The goal of qualitative research is to discover patterns which emerge after close observation, careful documentation, and thoughtful analysis of the research topic.

The researcher chose to use this qualitative approach as it is an inquiry process of understanding which allowed the researcher to develop a complex, holistic picture, analyse words from the participants, and conduct a study in a natural setting (Creswell, 2015). By applying this qualitative approach, it allowed the researcher to approach reality from a constructivist position, and to gain multiple meanings and perspectives from the participants (Denzin & Lincoln, 2011). This was deemed a point of vital importance as the researcher wishes to gain the perspectives and views from various participants and construct meanings from different angles.

4.4 RESEARCH DESIGN

According to Bryman (2012), research design is a collection and analysis of various types of data. In this research, the researcher used a single case study which is a qualitative approach. According to Yin (1984) a case study is an empirical inquiry that seeks to investigate a phenomenon which occurs in a real-life context. The research in question was a case study as it was set within a real-world context (Yin, 2009) and was an empirical inquiry about a contemporary phenomenon or case without clear

boundaries between the context and the phenomenon, where various sources of evidence are required. It strives to create a holistic understanding of how the research participants interact in a situation and make meaning out of the phenomenon that is being studied (Nieuwenhuis, 2010).

The purpose of this case-study research was to provide an interpretation or explanation, of the perceptions and views of Grade 3 Mathematics teachers, and involved the observation of the participants (Cousin,2005) while attempting to achieve a holistic portrayal and understanding of the research setting which were the schools that had been chosen to participate in the study.

This study took on the form of a single case study due to the fact that it involved an individual unit, a community, a family, a group or a whole culture (Bryman, 2012). According to Bryman (2012), a case study is an in-depth observation of a process, a programme or activity. This was true in this study where the researcher observed the Grade three teachers in-depth to gain a better understanding of their perspectives and views with regards to Mathematical teaching and learning. Bryman (2012) also refers to the fact that in a case study a researcher can investigate a smaller number of people in an in-depth way, through observation. My research required the observation of a minimal population of ten Grade 3 teachers.

Creswell (2007) indicates that qualitative research is the type of educational research that relies on the participant's vision, gathers data consisting of words from the participants, expresses and considers these words for themes. The researcher collected data in the form of words which will provide a detailed description and interpretation of the phenomenon. (MacMillan & Schumacher, 2001). She investigated, described and analyzed the views of the teachers towards teaching Mathematics; the proficiency level of teachers in teaching Mathematics; the teacher's successes and challenges in teaching Mathematics; and the possible strategies that can be employed to improve the teaching of Mathematics in primary schools. In the next section the type of sampling used for the research is explained.

4.5 SAMPLING

According to Creswell, Ebersöhn and Ferreira (2016) sampling refers to a process used to select a portion of the population intended to be studied. Qualitative research is based on non-probability and purposive sampling rather than using probability or random sampling approaches in research (Creswell et al., 2016). Purposive sampling means that participants are selected because of some defining characteristics that make the participant's holders of the data that will be needed for a research study. Purposive sampling entails selecting a sample with a purpose to represent a phenomenon, group, incident, location or type in relation to a key criterion (Ritchie & Lewis, 2003)

.

In this research study, the researcher used convenience sampling to select the participants that would participate. The researcher selected the population elements that were easily and conveniently available (Creswell 2016). According to Vos (2011), population sampling is the taking of a section of units of a population as representative of the total population. It is also referred to as a selection of a group or individuals from whom data is collected and which represents a total population (MacMillan & Schumacher, 2001). The population sampling of this study was teachers from three primary schools in the Daniëlskuil town. Convenient sampling technique was employed to sample five Grade three teaching Mathematics to make a total of five (n=5) participants. The sampled participants were believed to be in reach of information regarding teaching Mathematics. The researcher explored their views regarding teaching Mathematics in primary schools.

The researcher chose this method of sampling as it was an inexpensive, quick approximation of the truth (Creswell, 2016) and involved only a few participants to conduct the study. The Mathematics teachers who were chosen to participate in the study were all in the immediate vicinity as they were teachers in the town of Danielskuil, and did not need to travel far distances to participate in the research.

The research site is discussed next.

4.6 RESEARCH SITE

The researcher chose to conduct this study in three primary schools in Daniëlskuil. These schools have Grade 3 classes that teach Mathematics. Two of the chosen schools have Afrikaans as their language of instruction and the third school has Setswana as language of instruction. These schools were chosen for this research study as the researcher lives in Daniëlskuil and could easily and cost-effectively travel between the schools. The schools chosen by the researcher are the only primary schools in the town of Daniëlskuil. Next data collection and analysis are discussed.

4.7 DATA COLLECTIONS AND ANALYSIS

The researcher made use of semi-structured interviews, non-participatory observation schedules and examined various literature reviews as well as document analysis to collect data for this research study. This collection of data served to provide the researcher with better insight and understanding of the Grade 3 Mathematics teacher's perceptions and experiences with regard to the teaching and learning of Mathematics (Creswell, 2010).

4.8 SEMI-STRUCTURED INTERVIEWS

According to Creswell (2016), the aim of the qualitative interview is to see the world through the eyes of the participant, with the aim of obtaining rich descriptive data that will allow the researcher to understand the participant's construction of knowledge and social reality. Participants think that the topic that is being discussed is important and if the researcher has established a relationship of trust, they will provide the researcher with valuable information that cannot be obtained in any other way (Ebersöhn, Eloff & Ferreira, 2016). The semi-structured interview is used by the researcher to corroborate data that emerges from other data sources. According to Laforest, 2009) Semi-structured interviews are face to face with the participant and conducted with a fairly open framework which allows for focused, two-way conversation. The semi-structured interview has a set of questions that are set up before the interview commences. Its purpose is to probe the participants into talking openly and

freely and in return providing the researcher with an in-depth understanding and insight into the topic being researching.

Denscombe (2010) explains that researchers often opt to use semi-structured interviews as a way of data collection, as this method provides flexibility and because their informal nature which is based around a theme (Robson, 2011) allows the participants to speak their mind (Denscombe, 2010). Hollard (2013) explains that this type of interview allows the participant to express their perceptions and views in their own terms and this provides the researcher with reliable, comparable qualitative data. The researcher however in this process has to be unobtrusive (Denscombe, 2010) and allow the participant to give answers that make sense to them and not what they expect the researcher wants to hear.

The only real disadvantage that is observed in this semi-structured interview, is that the researcher must base their data on what the participant says and not in fact what they do (Newby, 2010). Newby (2010) explains that this is often a problem experienced by researchers, as people often feel obliged to give us the answer, they want us to hear and the words do not match the actions of the participants. This can be attributed to the fact that at times participants do not feel that speaking freely is appropriate as it may have an adverse effect on their jobs (Denscombe, 2010). To ensure that true data is collected the researcher often uses observation to precede these semi-structured interviews (Cohen, 2006). The Semi-structured interviews as used in this research study are discussed in the following section.

4.9 SEMI-STRUCTURED INTERVIEWS IN THIS STUDY

In the semi-structured interview, the researcher used a semi-structured interview questionnaire which contained 4 main questions. They are as follows: Question 1 - The demographic information of the teachers. Question 2 – The methods and approaches that are used in regard to teaching Mathematics. Question 3 – the challenges and successes experienced by the teachers in regard to the teaching of Mathematics. Question 4 – The strategies that can enhance the teacher’s proficiency in the teaching of Mathematics.

These main questions also have sub-questions that were answered by the participants in the study. The questions were designed to probe information from the participants and allow the researcher to gain a better understanding of the views and perspectives of the five primary, Mathematics teachers that participated in the study. This semi-structured interview questionnaire was marked as Appendix D on the researcher's ethical clearance form.

The semi-structured interviews, which were face-to-face with the participants, were conducted over a period of ten consecutive days. They were conducted after school to avoid the normal teaching and learning. During the interviews, a voice-tape recorder was used to record the conversations between the researcher and the participant (Isaac, 2017). The next way in which the researcher collected data was by using observation checklists to observe Grade 3 Mathematics teachers while teaching learners in the class. The observation checklists are outlined in the following section.

4.10 OBSERVATION CHECKLISTS

The researcher used the checklist to collect data during the non-participatory observation wherein teachers were observed while teaching (Liu & Matilis, 2010). According to Silverman (2008), observation is a systematic data collection approach, which requires researchers to use their senses to examine people in natural settings. There are a variety of reasons why a researcher will choose this type of data collection, and it can be used when the research question that needs to be answered is focused on a how or what type question. Observation can be a good source of collecting data when the topic that the researcher is exploring requires the researcher to explain how people behave in a particular setting or situation, or when a certain phenomenon should be studied in a natural setting (Silverman, 2008). Observation is also effective in establishing whether if what a person says is in fact what they do.

In this research study, the researcher used non-participatory observation data collection technique. According to McLeod (2015), this is an observation that has limited

interaction from the researcher with the people that are being observed. The researcher, in this case, was merely there to observe the participants in the research study and not to be a participant in the actual study.

4.11 NON-PARTICIPATORY OBSERVATION CHECKLISTS USED IN COLLECTING DATA

In this study the researcher used an observation checklist to determine Grade 3 Mathematics teacher's behaviours. The researcher decided beforehand what observations would allow them to get an accurate account of how the teachers teach and what approaches are actually used versus the approaches that are said to be used. During observations, field notes were also used to record observations that occurred while the researcher was in the field.

In this research, the researcher used an observation checklist to observe various behaviours of the participants (Silverman, 2008). The observation checklist that was used in this research study comprised of three main sections: specific theories foregrounding the teaching and learning of Mathematics; the teaching approaches used in the teaching and learning of Mathematics; and the successes, challenges and teaching strategies used during Mathematics lesson presentation. These sections were then divided into sub-headings which stressed what elements the researcher wished to assess. The researcher used this method of data collection as the observations were made in real-life situations and this allowed the researcher to access the context and meaning surrounding what the participants say and do (McLoed, 2015).

The researcher also chose this method as she wanted to make sure that what the participants said in the initial interview was accurate and not just an answer that they gave to please her. According to McLeod (2015), people are not always willing to tell a stranger what they really think in an interview. This can because participants may feel as if they will be judged or that the data may be included in their performance evaluations and this could have a negative effect on their careers.

Both the responses from the Semi-structured interviews and the non-participatory observation checklists were instrumental in connecting this research study to the interpretive research paradigm, as this design sort to give meaning to how individuals or communities experiences various realities and acquire meaning and understanding to these experiences(Creswell,2016). In this case it allowed the researcher to gain insight into the experiences of the grade 3 Mathematics teachers and to verify if what they claimed to do in their Mathematics classes, was in fact a reality or if it was just a matter of answering the questions in a way that was acceptable to the researcher.

4.11.1 Document Analysis

Document Analysis is described as a systematic procedure which is used for reviewing and evaluating printed and electronic documents (Bowen,2009). It is required to examine, interpret, give meaning and assist a researcher to develop empirical knowledge (Bowen,2009). Analyzing documents incorporates the coding of information into themes that are similar in nature. The documents that were analyzed in order to collect data for this research study were the official CAPS documents issued by the DBE for the teaching and learning of Mathematics in Grade 3, school policies on the assessment on teaching of Grade 3 Mathematics, lesson plans, National Protocol for Assessment Grade R-12, Assessment plans and activities, learner portfolios and learner's workbooks. The researcher also analyzed the individual school's ANA Statistics from 2012-2014. The document that was used to analyze the documents that were collected by the researcher is marked as Appendix. The expected standards that are required to be met in regards to the document analysis was to ensure that all grade 3 teachers were in possession of all the relevant documents and that the documents were completed correctly, contained all the required information and were in a good condition. A discussion of the data analysis procedure follows.

4.12 DATA ANALYSIS PROCEDURE

Analyzing data from semi-structured interviews: Conversation and thematic data analysis was used to analyse data collected through the use of semi-structured inter-

views. Conversation analysis is the study of a talk which generally attempts to describe the ordinary (Makhoba, 2009). The researcher studied the tape-recorded data which was obtained using a questionnaire. The data were then organized and transcribed. The process of transcribing data involves writing down what the participant said (Maree, 2011). Data was then coded. The researcher established themes or categories under which data was grouped (Uwe Flick, 2013). Data was analyzed by carefully studying the themes. These themes were further divided into categories so that the researcher could find a pattern or relationship between the various topics and identify how each is related to the other and compare these topics to a literature review to answer the research questions related to what theories are foregrounding the teaching and learning of Mathematics in primary schools.

The responses of the grade 3 Mathematics teachers would also allow the researcher to identify the successes and challenges that are experienced by the grade 3 teachers and to suggest strategies to improve their proficiency in teaching Mathematics to their grade 3 learners. It would also allow the researcher to determine the views of the grade 3 Mathematics teachers. Analyzing data from non-participatory observation: During observations, field notes were used to record observations that occurred while the researcher was in the field. The researcher organized the data that was collected into themes (Uwe Flick, 2013). Predetermined themes were derived from the research problem, the semi-structured interview guide, and literature and from the researcher's own general knowledge. Themes were used throughout the study to organize the data that was collected (Krueger, Casey, 2009). These themes were further divided into categories so that the researcher could find a pattern or relationship between the various topics. The researcher then organized the categories into a sequence according to how they were related.

The data that was collected from the non-participatory observation was used to answer the main research question which was to what extent to grade 3 Mathematics teachers make use of different teaching approaches to teach Mathematics. It also served to find out if these grade 3 teachers in Daniëlskuil are empowered to teach Mathematics to grade 3 learners and what their proficiency levels are. The researcher

used codes to identify various themes related to the aims of the research study. Similar responses and viewpoints were grouped together. The researcher then went through the data and interpreted the experiences of all the Grade 3 Mathematics teachers with regards to the teaching and learning of Mathematics. Furthermore, the comments that were made by the participants have been written in italics to provide insight into how these participants expressed themselves during the interview process.

Analyzing data from document analysis: Data collected from CAPS Mathematics Grade three subjects, Mathematics, Lesson plans, Mathematics Assessment Activities, Mathematics school-based policy, and ANA statistics for Mathematics from 2012-2014 was analyzed through the use of themes. Data were also collected by using the answers given by the teachers during the interviews as well as using the data that was gathered during the non-participatory observations. Responses from teachers as well as the data obtained from the observations were analyzed by grouping information into themes. The process of analyzing data included writing information that would give voice and meaning around the problem investigated (Krueger & Casey, 2009). Data collected during the interviews, non-participatory observation, and documents that were analyzed were captured and stored in a computer.

All captured documents were encrypted in order to avoid easy access to information. Both electronic and documents data will be placed in storage for five years. The researcher keeps the data in a password protected computer or in a locked cabinet or cupboard. The researcher used a document analysis checklist to analyze the data collected and it was marked as Appendix F. The data that was collected from the form the semi-structured interviews, non-participatory observation and from analyzing the documents led the researcher to assume, that, that which was theoretically expected of the grade 3 Mathematics teachers was not always practically implemented and that often the spoken word was not verified by the actions of the grade 3 teachers. This was a delimitation to the researcher as data had to be analyzed and reanalyzed to ensure that it was indeed correct and answered the main research question and sub-questions of the research study. The assumption that teachers often talk the talk

but fail to walk the walk left the researcher questioning how much of the underperformance was a system problem and how much of it was due to human error. The data that was collected by the researcher from the interview process did in some cases lead the researcher to assume because the participant couldn't answer the questions that were posed to them correctly that they lacked knowledge in the subject that they taught. This was a delimitation to the researcher as the researcher did not take into consideration that often participants battle to express themselves especially when nervous or trying to communicate in a second or third language. This assumption was often proved incorrect when observing the grade 3 teacher when practically teaching a Mathematics lesson. This leads to a discussion of validity, reliability, and ethics of this research study.

4.13 VALIDITY, RELIABILITY AND ETHICS

The researcher was ethically responsible for protecting the rights and welfare of the subjects that participate in the study. Most studies require that informed consent was obtained from the teachers, and participating schools, in order to protect the confidentiality of the data and the privacy of the subjects (Bera, 2011). The researcher informed all the participants about all the aspects of the research that were undertaken. Confidentiality and privacy were maintained at all times. The participants were informed about the interviews and the classroom observations that took place. Field notes and all documents analysis were discussed with the participants. Pseudonyms were used to protect the participants and schools. Any confidential information was discussed with the participants (Morrison, Cohen & Manion, 2011).

According to Singh (2016), the participants in any study should freely consent to participate and not be coerced or unfairly pressured into participating. The participants should be aware that they may decline if they do not want to participate and can withdraw at any time during the research study. According to Brickci (2008), the researcher has a responsibility to the participants they study as well as to the colleagues that the researcher presents their findings. When embarking on this research study, the researcher considers the ethical issues involved. At all times, the researcher respected the autonomy and rights of the individuals, and participants did

not experience any harm. The researcher considered the content carefully and pay special attention to sensitive topics.

The researcher firstly had to obtain ethical clearance from the University of South Africa. This ethical clearance ensures that the researcher is granted permission to conduct research in accordance with the standards that are held by the University. No researcher may commence with a research study if permission is not granted by the ethics committee. The researcher then obtained written consent from the District Senior Manager of the Northern Cape Department of Education. This was marked by Appendix G and is called a requisition letter which was addressed to the district. The researcher then obtained written consent from the principals from the three primary schools that were identified to participate in the research study. This was marked as Appendix H and is a requisition letter to the school. The researcher then needed to provide the participants with a participation information sheet that was marked as Appendix B. This informed the participants of what they study was about and what was expected of them. The participants, the Grade three teachers, were then given a consent form that they had to sign which confirmed that they would take part in the research study. This consent form was marked as Appendix C.

To ensure trustworthiness, participants were given enough time to articulate their views about the problem statement. Semi-structured interview questionnaires and observations checklists were made available to the teachers beforehand so that they could be sure that the same ones were used in the research. The researcher ensured reliability through developing a friendly relationship with the teachers which was facilitated by her status as a teacher from the same community (Her & Nijlen, 2004). The researcher conducted follow-up interviews to ensure reliability and validity. Next follows a discussion on the delimitations and limitations of the research study.

4.14 DELIMITATIONS AND LIMITATIONS

According to Simon (2011) limitations are characteristics that limit the scope and define the boundaries of the study. The researcher assumed that the following may form part of limitations of the study: teachers refusing to participate in the research

study; schools that may refuse to allow teachers to be observed when teaching; dishonest answers from teachers; assumptions that the research study may not bear fruits towards improving the teaching and learning; and schools refusing to disclose their statistics of the Mathematics ANA learners' performance of Grade 3.

Further, a number of factors affected the study. Limited resources such as funding and transport prevented the researcher from using respondents from other schools. This resulted in biased results of the research. The instrument used had its own limitations as some teachers in the Foundation Phase are still new and lack experience of CAPS. Furthermore, communication was a problem as some teachers could not understand the questions and required the interviewer to explain further. It was also difficult for them to express themselves in English and this resulted in them giving less information. Moreover, some respondents responded less freely to some of the interview questions until they were assured of their anonymity.

Lastly, limited knowledge of CAPS among some respondents hampered them from responding fully to the questions as expected. Nevertheless, semi-structured interview questions were meant to minimize such risks as it gives the interviewer access to the interviewee to clarify any difficult concept. In cases where the interviewee was absent on the agreed date or too busy, interviews were rescheduled. This reduced the possibility of revisiting some respondents where clarity was needed.

4.15 CONCLUSION

In this section, the researcher discussed the methodology that was used to be able to answer the research question and to gain a better understanding of the views and perspectives of Grade 3 Mathematics teachers in primary schools. The researcher discussed the research design, the research paradigm, and the way in which the participants were sampled to participate in the study. Data collection, data analysis, validity, reliability, ethics, delimitations and the limitations of the study were discussed by the researcher. The correct choice of methodology leads the researcher to be able

to conduct this research study effectively and gain the knowledge, in-sight, and understanding that they wished to acquire. The next chapter presents the results that were obtained from the research study.

CHAPTER 5

DATA ANALYSIS, INTERPRETATION AND PRESENTATION OF FINDINGS.

5.1 INTRODUCTION

In the previous chapter the researcher discussed the methodology that was employed in the research study, the chosen research design that was used, the approach that was applied, the research site where the study was conducted, how the participants were sampled and how the data was collected and analyzed. It also addressed issues of validity, reliability, ethics, limitations and delimitations of the research study and lastly provides the reader with a conclusion.

Chapter 5 focuses on the presentation of the research findings which includes the analysis of empirical data that was collected through semi-structured interviews, non-participatory observation and document analysis. It also presents the unique profiles of the Grade 3 Mathematics teachers, the Grade 3 Mathematics teacher's biographical information, the themes that emerged from the interview responses, the themes that emerged from non-participant observations, the documents that were analyzed and finally the conclusion. The next section deals with the biographical information that was gathered on each of the Grade 3 Mathematics teachers.

5.2 PROFILES OF THE GRADE 3 MATHEMATICS TEACHERS WHO PARTICIPATED IN THIS RESEARCH STUDY

The sample that was used for this research study was five Grade 3 Mathematics teachers from three primary schools in Daniëlskuil town. The participants were all female; this is purely for information purposes as gender was not a focal point in this study. All the participants in the research study have been teaching Mathematics in Grade 3 for ten or more years. All these teachers with the exception of one, have received some form of CAPS training in regard to the teaching of Mathematics and are qualified Foundation Phase teachers. The researcher has marked the participants in this study as a teacher 3a–3e. The three schools that were chosen to participate in this research study were represented by numbers from 1 to 3. This is so that the

identities of these participants will only be known to the researcher which in turn will ensure confidentiality. The below information sheds light on the profile of each individual Grade 3 Mathematics teacher.

5.2.1 Teacher 3a

Teacher 3a is a female Foundation Phase teacher for Grade 3 Mathematics and represents school no 1 with fourteen years of teaching experience. She has a 3-year diploma and later completed an Advanced Certificate in Education (ACE). Her subject specializations include Mathematics, Afrikaans, English, and Life Orientation. She has been teaching for 14 years. She received CAPS training on other Foundation Phase subjects including Afrikaans, English and Life Skills but could not remember being trained in CAPS Mathematics teaching and learning. The training that she received was conducted by the Department of Education in Upington in the Northern Cape.

5.2.2 Teacher 3b

Teacher 3b is a female Foundation Phase teacher for Grade 3 Mathematics and represents school no. 2. She has 20 years' teaching experience. Teacher 3 b has a 3-year diploma and has recently completed an Advanced Certificate in Education. Her subject specialization includes Mathematics, Afrikaans, English and Life Skills. During the interview process Teacher 3 b indicated that she had received CAPS training for the teaching and learning of Mathematics. This training was conducted by the Department of Education in Upington and Posmasburg in the Northern Cape.

5.2.3 Teacher 3c

Teacher 3c is a female Foundation Phase teacher representing school no.2, who has been teaching for 26 years. She has a four-year National diploma in Foundation Phase teaching. She specialized in Afrikaans, English, Mathematics and Life Skills. The teacher did not receive CAPS training in Mathematics and was very adamant that the documents pertaining to Mathematical teaching and learning delivered to her

respective school and she had to make sense of them herself. However, she stated that she attended workshops for other CAPS subjects which include Afrikaans and English.

5.2.4 Teacher 3d

Teacher 3d is a female Foundation Phase teacher with 34 years of teaching experience. She is presently teaching Mathematics to a Grade 3 class in school no.3 Teacher 3 d completed a 3-year diploma in Foundation Phase teaching and then completed an Advanced Certificate in Education. She specialized in Life Orientation. Teacher 3 d received training in Mathematics a swell as Afrikaans and English. The training was conducted by the Department of Education and commenced in Posmasburg and in Upington in the Northern Cape.

5.2.5 Teacher 3e

Teacher 3e is a female Grade 3 Mathematics teacher and represents school no. 3. She has a 3-year diploma in Foundation Phase teaching and has completed an Advanced Certificate in Education. Teacher 3e specialized in Afrikaans, English, Mathematics and Life Skills whist completing her 3-year diploma and later during her ACE diploma specialized in Mathematics for 2 years. Teacher 3e has been teaching for the past 18 years. She received CAPS training from the DBE in all the subjects that she teaches in Grade 3. These CAPS training workshops were conducted in Kimberly and Upington in the Northern Cape. Table 5.1 tabulates the biographical information of the Grade 3 Mathematics teachers.

Table 5.1: Teachers' Biographical Information.

Teacher Participant	Gender and Qualifications	Experience, Grade taught and subjects.
Teacher 3 a	Female Foundation Phase Teacher Qualifications: 3 Year Diploma in Foundation Phase teaching and an Advanced Certificate in Education. (ACE)	14 years, Grade 3, Mathematics, Afrikaans, English and Life Orientation (Life Skills).
Teacher 3 b	Female Foundation Phase Teacher Qualifications: 3-year diploma. Advanced Certificate in Education. (ACE)	20 years, Grade 3, Mathematics, Afrikaans, English, and Life Orientation. (Life Skills)
Teacher 3 c	Female Foundation Phase Teacher Qualification: (NPDE) 3 Year National Diploma in Foundation Phase teaching.	26 Years, Grade 3 Afrikaans, English, Mathematics, Life Skills.
Teacher 3 d	Female Foundation Phase Teacher Qualifications: 3-year diploma in Foundation Phase teaching. Advanced Certificate in Education (ACE)	34 years, Grade 3, Mathematics, Afrikaans, English, and Life Skills.

Teacher 3 e	Female Foundation Phase Teacher Qualifications: 3 Year Diploma in Foundation Phase teaching An Advanced Certificate in Education. (ACE)	18 Years Grade 3 Mathematics, Afrikaans, English, Life Skills. 2 years specialized in Mathematics.

The above information was used to compile the profiles of the Grade 3 teacher participants, who teach Mathematics; it portrays a group of teachers who seem to be well qualified and highlights the overall experience of these teachers who are all highly qualified and have been teaching Mathematics in the Foundation Phase for many years. The sample of selected participants includes five teachers who have more than 10 years' experience and have been teaching Mathematics for many years. Teacher 3 d has been teaching for 34 years which marks a lifetime of learning and learning, especially in a subject like Mathematics. If one were to combine their joint years of expertise it would amount to a grand total of 112 years. This in itself should pertain to excellent teaching, correct use of teaching methods and approaches, using varied methods and approaches to teach Mathematics, high levels of competency, excellent pedagogical knowledge and outstanding outcomes and results in Grade 3 Mathematics.

Fundamentally that is the assumption that one should arrive at, but is this in fact a proved reality? The general idea should equate to the fact that experience gained over time should enhance knowledge, increase skills and enhance productivity and effectiveness (King Rice, 2010) with an increase in learner achievement, especially in Grade 3 Mathematics. The underlying assumption in this case should thus be that due to the years of experience these teachers should be more of experience make more effective teachers?

From the responses that the researcher obtained during the interview process it could be assumed that years of experience is not always a factor that invariably produces outstanding outcomes especially in a complex subject like Mathematics. According

to Harris, Sass, Clotfelter and Ladd (2007), the greatest levels of productivity in teaching are witnessed in the first few years and after that productivity dwindles and marginal returns diminish. According to King Rice (2010), this could be due to the fact that experienced teachers after a certain length of time, are no longer interested in staying up to date with curricular pedagogical advances or battle to maintain performance levels due to inadequate support or because of teacher burnout. Another reason could be that when situated in a high poverty area like the participants in the location of the selected schools, teachers are not adequately equipped to be effective in such settings due to the complexity of their work and inadequate professional development (King Rice, 2010).

If one looks at the years of experience that is allocated to each participant, it will also be apparent to the reader that these teachers are not young anymore and many of them will be exiting the field of teaching in the next few years. Many may thus not see professional development as being beneficial to them as they will be retiring shortly. This can have a negative effect on their teaching practices as in order to keep up with current teaching methods and approaches, curriculum changes, changing ways in which learners learn, assessment policies and improved teaching strategies, and to be able to reflect on their own individual teaching practices, teachers should partake in professional development programmes (Teacher Education,2010).

These mature teachers may in fact retain positive outlooks on professional development, but may however find it difficult to maintain their energy levels, adapt to the ever-changing policies and teaching practices, and resent the behaviour of the learners that differ widely from when they started teaching (Day, 2009). If the maturity of these teachers could be compared to a good red wine, then age would improve the quality, but research tends to lean towards the fact that experience or passage of time will not make all teachers teach better or ensure that incompetent teachers become competent. According to Kini and Podolsk (2016) effectiveness does increase with experience if the teacher is mentored and rigorously evaluated.

During the interview process the researcher had expectations that years of experience and general maturity would equate to totally honest answers and reflections on

how the Grade 3 teachers experienced the teaching and learning of Mathematics in their respective classrooms. It would appear that some responses given demonstrated a gap between the ideal and lived experience with regards to the teaching and learning of Grade 3 Mathematics. According to Hammersley and Gomm (2008), often what people say in an interview can be shaped by what they think the interviewer wants to hear or by what they believe the interviewer would approve or disapprove of. According to Walford (2007) these responses may be far from the actual reality and may only reveal what the participants is willing to share about a circumstance or experience.

Thus, the researcher used observation to establish if the answers that were given by the participants where true or partially true. Observation will later form an instrument by which the researcher can examine the external behaviour of the participants and their inner beliefs (Alshenqeeti, 2014). The analysis of all the data collected from the various participants during the interview process, regarding the teaching and learning of Grade 3 Mathematics, has been grouped according to themes and is presented in detail in the next section. I will now discuss the empirical findings of the interview process.

During the interview process themes were coded and the themes were analyzed. These themes were further synthesized, and the four themes were highlighted and deemed the main themes by which the empirical findings could be discussed.

The main themes are as follows:

- The theories that endorse the teaching and learning of Mathematics.
- The proficiency levels of Grade 3 Mathematics teachers.
- Challenges and successes experienced by Grade 3 teachers with regard to the teaching of Mathematics.
- Strategies that could enhance the Grade 3 teacher's proficiency towards the teaching of Mathematics.

Under each theme were various headings that will be discussed in the next section.

5.3 THE MAIN THEMES THAT EMERGED FROM THE TEACHERS' INTERVIEW RESPONSES.

The researcher identified various themes that were highlighted during the face-to face semi-structured interviews of the Grade 3 Mathematics teachers. There are four prominent themes that were identified, and under each theme were headings that will now be discussed in detail. The responses of the Grade 3 participants are written in italics and presented after every theme and category.

5.3.1 Theme 1: The theories that endorse the teaching and learning of Mathematics

The participants were asked what theories are needed to be able to teach and learn Mathematics effectively. They were also asked to explain the meaning of social-constructivism, constructivism, behaviourism and connectivism and to explain how these theories are used in the teaching and learning of Mathematics.

The participants replied as followed:

> *"Theories, no I have no idea, I am negative towards maths, No idea:"*. (Teacher 3 a)

> *"Behaviourism, is how I as the teacher react and do things, it is connected to how the child behaves and how I behave towards the child."* (Teacher 3 a)

> *"Social constructivism, I only know what social means, society as a whole."* (Teacher 3 a)

> *"Constructivism it goes hand in hand with the construction of something. I do not really know."* (Teacher 3 a)

“Connectivism, how the child connects with something.” (Teacher 3 a)

“Behaviourism is how the child behaves towards Mathematics.” (Teacher 3 b)

“Social constructivism is how the child communicates with other children in the class.” (Teacher 3 b)

“Connectivism not sure what it is.” (Teacher 3 b)

” Behaviourism is the behaviour that the teacher shows towards the children in the classroom. Always be positive so that the children can be positive. Even if you do not understand what you are teaching you should never let the children know this. The teacher should always be positive if they want to teach Mathematics.” (Teacher 3 c)

*“Social Constructivism is when children socialize in a group. There are shy children who never socialize in the classroom, so group work forces them to do this. (*Teacher 3 c)

Connectivism I do not know what this is. (Teacher 3 c)
I use social constructivism in my classroom and Behaviourism. Both of them are very important.” (Teacher 3 c)

“Behaviourism it depends on the mood that the teacher brings to the classroom. Teachers cannot bring their moods to school. When they are in the classroom, they should portray a friendly, positive attitude. Teach Mathematics with enthusiasm so that the children will want to listen and to learn. Teach Mathematics on their level.” (Teacher 3 d)

"Social constructivism is when the learners work in groups and learn from each other. They compete with each other and build their own knowledge." (Teacher 3 d)

"Connectivism is digital apparatus that children can use to learn Mathematics. This can be calculators, tablets, and computers." (Teacher 3 d)

"I use Social – Constructivism because I use Group work." (Teacher 3 d)

"Behaviourism the teacher should act positively towards Mathematics, develop a love for it. The teacher should be spontaneous and follow the correct steps." (Teacher 3 e)

"Social constructivism is when children work in groups to learn number concepts. The children actively participate and talk about Mathematics and demonstrate to each other what they have learnt. These groups are rotated. Children learn from each other in the group." (Teacher 3 e)

"Connectivism is how children connect various subjects together. Children use reading and writing in order to answer Mathematical problems." (Teacher 3 e)

"I use all the theories in my classroom."

From the responses that were given by the Grade 3 Mathematics teachers the researcher formed the opinion that little was known about the various theories that are required for the effective teaching and learning of Mathematics.

Some participants had an idea what the theories were all about, but few knew how they fitted into teaching Mathematics and thus only incorporated limited elements of

these theories, failing to include everything that is required to teach Mathematics concepts effectively. This lack of knowledge may be the reason for the poor results in Grade 3 Mathematics.

5.3.2 Theme 2: What are the proficiency levels of teachers who teach Mathematics in Grade 3 classrooms?

Category 2.1.: The teaching approaches and methods that the Grade 3 teachers were familiar with. The Grade 3 Mathematics teachers were asked what approaches and methods they used to teach Mathematics in their respective classroom. Their responses were as follows:

> *"I use the DBE workbook, CAPS Document, Work with children at their tables and do group work. I use group work the most on the mat and direct instruction on the blackboard*." (Teacher 3 a)

> *"I use group work on the carpet, classical teaching, working in pairs, individual teaching to learners who struggle, I use direct teaching from the blackboard and DBE workbooks and sit next to children at their desks and help them to do the examples. I work with the different ability groups on the mat and explain abstract concepts by using concrete apparatus. I use flashcards for mental maths and number lines and counting cards."* (Teacher 3 b)

> *"I like to use creative activities like games and for activities like counting I use concrete items like beads or blocks. I also do finger activities or allow the learners to count objects like toes, fingers etc. I use concrete apparatus and pictures and cards that I make to explain concepts. I use problem solving and group work on the carpet. I make use of the DBE workbooks and teach using the blackboard. Group work is very important to take the child from the concrete to the abstract."* (Teacher 3 c)

"I firmly believe in using concrete apparatus to teach the children. The children should be able to physically touch and use manipulatives to build knowledge. If children do not experience things by seeing and touching them, they forget quickly. Working with apparatus creates better discipline in a classroom. I actively involve my children and often ask them to explain to me so that I can check for understanding. I use stronger children to help the weaker ones. I also let the stronger children help the children at their desks while I do group work on the mat. I use songs and games to link concepts or subjects together. I am a hands-on teacher that is usually barefoot and sitting with the learners on the carpet. I also make use of flashcards and counting cards." (Teacher 3 d)

"I use group work with apparatus to teach concepts and I rotate the groups daily. I execute my lessons step for step and check for understanding. I use group work to take the learners from abstract to concrete and use apparatus. I use place value cards, number lines, counting cards, concrete forms and allow children to learn measurement or volume by giving them items to measure or cups to fill up". I actively involve my learners and use everyday examples that children are familiar with. I demonstrate various concepts to my learners and ask them to explain it to me." (Teacher 3 e)

The responses that were given by the Grade 3 Mathematics teachers indicated that they are familiar with a few approaches or methods that should be used to teach Mathematics effectively, but do not have knowledge of all the approaches or methods. This would generally imply that they are only using a few methods or approaches to teach Mathematics and not making use of all the methods or approaches that are required to teach Mathematics effectively.

This finding relates to the literature that teachers are only deemed proficient in teaching Mathematics if they are able to vary their teaching approaches and engage their

learners in thinking, problem-solving and investigating mathematical content (Sansome,2016). The teacher also needs to be able to incorporate problem-solving into the learner's everyday experiences (Weyer,2015). A teacher who is proficient in Mathematics knows what to teach, how to teach the content and vary teaching styles and methods to engage all the learners in their classroom (Killen,2016). According to Tucker (2012) a proficient teacher exhibit skills and knowledge and represents the content in accessible ways, plans instruction and checks if learning is actually occurring in their classrooms. Proficiency levels of teachers in South Africa are low (World Bank 2014).

5.3.3 Theme 3: Challenges and successes experienced by Grade 3 Mathematics teachers

This theme held a lot of weight with most respondents because most experience problems daily that may or may not the reason for the poor results that are produced in Grade 3 Mathematics. Many challenges that were highlighted were similar in nature although the teachers were from different schools. The participants eagerly discussed the challenges they face daily but failed to mention any successes they had achieved. This theme was broken down into smaller categories that will now be explained.

The participants were then asked if their schools lacked resources and if poor infrastructure and the lack of financial resources prohibited them from teaching Mathematics in their respective Grade 3 classrooms. This led the researcher to establish the following theme:

Category 3.1: Lack of resources, funds and poor infrastructure.

"I really need more teaching aids and apparatus in the researcher's classroom. I really do not know if our school has funds or not. When I ask for something, I do not get it." (Teacher 3 a)

"I really need more resources and books that have Mathematical activities. Funds are not available to buy resources; available funds need to be used for more urgent matters." (Teacher 3 b)

"I never have photocopying paper to make activities and we also need other teaching aids. If I do not have teaching aids, I have to make them and I should spend my own money to do so. If we do not have paper or stationery for the children, we also buy it as without it we cannot teach properly. Often, we are only given one book and we have to make photocopies, sometimes we also have to pay for them. If we have no ink in the printer, we should pay at the shop to print our work. The walls in the researcher's classroom need paint. They are full of old Bostic that does not come off. I must cover it up by sticking up pictures. My carpet is very dirty, and our school has very few cleaners. My window has also been broken for how long and the winter is coming." (Teacher 3 c)

"I do not have the resources I need. The department also sends one or two books that need to be shared by the Grade. We should then make photocopies which is a waste of time and often we should pay for them which is a waste of money. Teachers buy a lot of the resources they need. If we had all the apparatus, we need we would definitely teach more effective lessons, much more concrete. We request apparatus to be purchased but are told that it was not in the budget. My carpet is very dirty and needs to be replaced." (Teacher 3 d)

“The lack of resources cannot prohibit you from teaching Mathematics effectively. If I do not have enough resources. I make smaller groups. A teacher should not develop a negative attitude to teaching because they need resources, they should improvise and make a plan.” (Teacher 3 e)

Most teachers of the grade3 teachers made mention of the fact that they lack resources, teaching materials, funds and contend with infrastructure that is failing within their schools. This finding relates to the literature by Berg (2008) which states that a lack of resources and teaching materials are a formidable challenge faced by South African teachers and leads to underperformance in Mathematics. It links to literature that states that schools in South Africa lack adequate facilities (Van der Nest,2012). According to Blignaut (2007) Some schools in South Africa have no windows, chairs, desks sanitation and running water. Panthi and Belbase (2017) state that schools in South Africa lack teaching aids, textbooks and workbooks.

The participants were asked if overcrowded classrooms led to discipline problems and if these discipline problems prohibited them from teaching Mathematics effectively. They were also asked what improvements could be made in this regard to assist them to teach more effectively.

The responses of the participants also led to the following theme:

Category 3.2: Overcrowded classrooms and discipline problems.

“I would like a smaller class where there is enough apparatus. This would help me to teach more effectively.” (Teacher 3 a)

"My classrooms are full and there is not enough material to teach with. This leads to serious discipline problems as the learners misbehave and prohibit me from teaching Mathematics effectively. The learners have no manners. If my class were smaller, it would allow me to manage my classroom more effectively and this would improve the way in which I teach." (Teacher 3 b)

"*My classroom is very full, and this prohibits me from giving each child individual assistance. If my classroom had fewer learners, I would be able to supervise each child and give individual assistance when it is needed.*" (Teacher 3 c)

"My classroom is overcrowded and there is no discipline because corporal punishment is no longer allowed. Classes are so big that I cannot involve all the children actively. Have complained about this problem, but somehow it feels as if everyone just keeps on dragging their heels." (Teacher 3 d)

"Classes are full, but that has no impact on teaching if you plan properly." (Teacher 3 e)

One of the findings was that the grade 3 classes are overcrowded, and this leads to discipline problems. According to Mtika (2010) the biggest problem that occurs in overcrowded classrooms is for the teach to try and maintain discipline while teaching.

The participants were then asked what they feel are the biggest reasons why learners in Grade 3 struggle to learn Mathematics effectively.
Their responses led to the following theme:

Category 3.3. Social problems and barriers to learning.

> *"Children cannot read and write and cannot sit still, kids just play and are not interested in learning, and parents do not assist them at home."* (Teacher 3 a)
>
> *"Children are behind in their education, cannot read, no discipline at home because parents are afraid of their children."* (Teacher 3 b)
>
> *"Children cannot concentrate or sit still and disrupt the class, big barriers to learning, behind when they get to Grade 3 because they skipped Grade R. Children are neglected are hungry and do not get nutritious food to eat, they suffer from alcohol syndrome and the biggest problem is no discipline."* (Teacher 3 c)
>
> *"Children come from very different backgrounds they live with grandparents on grants and are constantly hungry and dirty. They cannot be disciplined as they feel that they have too many rights. Alcohol in our community makes the children slow to learn*." (Teacher 3 d)
>
> *"We live in a very poor community so should walk the extra mile for the children*, *they cannot read."* (Teacher 3 e)
>
> The main finding was that grade 3 teachers find it very difficult to teach learners have severe barriers to learning. This links to the literature of Dreyer (2017) that states that one of the biggest challenges to date is teaching learners who have barriers to learning in a mainstream classroom.

The participants were then asked if the learners in Grade 3 Mathematics classrooms have a problem with understanding the language of instruction, Afrikaans.

Category 3.4. Language of instruction causes a barrier to learning in Mathematics

The participants were then asked if the learners in Grade 3 Mathematics classrooms have a problem with understanding the language of instruction, Afrikaans.

The Grade 3 Mathematics teachers responded in the following way:

> *"The biggest problem that I have in my classroom is the fact that the children cannot read. I think that it is because many of our learners speak Tswana or English at home and we teach in Afrikaans."* (Teacher 3 a)

> *"I have a few learners in my class that battle to understand me. It makes teaching more difficult as I do not know how to get through to them. Many of them can't read and no matter what I do to assist them it just doesn't help."* (Teacher 3 c)

> *"Reading is our biggest problem. The children cannot read and when we send homework home, the children complain that their parents were not able to assist them. One of the problems is that the home language is different to the language of instruction that we use at school" (Teacher 3 d)*

> Teachers 3 b and teacher 3 e had no problems with language barriers, so the *researcher did not include their answers.*

> *The main finding was that some grade 3 Mathematics teachers experience extensive challenges because of language barriers that exist in the mainstream classroom. This often occurs because teachers who teach Mathematics are not proficient in the LoTL a*

classroom do not know how to teach the intended content (Taylor,2012). According to NEEDU (2013) teachers in mathematical classrooms lack proficiency and language skills that are required to explain to the learners in a way that they can understand.

Category 3.5. Lack of Support from other stakeholders.

The Grade 3 Mathematics teachers were asked if they receive support in Mathematical teaching and learning from the Department of Education, the SGB, the SMT and the principal of their respective schools.
The Grade 3 teachers responded as follows:

"I never get one on one training, once in a while a demonstration is given and then amen. I am rarely supported by my SMT, but the SBG are too afraid to come into the class and assist us with their kids. Some will come for a day or two, but the whole lot are afraid of their kids" "The Headmaster, like in principal, Jo! No support" "The parents are not involved or interested." (Teacher 3 a)

"The SGB do not listen and do not give us what we want. The principal is not supportive, and the parents are scared to be involve."" (Teacher 3 b)

"The parents do not help the children at home because they cannot read or write. No one comes to the researcher's class and ask how it is going. My Principal only comes when I ask him to come and see if I am teaching properly. My HoD comes regularly and offers support." (Teacher 3 c)

"I get little support from the Department. Sometimes people do not support Mathematics as they do not like the subject. Parents do not support their children because they feel that after they drop

them off it is our job to do everything, because we get paid for it." (Teacher 3 d)

"I get support but need more. I ask for things in my classroom that I cannot get." (Teacher 3 e)

It was a main finding that the grade 3 teachers felt unsupported by other stakeholders in the education sector. This has a definite link to the literature by Bernstein (2015) which states that teachers feel unsupported by the Department of Basic Education and feel that they are not supported with regards to teaching learners with severe barriers to learning in diverse classrooms. According to Mbesgu (2010) when teachers are fully supported, they work harder to achieve the results that are expected of them.

Category 3.6. Increased workload and administration tasks.

The Grade 3 teachers were asked if the amount of administration tasks that they have to do and if their current workload has a negative impact on the teaching and learning of Mathematics in Grade 3.

The Grade 3 Mathematics teachers responded to this question in the following way:

"*Admin. Has just become too much. A lot of teaching time is being lost due to the fact that our administration tasks have increased in number. Less time should be spent on administration tasks and more time on task teaching activities.* (Teacher 3 a)

"Admin. Jo! Too much now. Takes up so much time that you do not have enough time to work with the children. The files are just too much." (Teacher 3 b)

"Administration tasks takes up a lot of time and sometimes I get behind, so I rush to get it finished. I often take it home to finish it which interferes with my family." (Teacher 3 c)

"Admin. Takes a lot of time so I take it home, our families need attention and we really do so much for such little salaries." (Teacher 3 d)

"The amount of time spent on admin. Is a waste of time" (Teacher 3 e)

The main finding was that that the grade 3 mathematics teachers felt that their admin tasks had increase significantly and had little time for their families as they had to take work home and even worked on holidays and weekends. This links to literature by the AN Nut Guide (2012) paperwork has become a burden to teachers. They spend excessive amount of time on paperwork and administration tasks which consumes non-teaching time, weekends and holidays.

Category 3.7. Lack of pedagogical knowledge

The Grade 3 teachers were asked if they felt that they possessed enough pedagogical knowledge in Mathematics and if they felt competent to teach Mathematics to Grade 3 learners.

Their responses were as follows*:*

"Mathematics is feared by people who lack knowledge in the subject. I do not feel competent to teach the subject as I find Mathematics difficult to understand." (Teacher 3 a)

"I am competent, but sometimes just do not really understand what I am expected to teach." (Teacher 3 b)

"I do not have enough knowledge that is why I said I need more training." (Teacher 3 c)

"I feel that I am competent to teach Grade 3 Mathematics, but I do lack knowledge in the subject." (Teacher 3 d)

"I am very competent and follow the correct steps and plan properly." (Teacher 3 e)

Category 3.8. Competency with regards to using CAPS documents to teach Mathematics to Grade 3 learners

The Grade 3 Mathematics teachers were asked if they felt competent to use the CAPS documents to teach Mathematics in Grade 3 classrooms.

The Grade 3 Mathematics teachers responded in the following way:

"I do not really use them that much, oh now I start reading the CAPS documents and give up after a while as the documents are very long, and I cannot understand them." (Teacher 3 a)

"Sometimes I use the CAPS documents, but I really just do not understand the documents. It is a big thick document and it is not easy to understand on your own." (Teacher 3 b)
"I do not understand everything, so I only use the parts that I feel is important. CAPS is very complicated, and I often need to use easier activities that the children can understand" (Teacher 3 c)

"If all the documents could be in my home language maybe I would understand better. I do not always understand what is expected of me, often I use goggle to translate the documents or to find out what various concepts are. Unfortunately, I do not have a computer in my classroom so I cannot always do this. The CAPS

document is very thick and contains a lot of information that I find irrelevant." (Teacher 3 d)

"I understand the document 100%. Everything is divided into terms and guides teachers and gives instructions on what a teacher should teach daily. Guidelines and overviews very explanatory. If you just read it you will know what to do. Some teachers are just too lazy to read. Not all of them use CAPS and when they do they take short cuts and only teach parts they understand. Mostly they do not understand and teach concepts hastily." (Teacher 3 e)

From the responses of the Grade 3 teachers it is evident that their experiences with teaching Mathematics has not been an easy task. The researcher is of the opinion that all these factors contribute to the low marks produced by the Grade 3 Mathematics classes and these matters should be researched further. The Grade 3 teachers were then asked what they would change in their classrooms that would make them more proficient in the teaching of Grade 3 Mathematics.

The responses of most participants were of a negative nature which led the researcher to believe that these teachers are really crying out for help. This was evident by the following responses:

"I really wish that I could do Mathematics, I try so hard, but have given up." (Teacher 3 a)
"*It sounds like we moan a lot, but what we say falls on deaf ears. Far too much is expected from teachers."* (Teacher 3 d)

"I cannot say anything even if I wanted to change things it wouldn't help as teachers are ignored. We are just dictated to and should oblige." (Teacher 3 c)

"Every year things change, and we should just do what we are told." (Teacher 3 d)

"I do not feel that I need to change anything, my children are doing well in Mathematics." (Teacher 3 e)

5.4. The successes that are experienced by Grade 3 Mathematics teachers

The Grade 3 Mathematics teachers were asked if they had implemented any intervention strategies to improve the outcomes of Grade 3 Mathematics in their schools and in their respective classrooms and whether or not these interventions have been successful in improving the Mathematics outcomes of their Grade 3 learners.

The responses of the participant to establish the following theme:

Category 3.9: Intervention programmes that assist struggling Grade 3 learners in the learning of Mathematics

The participants answered this question in the following way:

"Our school has implemented after school homework classes for learners that struggle with Mathematics. Due to the fact that these classes are conducted in smaller groups allows the teachers to give all the children individual attention, something that we cannot do in our classrooms during school hours. This has had a positive impact on some of the Grade 3 learners' Mathematics results." (Teacher 3 a)

"I have introduced extra lessons for learners who experience barriers to learning in Mathematics. If the learners attend regularly it does seem to improve their Mathematics outcomes." (Teacher 3 b)

"I have asked a parent to come and assist me after school, to maintain discipline in the researcher's classroom while I spend extra time with the children who are struggling with Mathematics. Spending this extra time on a one on one basis has had a positive impact on the Mathematics outcomes of my Grade 3 learners." (Teacher 3 c)

"*I have joined a Grade 3 Mathematics group that exchange best practices and gives each other tips on how to teach concepts to children that experience barriers to learning in Mathematics. This has helped me a lot as often I do not know how to get through to some of my learners."* (Teacher 3d)

"Our school has a study group, extra classes for Mathematics and a Mathematics league that the children take part in. These extra efforts to improve the Mathematics outcomes of Grade 3 learners has had a positive effect, but there is definitely a lot more that schools need to do to improve the Mathematics outcomes of Grade 3 learners." (Teacher e).

The main finding was that all the grade 3 teachers had implemented some form of intervention programme to assist struggling learners in their grade 3 classrooms. The literature that this finding is linked to is many intervention programmes in South Africa have to be launched to promote Mathematic improvement (UNESCO,2012)

5.4.1. Theme 4: Strategies to enhance teachers' proficiency towards the teaching of Mathematics

This theme emerged after listening to all the challenges that the Grade 3 Mathematics teachers faced. For every problem there has to be a solution. The researcher is of the opinion that professional development in Mathematics could solve some issues.

Most challenges demand funds, resources and active participation from all the stake-holders that promote the teaching and learning of Mathematics in Grade 3. However, no quick fix is available and addressing all the challenges will be an extremely long journey, marked with time, effort, dedication and positive motivation.

The following categories emerged:

Category 4: Teachers' developmental training

The responses of the participants revealed that they are in urgent need of develop-mental training. In their opinion training will help them to teach Mathematics more effectively and thus the learners in Grade 3 will achieve better results. The Grade 3 Mathematics teachers were asked if they feel that developmental training will help to improve their proficiencies in Mathematics teaching.

> *"I feel that I really need to receive more training in Mathematics teaching and learning. It is a desire of mine to develop my knowledge in Mathematics and be able to teach my learners more effectively*." (Teacher 3 a)

> *"One of my needs as a teacher is to update my knowledge and be able to use methods that help my Grade 3 learners to learn more effectively. Developmental training will really be beneficial to me."* (Teacher 3 b)

> *"I think that if I receive more training, I will feel more confident and I will gain a better understanding about what I need to include in my Mathematics lesson plans. I have a problem with planning lessons that include all the learners in my Grade 3 classroom."* (Teacher 3 c)

> *"More time is needed for training, not just once in six month or a year. I need to be trained on a continuous basis as I have a lot of*

problems in my Mathematics classroom that I need answers to." (Teacher 3 d)

"I think that more training will improve my knowledge and help me to become a better teacher. (Teacher 3 e)
The main finding was that grade 3 mathematics teachers need more training. This is linked by the statement by Walter and Biggs (2012) that states that professional development is of utter importance to teachers because it is concrete and classroom-based,brings expertise from outside the school and enables teachers to work collaboratively with their peers. It gives teachers the opportunity to partake in mentoring and coaching activities.

Category 4.2: Recommendations that Grade 3 teachers would make to SMT with regards to CAPS implementation

The Grade 3 Mathematics teachers were asked what changes they would make to lesson plans, teaching methods and approaches and assessment policies that are currently used in the teaching and learning of Mathematics in Grade 3 classrooms. These recommendations should be given to the SMT's of the various schools.

The following themes emerged from this question:

Category: 4.2. Lesson planning. What would you change about the lesson plans for Grade 3 Mathematics teaching and learning?

The Grade 3 teachers responded in the following way:

"I will make the Lesson plans for Grade 3 Mathematics easier to understand. At the moment our Lesson plans are too complex and are not easy to understand" (Teacher 3 a)

"I would change the Lesson plans so that they include activities for all the ability groups in Grade 3 classrooms. I will also include activities that move from concrete to abstract concepts." (Teacher 3 b)

"I will change the Lesson plans so that they include group work and work for all ability groups." (Teacher 3 c)

"Other schools have lessons that are worked out for them, we would also like them" "Give us whiteboards and projectors and televisions so that we do not always have to explain and children just listen, but we can show them how other people teach lessons." (Teacher 3 d)

"The whole grade should be together and plan the lessons on a weekly basis.it should include problem solving and group work. All teachers should use CAPS to plan their lessons correctly." (Teacher 3 e)

Category: 4.2.1. Teaching methods and approaches.

The Grade 3 teachers were asked what they would do to improve the methods and approaches which are currently being applied to teach Mathematics in Grade 3 classrooms

"I think that Grade 3 teachers can improve their teaching methods and approaches by going back to basics and using the methods that they were taught in college. We were taught to use apparatus to explain concepts and use group work and problem-solving activities." (Teacher 3 a)

"Most of the Grade 3 Mathematics teachers avoid group work in their classrooms because of the discipline problems and the noise

levels. We should change our approaches and methods for teaching Mathematics, by using group Work and concrete apparatus." (Teacher 3b)

"We should change our teaching approaches and methods to include lessons that are interesting, creative and fun for Grade 3 learners. Our teaching approaches and methods should include group work as it is very important, get the learners actively involved. We can also make our lessons more enjoyable for the Grade 3 learners and use games and songs." (Teacher 3 c)

"We should change our approaches and methods for Mathematical teaching and learning in Grade 3, to group work and practical activities. We can use whiteboards, projectors and televisions to present concepts to the Grade 3 learners. We should also include activities that will allow the learners to be actively involved in the Mathematics lesson. (Teacher 3 d)

"We should apply approaches and methods that include group work and problem- solving activities. Grade 3 Mathematics teachers should also teach towards understanding and teach by first using concrete objects and they move onto abstract concepts." (Teacher 3 e)

Category: 4.2.2. Assessment.

Grade 3 teachers were asked what changes they would make to the way in which Grade 3 Mathematics learners are presently being assessed.

The teachers responded by saying the following:

"We should use various forms of assessment, especially informal assessment." (Teacher 3 a)

*"Grade 3 Mathematics teachers should not just use formal assessments to assess the learners but can informally assess these learners during group activities and when they are solving problems while working with apparatus." (*Teacher 3b)

"Grade 3 Mathematics teachers should focus less on formal assessment tasks and their learners on a continuous basis. Assessments should be fun for the Grade 3 learners and should contain high and low order questions." (Teacher 3 c)

"Assessment should be set up according to CAPS guidelines. If you use the document, you won't have a problem." (Teacher 3 e)

Teacher 3 d did not want to say anything as she felt that she could not change the way in which Grade 3 learners were assessed even if she wanted to. This is due to the fact that each school has an assessment policy and prescribes how the learners are assessed. This should however be in line with the CAPS document.

In addition to using conducting interviews with the Grade 3 teachers, the researcher also engaged in non-participation observation which she will now discuss in the following section.

5.NON-PARTICIPANT OBSERVATION

The researcher used non-participant observation to observe the experiences of Grade 3 Mathematics teachers in selected schools. The reason for doing this was to observe the behaviors of these teachers in regard to Mathematical teaching and learning in Grade 3 classrooms. The researcher wished to gain a better understanding of the different teaching approaches and strategies that are used to teach Mathematics in Grade 3 and the extent to which these teachers vary these approaches in their daily lessons.

The researcher also wished to use this observation to gain a better understanding of the challenges that hamper the process of effectively teaching and learning of Mathematics in Grade 3 classrooms.

Non-participant observation allowed the researcher to determine where the gap lies between what is prescribed by the CAPS document with regard to what should be taught and what is actually being taught in Grade 3 Mathematics classrooms. The researcher embarked on a fact-finding mission to establish what factors either enabled or prohibited the Grade 3 teachers from fully complying with the approaches prescribed by the document for effectively teaching Mathematics.

This could thus be beneficial in the long run to find strategies that could increase the proficiency levels of Grade 3 Mathematics teachers, empower them to teach more effectively and obtain better outcomes in Grade 3 Mathematics classrooms.

The researcher wrote down the information that was obtained during this observation so that she could analyse and compare the information to that obtained through the interview process and the analysis of the documents pertaining to the teaching and learning of Grade 3 Mathematics.

The researcher obtained the following information from the non-participation observation.

5.5.1 Teacher 3 (a)

The Mathematics classroom of Teacher 3 (a) was observed by the researcher as being well organized, but very small, accommodating 42 Grade 3 learners. Although this Mathematics classroom was well organized, the classroom was in need of maintenance as the walls were extremely dirty, the carpet in need of replacing, only one light was working and the blackboard was peeling. Teacher 3 (a) did however make a continuous effort to brighten up the classroom and create an environment conducive to learning, by lining the walls with posters, pictures and word-charts. The

observer however did not observe any Mathematical language in the classroom. The desks in Teacher 3 (a)'s classroom was not arranged according to ability groups, but were arranged in straight lines, one behind the other.

Whilst observing Teacher 3 (a) during various Mathematics lessons, the researcher noted that Teacher 3 (a) favoured the use of direct instruction and relied heavily on the textbook and DBE workbook for examples and explanations of Mathematical concepts. She felt more confident to use a lecture approach to teach the Grade 3 learners in her classroom and applied the same method or approach throughout the entire lesson without varying her methods of instructions. Specialized approaches were not used to assist struggling learners in the Mathematics classroom. Teacher 3 (a) used memorization and rote counting in her classroom and learners were not asked questions to check for understanding. The learners in this Grade 3 Mathematics classroom ideally counted in sequence from memory and were not made aware of the value of each number.

Mathematics lessons in Teacher 3 (a)'s classroom was very teacher-centered, devoid of active learner participation, as learners were not encouraged to discuss their work or share ideas, but to sit quietly and work independently. The learners in Teacher (a)'s classroom were not asked questions or asked to explain what methods they used to arrive at an answer, but rather given the procedure to follow and the correct answer they should arrive at. These Grade 3 learners were not encouraged to construct their own knowledge or explore different methods and approaches that can be used in the teaching and learning of Grade 3 Mathematics.

Special activities were not provided for learners who have barriers to learning and highfliers were not given enrichment tasks to prevent them from becoming bored and disrupting the other learners. During Mathematics lessons in Teacher 3 (a)'s classroom the teacher did try and assist the learners who were struggling. She sat next to each of them and tried to explain to them. Unfortunately lack of knowledge on her part led to these learners not doing the work correctly and Teacher 3 (a) getting frustrated and moving on to the next child.

The researcher also observed the fact that Teacher 3 (a) had no idea of the theories that are needed to teach and learn Mathematics in Grade 3 classrooms. The theories that she should have had knowledge in included social constructivism, behaviourism and connectivism. Unfortunately, Teacher (a) did not know what these theories were or understand how these theories need to be incorporated into Mathematics lessons to ensure that optimal teaching and learning transpires.

Often these Mathematics lessons in Teacher 3 (a)'s classroom were disrupted by learners who misbehaved, and the noise level was at times almost deafening. The researcher observed that discipline was a problem in this teacher's Grade 3 Mathematics classroom and Teacher (a) seemed to lack the skills that are needed to maintain discipline in classrooms that are overcrowded.

Group-work was not conducted regularly but when the learners did work in groups on the carpet, the learners who remained at their desks talked continuously and Teacher (a) had to leave the group she was working with and attend to those learners. The carpet that this Grade 3 teacher used while doing group-work was very dirty and the space was very limited. The researcher also observed the fact teaching aids and apparatus were in short supply. This also disrupted the Mathematics lesson as learners had to share apparatus as there was not enough for each learner to have their own apparatus.

The researcher observed that many learners in Teacher (a)'s classroom were affected by social problems and could not concentrate or sit still. They also lacked the basic provisions that a learner should have: school shoes, school uniform, nutrition and stationery. Some learners in teacher (a)'s classroom continuously asked when they were going to go and eat. This also contributed to the fact that the learners could not concentrate due to the fact that they were hungry. It was also an observation of the researcher that many of these children could not read and had difficulty in writing legibly.

The researcher observed the fact that Teacher (a) did not use the CAPS document while teaching any Mathematics lessons. Teacher (a) lacked knowledge and skills

that are needed to teach Mathematics and came across as being unconfident. She also showed a negative attitude towards Mathematics which was prevalent in the way she talked about the subject and answered the questions when interviewed.

5.5.2 Teacher 3 (b)

The Mathematics classroom of Teacher 3 (b) was observed by the researcher as being well organized, but very small, and accommodating 41 Grade 3 learners. It provided little space for movement as it was overcrowded. The researcher observed that Teacher 3 (b)'s classroom was neat and tidy, but in need of intense cleaning and maintenance. The blackboard was peeling, lights needed florescent tubes, windows did not have latches on them, the door was broken and desk and chairs were in need of repair. Teacher 3 (b) did however try to improve the learning environment in the Grade 3 Mathematics classroom by ensuring that the classroom was print rich and filled with colourful illustrations. The classroom was divided into various themes and Mathematics language and diagrams were displayed on the Mathematics wall.

The desks in this classroom were arranged in ability groups with six learners in each group. Each table was equipped with counting cards and number lines, which were homemade and affixed to each table. The researcher did however observe that counting apparatus and manipulatives were in short supply and had to shared, especially when the Grade 3 learners participated in group activities.

The researcher observed that Teacher 3 (b) had a vague idea of the theories of social constructivism and behaviourism but had no idea what connectivism was. She also did not know that these theories are vitally important to the teaching and learning of Mathematics. The influence of behaviourism and constructivism were evident in this teacher's classroom but occurred ad hoc.

Teacher 3 (b) used classical teaching, direct teaching using the textbook and blackboard, group-work conducted on the carpet with various ability groups and made use of various concrete apparatus to explain Mathematics concepts to the Grade 3 learners. The teacher also made use of working in pairs so that stronger learners could

assist the learners who were struggling to understand and learn Mathematics in this Grade 3 classroom.

Teacher 3 (b) presented many lessons in a learner-centred manner by encouraging active participation from learners in the form of discussing answers and explaining methods and approaches that they had use to solve problems. Although this teacher did use various methods and approaches to teach Mathematics in her classroom, little time was spent on mental Mathematics and not much time was spent on problem–solving activities or word problems. In Teacher 3 (b)'s Mathematics classroom counting was done in a rote fashion and learners were not asked to count from random numbers but counted in sequence displaying little understanding of the value of numbers.

Learners in Teacher 3 (b)'s classroom could not do basic subtraction sums, tell time or work with volume and measurement. During the observation Teacher 3 (b) tried to explain these concepts to the Grade 3 learners but had no success in explaining these basic operations and lacked pedagogical knowledge in mathematical teaching and learning. Practical activities were seldom done, and children were not given the opportunity to estimate, predict or solve problems that were connected to their everyday experiences.

Times tables were also taught in parrot fashion. No special activities were provided for learners who experienced barriers to learning and high-flyers who had completed their activities walked around or talked as they were bored.

Teacher 3 (b) did not use the CAPS document for teaching Mathematics during the Mathematics lessons and seldom checked the Lesson plan to see if what she was teaching was prescribed for that week. She did however use the DBE workbook during most of her lessons.

The discipline during group-work was extremely poor and the classroom was extremely noisy, causing Teacher 3 (b) to become frustrated and later shouting to try and keep her Grade 3 learners under control. Teacher (b) lacked skills and knowledge

to maintain discipline in a classroom that was overcrowded. The researcher also observed that the learners lacked their own stationery so walked around to try and borrow from their fellow learners. This also increased the discipline problem in Teacher 3 (b) ‘s classroom.

During the observation, the researcher did not observe any language barriers but did concur that social problems and poverty played a huge role in the underperformance of many Grade 3 learners in Teacher (b)’s classroom. Many learners in this classroom lacked hygiene, were ill, had no stationery and were in need of school uniform. A large number of pupils were also absent from school. Lessons in teacher (b)’s classroom were also interrupted regularly as Teacher (b) was often called to the office to sort out matters concerning the union, as Teacher (b) was a site steward for a respective union.

The researcher observed that Teacher (b) was confident to teach certain concepts in her Mathematics classroom, but less confident when teaching concepts that she did not understand or found difficult to explain to her Grade three learners.

5.5.3 Teacher 3 (c)

The researcher observed the Mathematics classroom of Teacher 3 (c) as being disorganized, dirty and in need of maintenance. This classroom was extremely small and was filled beyond capacity and made to accommodate 43 learners. The researcher observed that the walls and blackboard were peeling, old Bostic was stuck on the walls, the carpet was frayed and dirty and a large window was broken and temporarily repaired by using plastic and brown tape. The desks in Teacher 3 (c)’ s classroom were not organized in ability groups, but rather in straight lines with the desks placed one behind the other. Teacher 3 (c) had posters on the walls, but the themes were unrelated to the present lessons and no mathematical language or pictures were present in the classroom.

Teacher 3 (c) was mostly in favour of using whole class instruction, which was conducted on the carpet in the classroom. During these lessons Teacher 3 (c) used creative games and activities to teach counting and other Mathematical concepts like more and less or equals to. The Grade 3 learners did action rhymes, counted body part and objects in the classroom and sang songs that were related to mathematical learning. Teacher 3 (c) also demonstrated concepts like measurement, volume and time by using practical activities and using concrete objects, pictures and cards so that the Grade 3 learners could explore and construct their own knowledge.

When the learners were sitting at their desks, Teacher 3 (c) used direct teaching to teach Mathematical concepts. She used the DBE workbook for examples and wrote the work on the board. It was observed by the researcher that detailed explanations were not given to the learners and questions were not asked to check if the learners fully understood what they were expected to do. Teacher 3 (c) did not use the CAPS document while teaching her lessons, and although there was a Lesson plan on her desk, she seldom looked at it.

Teacher 3 (c) displayed limited knowledge of the theory of behaviourism and social constructivism but displayed no knowledge of the theory of connectivism. Certain elements of behaviourism and social constructivism were present in her lesson presentation, but occurred by accident and were not purposely implemented into the Mathematics lessons.

The researcher also observed that very little group work was conducted in Teacher (c)'s Grade 3 Mathematics classroom. Teacher 3 (c) did not alternate between methods and approaches while conducting her Mathematics lessons and no specialized methods were used to accommodate the Grade 3 learners that experienced barriers to learning in Mathematics. All the learners received the same type of activities and activities were not adapted for learners who were experiencing barriers to learning in Mathematics. Teacher 3 (c) also failed to provide the learners who had a higher aptitude for Mathematics with enrichment activities.

The researcher also observed that a large percentage of the learners in Teacher 3 (c)'s classroom was severely affected by social problems and poverty. These learners were very neglected, undernourished, lacked stationery and suffered from Foetal Alcohol Syndrome. Language barriers were also a factor that affected these learners as their home language was Tswana and the language of instruction was Afrikaans. These learners did not understand the concepts that were being explained in Afrikaans and unfortunately Teacher 3 (c) could not translate the concepts into their home language, as she was Afrikaans-speaking and had no command of the Tswana Language. The researcher observed that Teacher 3 (c) lacked the skills and knowledge that are needed to maintain sound discipline in a Mathematics classroom. The learners were very disruptive, walked around talked excessively and fought with each other.

Teacher 3 (c) did however try and assist the learners who were struggling with Mathematics, by sitting next to them and trying to assist them. This however did not really have an impact as other learners started misbehaving and Teacher 3 (c) had to stop assisting these learners and try to resume control in her classroom.

It was a general observation of the researcher that Teacher 3 (c) did have a positive attitude towards Mathematics teaching and learning and interacted with her learners in a positive and encouraging manner. She was very confident when teaching certain concepts, but lost confidence when the learners in her classroom started misbehaving.

5.5.4 Teacher 3 (d)

The researcher observed that the Grade 3 Mathematics classroom of Teacher 3 (d) was well organized but tended to be a bit cluttered as it lacked cupboard space and shelves. The classroom was very small and accommodated 39 learners. The general perception that the researcher got from this classroom was that it was in need of extensive cleaning and maintenance as the carpet was dirty, the walls were in need of paint, some of the chairs were broken and desk tops were loose. The researcher also observed that a few of the windows required replacing and not all the lights were

working. The walls of Teacher 3 (d)'s classroom was lined with various pictures and posters but were not representative of the current theme that the Grade 3 learners were currently studying and little space was allocated to mathematical language and concepts. Unlike the some of the other Foundation Phase classrooms that the researcher observed, this classroom did not have a basin which is essential in Foundation Phase classrooms. The researcher observed that the desks in Teacher 3 (d)'s classroom were organized in ability groups.

During the Grade 3 Mathematics lessons it became apparent that Teacher 3 (d) had some knowledge of social constructivism, behaviourism and connectivism, all vitally important theories for the teaching and learning of Grade 3 Mathematics. The researcher also observed that Teacher 3 (d) used direct instruction using the blackboard and the DBE workbook, various group-work activities with concrete apparatus and manipulatives which allowed the learners to construct their own knowledge, flashcards and counting cards to teach her Grade 3 Mathematics lessons.

She also allowed the learners to work in pairs relying on the stronger learners to assist the weaker ones while she continued to work with groups on the carpet. Teacher 3 (d) also allowed the Grade 3 Mathematics learners to explain the work back to her after she had taught various concepts, thus checking for understanding and to ensure that optimal learning had taken place. It was however observed by the researcher that Teacher 3 (d) did not include many practical lessons to teach concepts like time, volume, capacity and measurement in her Mathematics lessons and not many opportunities were presented for learners to explore, predict or solve everyday problems in the classroom.

The researcher also observed that special methods and approaches were not included into the lesson plan of Teacher 3 (d) to assist learners with barriers to learning, nor were activities adapted to accommodate the diverse needs of these specific learners. No enrichment activities were included for learners who had a higher aptitude for Mathematics, which often led to children who finished first being disruptive and walking around in the classroom.

During group work the classroom was very unruly, even though Teacher 3 (d) employed the stronger learners to assist the weaker ones at their desks while she continued to give learners individual attention on the carpet. This was done to try and maintain discipline in the classroom, but led to learners fighting, talking continuously and walking around.

The researcher also observed that this Mathematics classroom was under resourced and during group work learners had to share apparatus and manipulatives. This also led to behaviour problems as learners were not eager to share the apparatus and fought continuously. During the Mathematics Lessons Teacher 3 (d) put in a concerted effort to actively involve all the learners in the classroom, but some learners refused to participate and did not answer any questions or follow any of the instructions that Teacher 3 (d) gave them. The lessons were also disrupted regularly by learners needing to go to the bathroom or asking to drink water.

The learners in Teacher 3 (d)'s classroom were severally handicapped by social problems and poverty. Many learners were neglected, in need of hygiene, lacking school uniform, stationery, school shoes, displaying signs of illness and suffering from Alcohol Syndrome. The researcher also observed the fact that many of these children were hungry, as they continuously asked when they were going to have lunch. Many learners in Teacher 3 (d) classroom could not read and language barriers were also prevalent in this Mathematics classroom as the learner's home languages differed from the language of instruction.

It was observed by the researcher that during Mathematics Lessons Teacher 3 (d) did not use the CAPS document or a lesson plan to guide her lesson instruction but did however teach with confidence. The researcher observed that Teacher 3 (d) was competent to teach certain concepts but lacked vital knowledge and skills to teach concepts that required more practical demonstration like time, volume, capacity, measurement and problem-solving skills.

5.5.5 Teacher 3 (e)

The researcher observed Teacher 3 (e)'s classroom to be well organized, neat and tidy and creating a learning environment that is conducive to effective teaching and learning. The walls of Teacher 3 (e)'s classroom was divided into various themes and subjects and mathematical language and mathematical concepts were prominent and neatly displayed with detailed explanations and labels. Teacher 3 (e) had her desks arranged in ability groups to accommodate the 41 learners that were present in this classroom. The only physical defects that the researcher observed in this classroom was the fact that many of the plastic chairs were broken, the blackboard was peeling and the carpet was dirty.

During the observation of Teacher 3 (e)'s Mathematics lessons, the researcher observed the fact that Teacher 3 (e) had knowledge of social constructivism, behaviourism and connectivism. She used social constructivism during her group-work sessions and behaviourism when modelling and scaffolding learners who were experiencing barriers to learning, but connectivism was not present in the Mathematical lessons.

The researcher observed that Teacher 3 (e) used group work with concrete apparatus and manipulatives, place-value cards, counting cards, number lines and concrete forms to teach various concepts in her Grade 3 Mathematics classroom. She used a very learner-centred approach to conduct her lessons and actively involved her learners by asking questions and asking her learners to explain work back to her to check for understanding and to ensure that the learners had mastered the intended content. Practical lessons were demonstrated by using concrete forms to teach concepts like shape, measurement and volume. Teacher 3 (e) rotated these groups daily and spent more time with the last group which was struggling to understand and grasp the basic concepts required in mathematical learning. The researcher did however observe that Teacher 3 (e) did not include problem-solving activities in her group work sessions and data handling was not addressed.

During group work it was the observation of the researcher that discipline was seriously lacking and learners who were supposed to be completing work at their tables, talked continuously, fought with each other, used peashooters to shoot paper around the classroom and wandered around aimlessly. Teacher 3 (e) seemed to ignore this behaviour and seldom addressed it. Activities were not adapted for learners with barriers to learning. These learners were given the same activities as the rest of the class and because of their inability to complete these activities became disrupted and displayed behaviour problems. Teacher 3 (e) did not provide extra work for learners that had a higher aptitude for Mathematics and these learners contributed to the discipline problem by finishing first and then disrupting other learners.

The researcher also observed that other than the extra assistance that was provided to learners with barriers to learning, during group-work, Teacher 3 (e) did not offer assistance to struggling learners. These learners were left to their own devices and whether they completed an activity or not was not an issue. The researcher also observed the noise level in this specific classroom was high and bordered on deafening.

Learners in Teacher 3 (e)'s classroom were affected by social problems and poverty, as their general health and hygienic conditions were poor, lacked nutrition, and were devoid of the basic needs that learners should possess. A large percentage of the children could not read. The lack of resources were not observed as being a challenge in the classroom of Teacher 3 (e) as many resources that were used in her Mathematics lessons were either homemade or made from recycled materials and everyday items that were collected by the learners. This included bottle tops, pebbles, corks and beads.

During the lessons that were presented by Teacher 3 (e) the researcher observed that Teacher 3 (e) did not use the CAPS document or refer to the lesson plan that was laying on her desk. She did however seem to know the steps that she should follow and presented her lessons in a confident and competent manner.

The content that was analyzed in various documents pertaining to teaching and learning Mathematics in Grade 3 will now be discussed.

5.6 DOCUMENT ANALYSIS

According to Mills (2010) a document refers to a way of recording a specific human activity which will later provide the researcher with sources of valuable data in their research study. The way in which this document is scrutinized and interpreted is the referred to as document analysis. Santhanam (2015) refers to this process as occurring in qualitative research to allow the researcher to review, analyse and assess various documents in order to establish an appraisal theme.

According to Sidhu (2006) document analysis is a way of ultimately breaking down data that a researcher has collected into smaller parts for the purpose of, later use and interpretation. O'Leary (2014) refers to document analysis as being a form of qualitative research, allowing the researcher to interpret documents and further give voice and meaning to a given topic of research. O'Leary (2014) states that there are three types of documents that can be analysed: public records, personal documents and physical evidence.

In this research study the researcher had to review or analyse documents that pertained to the effective teaching and learning of Grade 3 teachers in selected schools. They included official CAPS documents issued by the DBE for the teaching and learning of Mathematics in Grade 3, school policies on the assessment on teaching of Grade 3 Mathematics, lesson plans, National Protocol for Assessment Grade R-12, Assessment plans and activities, learner portfolios and learner's workbooks. The researcher also analyzed the individual school's ANA Statistics from 2012-2014.

The selected documents served as an important form of data collection as they provided information on the methods and approaches that are used to teach Grade 3 Mathematics, the way in which assessment is conducted, various forms of assessment, how lessons are planned and curriculum coverage results of Grade 3 Mathe-

matics learners. The policy documents were analyzed to allow the researcher to compare findings from the research study and interpret them against the background of what is prescribed for Grade 3 Mathematics and what actually is being taught.

The following documents were chosen and analyzed by the researcher:

- The National Protocol on Assessment Grade R-12
- School policies pertaining to teaching and assessment in Grade 3 Mathematics
- Lesson plans of teachers.
- Teacher's Assessment plans and activities
- Learners' books and portfolios
- Interview sheets
- Statistics for ANA results for 2012 – 2014 where available
- DBE (2011) Curriculum and Assessment Statement for Teaching Mathematics Grade R-12
- DBE (2010) Guidelines for Inclusive Teaching and Learning
- DBE. (2012). Report on the Annual National Assessments 2012.Pretoria: DBE.
- DBE. (2011). Report on the Annual National Assessments of 2011.Pretoria: DBE.
- DBE. (2011b). Report on the Annual National Assessments of 2011.Pretoria: DBE.
- DBE (2013) Report on Annual National Assessment Grade 1 to 6 and 9
- DBE and Department of Higher Education and Training (DBE and DHET). (2011).
- DBE (2018) Mathematics Teaching and Learning Framework for South Africa: Teach Mathematics for Understanding.
- DBE (2011) National Curriculum Statement (NCS) National Protocol for Assessment Grades R – 12

5.6.1 The approach used in document analysis

In this research study, the researcher used a deductive qualitative approach to analyse the respective documents. The researcher based her document analysis on how various themes emerged from the study, divided them into categories, and made use of thematic analysis for the analyzing of the Grade 3 Mathematics teacher's responses in the interviews.

The themes that emerged from this document analysis and their categories from relevant text will now be discussed:

5.6.2 Theme 1: The availability of CAPS documents for Grade 3 Mathematics teachers

Teacher 3 (a)

The researcher observed that Teacher 3 (a) did in fact possess the CAPS document for the teaching and learning of Mathematics, but this document was a photocopy and was severely faded and some parts of the document were hardly legible. The researcher asked Teacher 3 (a) Why the document was not recopied? Teacher 3 (a) replied as follows:

> "I have been meaning to recopy the document for a while now, but I do not have photocopy paper to do it". (Teacher 3 a)

Teacher 3 (b)

The researcher observed that Teacher 3 (b) had the CAPS document for teaching and learning Mathematics. This document was also a photocopy but was legible and neatly bound in a folder. When teacher 3 (b) was asked by the researcher "Why is the document a photocopy?" The response was as follows:

“We only received one book from the Department of Education, and we were told to make photocopies for the rest of the Grade 3 teachers”. (Teacher 3 b)

Teacher 3 (c)

Teacher 3 (c) also possessed the relevant CAPS document for the teaching and learning Mathematics. The researcher observed that this document was an original copy and was neatly bound in a folder.

Teacher 3 (d)

Teacher 3 (d) was in possession of the relevant CAPS document for the teaching and learning of Mathematics. The researcher observed that Teacher 3 (d)’s CAPS document for teaching Mathematics was not an original booklet, but a faded photocopy of the original CAPS document. The researcher asked Teacher 3 (d) “Why the document was not original and so severely faded?” Teacher 3 (d) responded as follows:

“We only received one original CAPS document and had to make photocopies for the rest of the Grade 3 teachers. Unfortunately, we no longer have an original copy, as when teachers change grades, they take the teaching material with them and then the documents seem to go missing.”

Teacher 3 (e)

The researcher observed that Teacher 3 (e) was in possession of the CAPS document that is required for the teaching and learning of Mathematics. Teacher 3 (e)'s CAPS document for teaching and learning Mathematics was a photocopied document but was easily legible and neatly organized in a file.

This theme was then broken down into smaller categories that occurred in the document analysis process.

5.6.3 Category 1: Teachers are in possession of the CAPS document for the teaching of Grade 3 Mathematics, but are these teachers competent to use them?

Many participants stated that they had the relevant documents but did not understand them or only taught the parts of the document that they understood.

The researcher was of the opinion that although CAPS provided each Mathematics teacher with a week by week instruction of what should be taught, when and for what allocation of time, the Grade 3 teachers did not understand what methods to use to teach the content. In this case simply possessing a document is not enough. Teachers need to be guided and monitored to issue the proper use of CAPS documents, especially in Mathematics.

Teacher 3 (a)

During the Mathematics lessons that were executed by Teacher 3 (a) the researcher observed that Teacher 3 (a) did not use the CAPS document while teaching her Mathematics lessons.

Teacher 3 (b)

The researcher observed that in Teacher 3 (b)'s classroom, Teacher 3 (b) did not use the relevant CAPS documents to teach Mathematics her in Grade 3 classroom.

Teacher 3 (c)

It was observed by the researcher that Teacher 3 (c) did not use the CAPS document to teach Mathematics lessons in her Grade 3 classroom.

Teacher 3 (d)

In the classroom of Teacher 3 (d) the researcher observed that Teacher 3 (d) did not use the CAPS document to teach her Mathematics lessons to Grade 3 learners.

Teacher 3 (e)

It was an observation made by the researcher that Teacher 3 (e) did not use the CAPS document for teaching and learning Mathematics when teaching Mathematics to her Grade 3 learners.

When asked by the researcher if they were competent to use the CAPS document to plan and teach Mathematics to Grade 3 learners, the Grade 3 teachers responded as follows:

> *"I do not really use them that much, oh now I start reading the CAPS documents and give up after a while as the documents are very long, and I cannot understand them."* (Teacher 3 a)

> *"Sometimes I use the CAPS documents, but I really just do not understand the documents. It is a big thick document and it is not easy to understand on your own."* (Teacher 3 b)

> *"I do not understand everything, so I only use the parts that I feel is important. CAPS is very complicated, and I often need to use easier activities that the children can understand."* (Teacher 3 c)

> *"If all the documents could be in my home language maybe I would understand better. I do not always understand what is expected of me, often I use goggle to translate the documents or to find out what various concepts are. Unfortunately, I do not have a computer in my classroom so I cannot always do this. The CAPS document is very thick and contains a lot of information that I find irrelevant."* (Teacher 3 d)

> *"I understand the document 100%. Everything is divided into terms and guides teachers and gives instructions on what a teacher should teach daily. Guidelines and overviews very explanatory. If you just read it, you will know what to do. Some teachers are just too lazy to read. Not all of them use CAPS and when they do they take short cuts and only teach parts they understand. Mostly they do not understand and teach concepts hastily*." (Teacher 3 e)

The answer that was provided by Teacher 3 (e) was very interesting to the researcher as although this teacher answered that she was fully competent to use the CAPS document to teach Mathematics to Grade 3 learners, it was observed by the researcher that Teacher 3 (e) did not use this document during any of her Mathematics lessons. This enforced the fact that possessing the CAPS document for teaching Mathematics is not enough; it should be used correctly and in the way that is prescribed by the DBE.

5.6.4 Category 2: More training is needed to use the CAPS documents effectively

Many participants stated that they did not use the CAPS documents as often as they should as they found them difficult to understand and only taught the content that they understood.

> *"I do not understand everything, so I only use the parts that I feel is important. CAPS is very complicated, and I often need to use easier activities that the children can understand."* (Teacher 3 c)

Msibi (2013) cited in Singh (2015) makes mention that the main reason for CAPS implementation was a teacher-proof approach to curriculum delivery and it could be followed by even poorly educated teachers.

In the researcher's opinion no approach can be teacher-proof as guidance is needed to use the documents in the way they are intended. Skills need to be taught in order

to increase competencies (Knight, 2002) especially in regard to document use and understanding.

5.6.5 Theme 2: Lesson plans for teaching Mathematics to Grade 3 learners

All Mathematics teachers should be in possession of a comprehensive Mathematics lesson plan. This lesson plan should be detailed and include all the concepts that the teacher wishes to teach, the methods and approaches that will be applied, activities that the learners should complete, special activities for learners that experience barriers to learning, enrichment activities for high-flyers, the resources that are required to conduct the lesson and the forms of assessment that will be used to assess the learners. The CAPS document for teaching Mathematics to Grade R-12 specifically states exactly what should be included in lesson plan. It should include whole class teaching, small group teaching, practical lessons and problem-solving activities.

It gives the teachers a complete scope of areas of content that should be taught, the time duration and weight each content carries, including small group teaching, whole class teaching, practical problem solving and independent activities. It also talks about including all learners' capabilities in lesson plans, including learners with barriers to learning and providing enrichment for high-flyers in the classroom. Various literature and the observations of the researcher led the researcher to form the opinion that Grade 3 teachers do not know how to plan their Mathematics lessons appropriately.

During the observation the researcher observed the following about each of the Grade 3 teachers' Mathematics classrooms:

Teacher 3 (a)

Teacher 3 (a) did not use a Mathematics lesson plan while conducting her Mathematics lessons. The lesson plan was not visible during the Mathematics lessons and Teacher 3 (a) never consulted the lesson plan in order to maintain if she was following the correct steps, using the correct approaches and methods to teach Mathematics

to her Grade 3 learners, or to determine if she was teaching the correct concept that was prescribed for that day. When Teacher 3 (a) produced her lesson plan, it was observed by the researcher that this Mathematics lesson plan for Grade 3 learners, was not complete and lacked group-work and practical activities, specialised activities for learners who experience barriers to learning and enrichment activities for high-flyers. Teacher 3 (a)'s lesson plan also lacked the forms of assessment that would be used to assess the Grade 3 Mathematics learners.

However, these incomplete lesson plans were signed off by the HoD, indicating that the HoD lacked knowledge and skills in Mathematics teaching and learning. It is the researcher's opinion that If the HoD knew what these lesson plans should entail, then he/she would deem this lesson plan to be incomplete, and not sign it off.

Teacher 3 (b)

The researcher observed that during the Mathematics lessons that were conducted by Teacher 3 (b), the teacher had a lesson plan for the teaching of Mathematics, but seldom checked it during the Mathematics lessons. On observing the lesson plan the researcher found the lesson plan to be incomplete and not signed by the HoD. The lesson plan did not include group-work or practical activities, lacked activities for children with barriers to learning and did not include enrichment activities for high-flyers. This lesson plans for teaching Mathematics to Grade 3 learners also failed to include the resources that Teacher 3 (b) would need to conduct these Mathematics, nor did it include the methods or approaches that Teacher 3 (b) intended to use doing her Grade 3 Mathematics lessons.

Teacher 3 (c)

The researcher observed that the lesson plans that Teacher 3 (c) constructed for teaching Mathematics to her Grade 3 learners was incomplete and lacked vital elements that should be included in Mathematics lesson plans. The lesson plan did not include group-work or practical activities, lacked activities for learners who experienced barriers to learning and contained no enrichment activities for learners with a

higher aptitude for Mathematics. The lesson plan was also not signed by the HoD. During the researcher's observation of Teacher 3 (c)'s Mathematics lessons, Teacher 3 (c) seldom looked at this Mathematics lesson plan while teaching her Mathematics lessons to her Grade 3 learners.

Teacher 3 (d)

Teacher 3 (d) had a very detailed lesson plan for teaching Mathematics to Grade 3 learners. It was set up in alignment with the CAPS documents and contained all the necessary elements that are required on a Mathematics lesson plan for Grade 3 Mathematics teaching and learning**.** The researcher perceived this lesson plan to be well planned, including activities for learners who experience barriers to learning and enrichment activities for high-flyers. It also included group and practical activities. The only element that was missing in this Mathematics lesson plan was problem-solving activities. The researcher observed that this lesson plan had been checked by the HoD, signed off and dated. It was however observed by the researcher that this lesson plan was not used by Teacher 3 (d) during her Mathematics lessons in her Grade 3 classrooms.

Teacher 3 (e)

The researcher observed that Teacher 3 (e) had a lesson plan for teaching Mathematics to her Grade 3 learners. But although it was on her desk during the Mathematics lesson, she did not use it. Teacher 3 (e)'s Mathematics lesson plan was very well planned and included all the elements that CAPS prescribes Mathematics teaching plans for Grade 3 should contain. Detailed explanations were given to discuss each step of the lesson, included activities for all ability groups, teaching approaches various, types of activities, the required resources for teaching the lesson and the way in which the Grade 3 learners would be assessed. Teacher 3 (e)'s lesson plan was also assessed, signed and dated by the HoD.

Even with all this information available teachers did not understand exactly what should be included in the lesson plans. According to Richard (2013) effective lesson

planning is at the centre of any quality lesson. Without effective and complete lesson lessons no teacher can teach effectively and with confidence (Reed, Michaud, 2010) they generally waste time looking through textbooks or running to make photocopies. According to Umalusi (2014), teaching plans could not be developed by the teachers due to a lack of expertise and time so CAPS documents were provided so that they would know exactly what to teach. Unfortunately, it was realized that this programme would require highly skilled teachers to deal with critical issues in depth as so little guidance was given. According to Catholic Institute of Education (2010), there is a need to provide teachers with guidance on how to work with CAPS documents.

The CAPS document for teaching Mathematics to Grade R-12 specifically states exactly what should be included in lesson plan. It should include whole class teaching, small group teaching, practical lessons and problem-solving activities.

It gives the teachers a complete scope of areas of content that should be taught, the time duration and weight each content carries, including small group teaching, whole class teaching, practical, problem solving and independent activities. It also talks about including all learners' capabilities in lesson plans, including learners with barriers to learning and providing enrichment for highflyers in the classroom (DBE, 2011). Even with all this information available teachers did not understand exactly what should be included in the lesson plans.

5.6.6 Theme 3: School policies on assessment, teachers' assessment plans and assessment activities

Teacher 3 (a)

Teacher 3 (a) had sufficient evidence to show how and why Grade 3 Mathematics learners are assessed. Teacher 3 (a) was in possession of a quarterly assessment plan but did not have a yearly assessment plan that showed what would be assessed during the year. Teacher 3 (a) had various examples of assessment tasks in a file, and different levels of questions that would cater for the Mathematical abilities of all

Grade 3 learners. The researcher observed that these assessment plans and activities were not checked by the HoD, as they were not signed or dated. Teacher 3 (a) was not in possession of the School Assessment policy which prescribes how assessment should be conducted in the Foundation Phase.

Teacher 3 (b)

Teacher 3 (b) possessed a detailed assessment plan for Grade 3 Mathematics learners, for each term, that showed what would be assessed, by using what form of assessment and for what period this assessment commence. It contained all the assessment standards and questions that would be used in each assessment. Examples of various activities accompanied the assessment programme and was moderated and signed by the HoD. Teacher 3 (b) had a copy of the school policy on assessment for Foundation Phase learners, but this policy was outdated and was compiled before the implementation of CAPS.

Teacher 3 (c)

The researcher observed that the assessment plan of Teacher 3 (c) contained a quarterly assessment plan but did not contain a plan for yearly assessment. This assessment plan included various assessment standards, examples of questions that would be asked to assess the Grade 3 Mathematics learners and various activities that would be used during assessment.

The participants all had proof of how they assessed the learners but did not have year plans that showed exactly what would be assessed during the year. Yearly assessment plans were not done, but most teachers had a quarterly plan which explained what they had assessed for the term. The School policy for Assessment that Teacher 3 (c) possessed was also outdated and not in alignment with the prescribed CAPS document as it was last updated in 2010.

Teacher 3 (d)

The researcher observed that Teacher 3 (d) possessed an assessment plan for the past term but did not have a yearly assessment plan, which prescribes what should be assessed, when it should be assessed and what forms of assessment will be included to assess Grade 3 Mathematics learners. This assessment plan did include various examples of assessment activities and questions that could be used to check for understanding and assess the abilities of Grade 3 Mathematics learners. Specialized assessment activities were not included in Teacher 3 (d)'s assessment plan to accommodate learners who experience barriers to learning in Mathematics. Teacher 3 (d) had to go to the principal to request the school's policy on assessment for Foundation Phase learners. This policy was outdated, as it was drawn up in 2007 and had not been reviewed since.

Teacher 3 (e)

The researcher observed that Teacher 3 (e) had a detailed assessment plan that included what should be assessed on a quarterly and yearly basis. It contained the assessment standards, what should be assessed, the form of assessment that was required for the assessment, the period or week when assessment would commence, examples of activities that would be used and examples of questions that would be used to assess the Grade 3 Mathematics learners. The assessment plan did however lack specialized activities for learners that experienced barriers to Mathematical learning, and resources that would assist Teacher 3 (e) to conduct this specific assessment. Teacher 3 (e)'s assessment plan was reviewed by the HoD, signed and dated.

The researcher observed that Teacher 3 (e) did not possess the school's policy on assessment for Mathematics learners in the Foundation Phase. The principal was later asked to produce this document and it was observed by the researcher to be outdated and compiled before the implementation of CAPS, dating back to 2007.

The NCS policy on Assessment states that each Grade should submit a formal assessment programme to the SMT before the year begins.

5.6.7 Category 1: The forms of assessment used by Grade 3 Mathematics teachers to assess Grade 3 learners

Teacher 3 (a)

The researcher observed that Teacher 3 (a) used formal assessments to assess the Grade 3 learners in her classroom, but rarely used informal assessments, particularly during practical and group-work activities. It was also observed that Teacher 3 (a) did not conduct formal assessments regularly. Teacher 3 (b) used formal and informal assessments to assess her Grade 3 learners in her Mathematics classroom. This was evidenced by using class lists to informally assess the learners during group-work activities. Each column listed a concept, task or activity that the Grade 3 learners had to master; it was dated and was accompanied by a mark out of 10. Teacher 3 (b) used this information to reteach mathematical concepts that learners did not understand or to redo activities that these learners could not master.

Teacher 3 (c)

The researcher observed that Teacher 3 (c) conducted both formal and informal assessments for Mathematics in her Grade 3 Mathematics classroom. Teacher 3 (c) had a file that contained the names of all the learners in her Mathematics classroom, certain concepts that she wanted them to master during group-work activities, and marks were allocated for each activity that the learners completed. Teacher 3 (c) used this file to establish what concepts she successfully taught to the Grade 3 learners and what concepts or activities required more attention. Learners who struggled to learn these concepts or complete the desired activity remained on the carpet for extra attention, while the other learners returned to their desks to complete their work.

Teacher 3 (d)

It was observed by the researcher that Teacher 3 (d) focused predominantly on formal assessment tasks in her Grade 3 Mathematics classroom and payed little attention to informal assessment that should be conducted daily during group-work and practical activities. Teacher 3 (d) had no evidence of informal assessment that she had conducted, although she was adamant that she did conduct informal assessments of her Grade 3 Mathematics learners. There was however evidence of the formal assessment tasks that had been completed by the Grade 3 Mathematics learners.

Teacher 3 (e)

It was observed by the researcher that Teacher 3 (e) conducted both formal and informal assessments in her Mathematics classroom. Teacher 3 (e) used a “Mat book” to conduct all her informal assessments during group work activities. This book contained the names of the Grade 3 Mathematics learners in Teacher 3 (e)’s classroom, what ability group they form part of, various counting activities, new concepts that the learners need to know, and the date that each lesson was conducted on. There was also a column that contained ticks and crosses, which assisted Teacher 3 (e), determine if a learner was able to master the new concept or activity, or if additional assistance was required. Teacher 3 (e) then retaught the concept to the learners who did not reach the desired outcomes. The research observed that formal assessments were also conducted regularly.

Grade 3 Mathematics teachers clearly evidence formal assessment, but do not do a lot of informal assessment. According to CAPS document for teaching of Mathematics a variety of assessment instruments should be used as a learner may find that one particular instrument does not allow them to show what they can do. According to NCS National Protocol for Assessment Grades R-12 evidence of achievement needs to be collected by using various forms of assessment. Informal assessment should be done daily.

5.6.8 Category 2: Feedback given by Mathematics teachers to Grade 3 learners

Teacher 3 (a)

The researcher observed that Teacher 3 (a) did not provide feedback to the Grade 3 learners regularly, and corrections were not done or discussed in the Mathematics classroom. Teacher 3 (a) did not write comments under the learners work or explain to them where they had gone wrong with calculations, procedures or approaches and methods that they chose used to solve problems. It was also observed that classwork books were marked, but the books issued by the DBE were not marked. Teacher 3 (a) responded to this observation in the following way:

> *"We do the work with the learners on the board, so the learners shouldn't make mistakes and therefore this work does not need to be corrected."* (Teacher 3a)

Teacher 3 (b)

The researcher observed that Teacher 3 (b) provided the Grade 3 learners with verbal feedback after the learners that completed an activity in the Mathematics classroom. However, learners were not encouraged to do corrections or made aware of the mistakes they had made after completing a Mathematics activity. On the rare occasion that corrections were done, they were not marked so Grade 3 learners did not know if their work was either correct or incorrect. Teacher 3 (b) marked the class workbooks, but DBE workbooks were not marked or signed. Teacher 3 (b) did not write any remarks in the Grade 3 learners' books, nor did she stick stickers to reward good work or offer encouragement for the learners to try harder in Mathematics. The work that was completed was never discussed and learners were not given the opportunity to discuss their methods and approaches and explain how they arrived at a specific answer.

Teacher 3 (c)

In the class of Teacher 3 (c) the researcher observed that feedback was given to the Grade 3 Mathematics learners regularly, corrections were done, marked and discussed and learners got the chance to analyse their work and to talk about the mistakes they made, in turn finding more effective ways to approach Mathematics and solve problems. Teacher 3 (c) also marked all the class work books as well as the books provided by the DBE.

Teacher 3 (d)

Teacher 3 (d) rarely discussed the Grade 3 learners work with them. Corrections were not done after every Mathematics activity and learners were not asked to discuss their work, the methods and approaches they used, or to explain how they arrived at a specific answer. The researcher observed that classwork books were signed, but not marked and DBE workbooks were neither marked nor signed.

Teacher 3 (e)

In the classroom of Teacher 3 (e) it was observed by the researcher that Teacher 3 (e) spent a few minutes after each Mathematics lesson to discuss the learners' work with them for these learners to be able to evaluate their own work and to determine if their answers are correct or incorrect. The learners were also given the opportunity to discuss the methods and approaches that they used to arrive at a specific answer. Teacher 3 (e) also provided her learners with alternative methods, approaches and procedures that can be used to arrive at the same answer. Teacher 3 (e) ensured that corrections were done regularly and stuck rewards stickers in the Grade 3 learners' books and wrote remarks of encouragement. Class workbooks as well as the DBE workbooks were up to date, marked accurately and signed.

According to Russel (2017) by doing corrections a learner can reflect on problems they missed and learn from their mistakes. It is also a perfect time for the teacher to explain the mistake to the learner. Wiggins (2017) mentions that feedback can be one

of the most important influences on academic achievement. It also has the highest effects on student learning as it provides the students with effective strategies for improvement, articulates for the student what they understand and identifies areas in which the learner needs guidance and strategies for improvement.

The NCS on Assessment states that feedback should be provided to learners after assessment to enhance the learning experience.

5.6.9 Category 3: Evidence of assessment in Grade 3 Mathematics learners portfolios

Teacher 3 (a)

In Teacher 3 (a)'s Grade 3 Mathematics classroom, the researcher observed that the learners' assessment tasks were stored in cardboard boxes on the top of a cupboard. Teacher 3 (a) did not keep each learners' tasks together, but randomly mixed all the Mathematics learners' tasks together.

Teacher 3 (b)

Teacher 3 (b) placed each learner's tasks in a separate plastic sleeve. These plastic sleeves were then placed in a separate file for each individual term. The assessment tasks of the learners in Teacher 3 (b)'s classroom were well organized and easy to access when required.

Teacher 3 (c)

Teacher 3 (c) had small ring binder files for each Grade 3 Mathematics learner, which was separated into individual terms. Teacher allocated a number to teach learner and that number appeared on the outside of the file, allowing Teacher 3 (c) to reuse these files for future Grade 3 learners. Teacher 3 (c) organized her learners 'assessments tasks in an effective way so that these files could easily be accessed on request.

Teacher 3 (d)

Teacher 3 (d) placed each individual learner's assessment tasks in a plastic portfolio file. Each learner had two files, one for term 1 and 2, and the other for term 3 and 4. Organizing the learners' assessment tasks in this way is very effective and allows the teacher to access and review any learners work at any time, without becoming a time-consuming task which requires searching and sorting through random piles of assessment tasks.

Teacher 3 (e)

Teacher 3 (e) evidenced her assessments by organizing some of her Grade 3 Mathematics assessment tasks into plastic portfolio files; the remaining tasks were stored in cardboard photocopying boxes. When Teacher 3 (e) was asked why she chose to store these tasks in two different ways, she stated the following:

> *"We have more Grade 3 learners this year, than we did last year, so we require more plastic portfolio files. I have asked on numerous occasions for more plastic folders, but always get the same answer, it was not in the budget so I will have to wait until funds are available."* (Teacher 3 e)

The NCS document for Assessment states that records of learner performance should be used to verify progress made by learners in the teaching and learning process and should provide evidence of learner's conceptual progression within a Grade and his/her readiness to be promoted to the next Grade.

5.7 CATEGORY 4: ASSESSMENT TASKS SET UP BY TEACHERS SHOULD CONTAIN A PRE AND POST MODERATION

Some tasks set by the Grade 3 Mathematics teachers were not correctly moderated. Pre and post moderation forms were not completed correctly, and learners' tasks were not moderated.

Teacher 3 (a)

Teacher 3 (a) had pre and post moderation forms in her assessment file, but these forms were incomplete as post moderated marks were not filled in for the learners whose scripts were moderated**.**

Teacher 3 (b)

Teacher 3 (b) ‘s moderation forms contained the same evaluations for every quarter and the errors that were found were repeated. No evidence was found to show that these mistakes were corrected, as only the first attempt was filed not the corrected version of the assessment task. If errors are found on an assessment task then all the incorrect attempts should be filed along with the final task that is finally approved by the HoD. This serves as proof that identified errors are corrected and not just ignored.

Teacher 3 (c)

Teacher 3 (c) had pre and post moderation forms but they contained the same dates, which is unlikely to be the case if moderation was done before the assessment was conducted. It was also observed that the same learner’s assessment tasks were sent in for moderation every quarter, and some of the tasks that were completed by the learners contained vital errors that had not been corrected by Teacher 3 (e) before she administered the assessment task.

Teacher 3 (d)

Teacher 3 (d) ‘s moderation forms were completed correctly and first, second and even third attempts were documented. The corrected assessment tasks were also filed, proving to the researcher that assessment tasks were properly moderated, and tasks were only given to the learners when they were 100% correct.

Teacher 3 (e)

The researcher observed that pre moderation and post moderation was done correctly, forms were accurately completed, and incorrect and corrected assessment tasks were included in Teacher 3 (e)'s assessment file.

NCS document for Assessment for grad R-12 states all school-based assessment and practical assessments should be moderated and evaluated.

5.7.1 Theme 4: Grade 3 Mathematics Statistics achieved in the ANA exams for 2011-2014

Teacher 3 (a)

Teacher 3 (a) could not provide the researcher with any Mathematics statistics for ANA exams that were written by Grade 3 learners. The researcher asked the principal for these statistics, but had to rely on the principal's account for the learner outcomes in these exams as the school's main frame computer had been stolen, which possessed a digital copy of these results and print documents were destroyed after being archived for five years. The principal maintained that the Grade 3 Mathematics results had showed a slight improvement during the period that ANA exams were administered and were continuously showing signs of improvement from year to year.

Teacher 3 (b) and Teacher 3 (c)

Teacher 3 (b) and (c) had files that contained the ANA results for Grade 3 learners over the three-year period that ANA exams were administered. The researcher observed that a slight improvement had occurred over the years, as Grade 3 learners obtained 41% in the first year, 43% in the second year, 46% in the third year and 52% in the last year that ANA was administered. The researcher combined the observations that were made in both Teacher (b) and (c) as the Grade 3 teachers were from the same school.

Teacher 3 (d) and Teacher 3 (e)

Teacher 3 (d) and Teacher 3 (e) did not have the statistics that the researcher requested to analyze the ANA statistics for Grade 3 Mathematics achievement for 2011-2013. It was later requested from the principal, who had problems with his computer and took a long time to provide the researcher with these statistics. The principal however could not provide results for 2014. D to SADTU strikes, this particular school did not write the 2014 ANA exam. In 2011 Grade 3 Mathematics learners achieved 51%, in 2012, 45% and in 2013, 56%.

There was a slight overall improvement in 2011 and 2013, and a decline in Mathematics achievement in 2012. The researcher combined the observations of these two teachers as they hailed from the same school.

5.7.2 Theme 5: Teaching Strategies

Some teachers did not use group activities to teach lessons. They complained about lack of space and maintaining discipline in overcrowded classes during such lessons.

Teacher 3 (a)

Teacher (a) did not vary her teaching approaches and methods during her Mathematics lessons, avoided using group work and practical lessons and did not use specialized teaching methods and approaches to assist learners who experienced barriers to learning in Mathematics.

Teacher 3 (b)

Teacher 3 (b) used various methods to teach her Mathematics lessons, but very rarely used practical lessons or problem-solving activities where learners could solve problems that were connected to the everyday experiences of these Grade 3 Mathematics. No specialized teaching methods or approaches were used to assist learners who experienced barriers to learning.

Teacher 3 (c)

Teacher 3 (c) preferred to use whole class teaching and direct instruction to teach Mathematics in her classroom. The researcher also observed that very little group work was conducted in Teacher (c)'s Grade 3 Mathematics classroom. It was also observed by the researcher that Teacher 3 (c) did not alternate between methods and approaches while conducting her Mathematics lessons and no specialized methods were used to accommodate the Grade 3 learners that experienced barriers to learning in Mathematics.

Teacher 3 (d)

Teacher 3 (d) used various methods and approaches to teach her Mathematics lessons, one of which was the use of small group teaching but did not adapt or used specialized methods to teach Mathematics to the learners who experienced severe barriers to learning.

Teacher 3 (e)

Teacher 3 (e) used various methods to teach her Grade 3 Mathematics lessons, including working in pairs, direct instruction, small group teaching and practical lessons, but failed to use problem-solving activities during her group work instruction. Teacher 3 (e) also failed to adapt to teaching methods and approaches to assist learners in her Grade 3 classroom who experienced barriers to Mathematical learning.

The CAPS document for teaching of Mathematics Grade R-12 repeatedly talks about the benefit of teaching in small interactive groups. Inclusivity should also become the central part of the organization including planning and teaching at each school. To address barriers to in classrooms teachers should use various strategies such as those included in the DBE guidelines for inclusive teaching and learning (2010).

5.7.3 Category 1: School policies on how Mathematics should be taught in Foundation Phase classroom

Teacher 3 (a)

Teacher 3 (a) was not in possession of a school policy that instructs the teacher on how they should teach Mathematics in Grade 3, what they should teach, and the methods or approaches that they would use to teach Mathematics in the Foundation Phase. Teacher 3 (a) tried to obtain the school policy on the teaching of Mathematics in the Foundation Phase from the principal but was told the school's computers were currently not operational and thus the researcher could not analyze this policy document.

Teacher's 3 (b) and (c)

These teachers did not possess the school's policy on how Mathematics should be taught in the Foundation Phase, to promote understanding, and to ensure that optimal learning occurs in Mathematics classroom. The principal of this school promised the researcher to make this document available, but never did.

Teacher's 3 (d) and (e)

These Grade 3 Mathematic teachers were in possession of the school's policy on how Mathematics should be taught in the Foundation Phase, but this policy was not reviewed regularly and was outdated

5.7.4 Category 2: Are Grade 3 Mathematics lessons learner or teacher-centred?

In some of the schools that participated in this research study traditional methods for teaching were used which were very teacher-centred.

Teacher 3 (a)

Teacher 3 (a) used old traditional methods to teach Mathematics to her Grade 3 learners. These methods included direct instruction from the DBE workbook and text-book, lecture style instruction, rote counting and memorizing and repeating facts in a parrot fashion. She applied a very teacher-centred approach when teaching Mathematics in her classroom, excluding group-work, discouraging active participation and discussion and not presenting opportunities for the learners to explore or construct their own knowledge. Teacher 3 (a) told the learners what procedures they should follow, what methods to use and what the correct answer was.

Teacher 3 (b)

Teacher 3 (b) applied a learner-centered approach to teaching Mathematics to her Grade 3 learners. She encouraged her learners to actively participate in the Mathematics lessons, explain the methods and approaches that they used, discuss their work and used group work to explain mathematical concepts and to allow these Grade 3 learners to construct their own knowledge.

Teacher 3 (c)

Teacher 3 (c) used both a teacher-centred approach as well as a learner-centred approach to teach Mathematics in her classroom. She did actively involve her learners in her Mathematics lessons by using rhymes, songs, creative counting activities and allowed learners to explore and construct their own knowledge during group activities, but still relied on direct teaching from the DBE workbook and did not allow for discussion or questions to asked or answered. She also did not provide the Grade 3 learners to explore, predict or solve everyday problems that these learners were familiar with.

Teacher 3 (d)

Teacher 3 (d) used a learner-centred approach to teach Mathematics to her Grade 3 learners. She applied a learner-centred approach by actively involving her learners during group work, using concrete apparatus and manipulatives to help learners to construct their own knowledge and understanding and by allowing learners to work in pairs. Teacher 3 (d) did however rely on direct teaching using the textbook and DBE workbook to teach certain concepts and failed to provide opportunities for learners to predict, explore and problem-solve.

Teacher 3 (e)

Teacher 3 (e) applied a learner-centred approach to teach Mathematics to her Grade 3 learners. She actively involved her learners during Mathematics lessons, used group-work and concrete apparatus to allow learners to construct their own knowledge and understanding, allowed for discussion and learner explanations and conducted practical lessons.

The CAPS document for teaching Mathematics from Grade R-12 aims at ensuring that children acquire and apply knowledge and skills in a way that is meaningful to their own lives. It encourages an active and critical approach to learning rather than rote and uncritical learning of given truths and to identify and solve problems using critical and creative thinking. In early grades children need to be exposed to Mathematical experiences that give them many opportunities to do, talk and record their math's thinking. Group sessions should be interactive.

According to Pennycuick (1993), many schools have not yet adopted the more demanding and higher quality student-centred learning process. Carron and Chau (1996) remark that teaching styles in many schools remain traditional and teacher-centred (Ellison, 1999) promoting passivity and rote memorization. Cagily (2006) makes further comment on the type of lessons that are presented by Foundation Phase Mathematics teachers by stating that modern learning should be more learner-centred and allow the learner to construct their own knowledge by active participation.

According to Molwane (2010), many of the problems that are found in Mathematics classes are due to the fact that teachers are not using effective teaching methods and are unaware of alternative approaches to teaching, choosing to use outdated traditional methods that are teacher-centred.

5.7.5 Category 3: Does the teacher use the schools' intervention policy to assist struggling learners?

Most of the schools had intervention policies to assist struggling learners, but most intervention is done after school to be able to give the individual attention to struggling learners. In overcrowded classrooms the teachers group learners in ability groups and work with the group with the lowest ability every day. Small group activities on the mat are ideal to offer extra assistance and guidance to these learners. Sometimes however teachers complain that these learners who experience barriers to learning cannot do anything and just disrupt the classroom. Children that are gifted or high flyers also cause problems as they get bored easily and cause discipline problems.

The researcher observed the following intervention strategies that were implemented by each Grade 3 Mathematics teacher:

Teacher 3 (a)

Teacher 3 (a) followed an intervention programme to assist the learners in her classroom who were struggling with Mathematics. After the first quarter children are identified who are not achieving success in Mathematics, their parents are consulted, give permission for extra assistance and these learners remain after school to receive extra help in Mathematics understanding and learning. Unfortunately, this intervention programme is conducted after school and little or no intervention strategies are used while the teaching her Mathematics lessons.

The researcher observed that during Mathematics Lessons Teacher 3 (a) did not use small group teaching to assist the learners who were struggling with Mathematics. The only assistance she offered was to sit next to each learner and try to explain the

work to them, failing to do this successfully caused Teacher 3 (a) to become frustrated and move onto the next learner.

The researcher also observed that activities that were used for intervention were not custom designed to address individual learner problems, but rather, all learners in the intervention group received the same activity regardless of individual need. Teacher 3 (a) was not in possession of a School Intervention Policy and was not sure if her particular school had one.

Teacher 3 (b)

It was observed by the researcher that Intervention programmes for learners who were struggling with Mathematics was predominantly an after-school activity rather than one that occurred during Mathematics lessons. Learners who struggled with Mathematics were required to stay after school, so that the teacher can work with these learners in smaller group in a more disciplined classroom with fewer disruptions and give each learner individual attention.

Teacher 3 (b) did however make use of allowing learners to work in pairs so that stronger learners could assist the learners that were struggling to understand and learn Mathematical concepts in this Grade 3 classroom. Teacher 3 (b) made use of group work but did not devote addition time to offer individual assistance to learners who were experiencing barriers to mathematical learning. The weaker group of learners were allocated the same amount of group work time as the strongest groups. Teacher 3 (b) was not in possession of the Schools Intervention Policy but conceded to the fact that the school did in fact possess one. She later obtained a copy of the policy from the principal. The researcher observed that this policy was in need of review as it was last updated before the implementation of CAPS.

Teacher 3 (c)

Teacher 3 (c) did most of her intervention for learners who struggled with Mathematics after official school hours. Learners who struggled with Mathematics were requested to remain after school, so as to receive one on one attention and assistance. This was done with the consent of the parents, by signing forms to acknowledge the difficulties their children are experiencing and give permission for their children to remain behind after school.

The researcher observed that intervention activities were not designed to address the individual needs of the learners, but all learners in the group completed the same activities.

During school however Teacher 3 (c) did make an attempt to try and assist the learners who were struggling with Mathematics, by sitting next to them and trying to assist them. Limited time was allocated to this kind of intervention, as the rest of the class started misbehaving and Teacher 3 (c) had to stand up from what she was doing and try to regain discipline and control in her classroom.

The researcher observed that Teacher 3 (c) did not possess the Schools Intervention policy but would ask the school principal to provide her with a copy; this copy however never materialized.

Teacher 3 (d)

The researcher observed that Teacher 3 (d) was not in possession of the Schools Intervention Policy. She admitted that she had never seen it, but was instructed by the HoD on how intervention was to be done with learners that experienced barriers to learning.

Teacher 3 (d) commenced with her intervention programme after school, and not when the class was overcrowded, limiting the amount of attention she could give to individual learners.

During school hours Teacher 3 (d) used stronger learners in the class to explain to the weaker ones.

Teacher 3 (e)

Teacher 3 (e) also conducted her intervention programme after official school hours. Teacher 3 (e) conducted practical Mathematics lessons during these intervention sessions and only after intense practical demonstrations and explanations allowed the learners to complete activities that were designed to address each learner's individual problem and need. The activities that were given to learners were not the same unless more than one learner experienced the same problem.

Teacher 3 (e) was in possession of the School Policy on the teaching and learning of Mathematics in the Foundation Phase, but this policy was not reviewed regularly and was outdated.

Five Grade 3 Mathematics teachers (a-e) failed to provide specialized activities for learners who experience barriers to learning and did not provide enrichment activities for highflyers or learners who have a higher aptitude for mathematical learning.

The NCS for teaching Mathematics for Grade R-12 states that inclusivity should become a central part of the classroom and should be included in all planning and teaching. To address barriers to learning in classrooms the teacher should use various curriculum differentiated strategies such as those included in the DBE guidelines for inclusive teaching and learning (2010). It also states that slower learners should not be underestimated but stretched. Lessons should also include enrichment for highflyers.

According to Bailey (2017), all schools should implement models of diagnosis and intervention so that educational provision can be made for learners who have special needs. This intervention programme will help improve student performance because it addresses the individual needs of the learners and provides extra help and assistance to children who experience barriers to learning (King, 2011).

5.7.6 Category 4: Alternating of teaching methods in Grade 3 Mathematics classrooms. Do Grade 3 Mathematics teachers alternate their teaching methods during Mathematics lessons? To what extent does this occur?

Many researchers complain that teachers do not use alternate methods to teach Mathematics in their classrooms. According to research they tend to stick only to one or two methods and not change their approach if they find the children do not understand.

Literature also refers to the fact that teaching styles, approaches and methods are problematic in Mathematics classrooms (Vilardi, Rice, 2014: Holaelan, Llam, Iran, 2015; Umugiraneza and Bansilal, 2017). Due to this the National Strategies (2010) came up with ten approaches that should be applied to teach Mathematics effectively. It states that lessons should be well planned, well organized and provide experiences for children to explore, acquire, consolidate and apply their knowledge and skills. The teacher should give the children opportunities to use their skills, test their ideas and think and reason.

Ways should be incorporated in Mathematic classrooms to creatively present, measure and predict. Mathematics teachers should model to their learners how to direct and steer their own learning and give children the opportunity to consolidate what they learn, practice various skills and recognize how to build new knowledge. All lessons should engage all the learners in the class and allow for discussion, dialogue, reflection on ideas and explanation of how the learners came to the answer.
Teachers in Mathematics classrooms should demonstrate new concepts and use symbols, diagrams and models to support thinking, reasoning and problem-solving skills. Children should be taught how to use the Mathematical language correctly and be provided with plenty of activities that allow them to explore, discover and apply what they have learnt to solve problem. It is also the teacher's responsibility to teach the learners various methods, approaches and strategies and allow these learners to enquire, interpret and explain their own methods, results and strategies.

Learners also need to be taught how to identify their skills, understand what they learnt and to acquire new skills. Learning activities should make sense to the learners and have a connection to their everyday situations. Teachers also need to get to know their learners and establish in what ways they learn. Methods that teachers use in classrooms should thus appeal to the learning styles of all learners in their classrooms.

According to UNESCO (2004) teachers recognize the need to adapt, modify and teach using differentiated methods, but cannot do it as they lack skills, knowledge, resources and their classrooms are overfull. Learning new and effective teaching methods and approaches will take time and for this to materialize teachers need continuous in-service training.

5.7.7 Category 5: Teachers lack pedagogical knowledge and skills

A prevalent theme throughout this research study is the need for Grade 3 teachers to receive more training in the effective teaching and learning of Mathematics. According to Spaull (2013), unless content knowledge and pedagogical knowledge of Mathematics teachers improve, it will be difficult to raise learner achievement. Spall states that South Africa has some of the least knowledgeable primary school Mathematics teachers in Sub-Saharan Africa, many of which have below basic levels of content knowledge. Dr Nick Taylor (NEEDU, 2013) states that teacher competency is an important factor that leads to the poor outcomes in Mathematics; teachers simply do not have enough subject knowledge. Teachers are not effectively trained to teach Mathematics (McCarthy and Oliphant, 2013). The DBE (2010) states that the majority of teachers exhibit poor grasp of subjects that they are responsible for. It is a growing concern as so much money is invested in training teachers, but it has not helped to raise their educational capabilities and they still lack pedagogical knowledge (DBE, 2010).

This need for more training was confirmed by the Grade 3 Mathematics teachers during the semi-structured interviews. They responded by saying the following:

"I feel that I really need to receive more training in Mathematics teaching and learning. It is a desire of mine to develop my knowledge in Mathematics and be able to teach my learners more effectively." (Teacher 3 a)

"One of my needs as a teacher is to update my knowledge and be able to use methods that help my Grade 3 learners to learn more effectively. Developmental training will really be beneficial to me." (Teacher 3 b)

"I think that if I receive more training, I will be feel more confident and I will gain a better understanding about what I need to include in my Mathematics lesson plans. I have a problem with planning lessons that include all the learners in my Grade 3 classroom." (Teacher 3 c)

"More time is needed for training, not just once in six month or a year. I need to be trained on a continuous basis as I have a lot of problems in my Mathematics classroom that I need answers to. " (Teacher 3 d)

"I think that more training will improve my knowledge and help me to become a better teacher. (Teacher 3 e)

It is the opinion of the researcher that teachers possess poor knowledge and skills not due to a lack of initial training, but from a lack of effective continuous professional development. The participants received training, but in most cases complained about the standard and presentation of the sessions.

5.8 CONCLUSION

By analyzing the non-participant observations and the responses that were provided by the grade 3 Mathematics teachers, it can be deduced that these teachers experience many challenges on a daily basis, which prohibit the grade 3 Mathematics from effectively teaching Mathematics to grade 3 learners. It can also be seen that the challenges that are faced seem to heavily outweigh the successes that these grade 3 teachers have experienced in mathematics teaching and learning.

The researcher will now discuss the summary of the reviewed literature, the conclusions that arose from these findings and various recommendations.

CHAPTER 6
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 INTRODUCTION

In chapter 5 the researcher presented the empirical findings obtained through semi-structured interviews, observations and other sources of data collection used in this study. This study aims to explore to what extent, if any, Grade 3 Mathematics teachers in Daniëlskuil, South Africa make use of different teaching approaches, and strategies that can be suggested to empower their proficiency with regard to the teaching of Grade 3 Mathematics learners. It also aims to establish the successes and challenges that are faced by Mathematics teachers in Grade 3 in Daniëlskuil and to determine what Grade 3 Mathematics teachers believe are factors that impede the effective teaching of Mathematics in primary schools.

This chapter summarizes the findings on the literature review, and the empirical findings obtained through semi-structured interviews, observations, and documents analysis of Grade 3 Mathematics teachers. The summary will focus on the broader themes identified in the analysis, which are: the theories that endorse the teaching and learning of Mathematics; the proficiency levels of teachers who teach Mathematics in Grade 3 classrooms; the challenges and successes that are experienced by Grade 3 Mathematics teachers; strategies to enhance teachers' proficiency towards the teaching of Mathematics; the availability of the CAPS documents for Grade 3 Mathematics teachers; lesson plans for teachers who teach Mathematics in Grade 3; school policies on assessment; teachers' assessment plans and assessment activities and teaching strategies that are used by Grade 3 Mathematics teachers. The findings were then synthesized to show relevant themes that existed throughout the study, to draw conclusions and to make recommendations.

In the next sections a summary of the literature and the findings for the empirical study which pertain to the teaching and learning of Mathematics in Grade 3 classrooms were outlined.

6.2 THE SUMMARY OF THE LITERATURE REVIEW

One of the main findings in the literature review was the fact that Mathematics teachers need extensive training (Sargent, 2011). The reason for this stems from the fact that teachers lack content knowledge, lack pedagogical knowledge, have low proficiency levels in Mathematics and lack the skills they need to teach Mathematics effectively (Needu Report, 2013). Another predominant finding was the fact that all Mathematics teachers receive some form of training, but the quality that they receive is questionable (Ono and Ferreira, 2010), brief, fragmented and ineffective as it did not address the practical aspects of teaching and learning of Mathematics.

Literature also indicated that because of this lack of knowledge teachers are not confident, use incorrect or outdated methods and approaches to teaching Mathematics (Mamosa, 2010), excluded teaching parts of the curriculum that they found difficult (Carnoy and Taylor, 2011), used textbooks as a last resort and taught in a parrot fashioned manner (Killen, 2014). Teachers are expected to teach a subject they know nothing about (Bertram and Christiansen, 2012), use varied methods and approaches to teach without understanding how learners learn Mathematics (Killen, 2014), do not cater for all unique learning styles and learners with severe barriers (Donald et al., 2010) and improve outcomes in Mathematics, without being provided with the knowledge or skills they need.

The literature reviewed on the teaching and learning of Grade 3 Mathematics highlighted many challenges that Grade 3 Mathematics teachers endure daily and which have a negative effect on their ability to teach effectively and produce results. The main findings were that teachers lack resources, apparatus and teaching aids (Umlasi, 2014) infrastructure of classrooms are in poor repair (Van der Nest,2012) and are filled to bursting (Bak, Behandien, Morrow and Pendleburg, 2017) with learners that have extreme or severe barriers to learning (Donald et al., 2010). In such classrooms, teachers find it extremely difficult to manage the classroom and maintain discipline so that effective learning can take place. Teachers also readily complained that they were not supported by other stakeholders who should be assisting teachers

to improve teaching and learning and maintain discipline in such classrooms (Bernstein, 2015). Another important finding was that teachers feel that their workload has become too extensive and their administration tasks demand a lot of their time. So much so that they take work home and this interferes with their family lives. The following is the summary of the empirical study.

6.3 SUMMARY OF THE EMPIRICAL STUDY

The researcher used semi-structured interviews, observation and document analysis. From these forms of data collection the following main themes emerged: the theories that endorse the teaching and learning of Mathematics; the proficiency levels of teachers who teach Mathematics in Grade 3 classrooms; the challenges and successes that are experienced by Grade 3 Mathematics teachers; strategies to enhance teachers' proficiency towards the teaching of Mathematics; the availability of the CAPS documents for Grade 3 Mathematics teachers; lesson plans for teachers who teach Mathematics in Grade 3; school policies on assessment; teachers' assessment plans and assessment activities and teaching strategies that are used by Grade 3 Mathematics teachers.

6.3.1 Training received by Grade 3 Mathematics teachers

A main finding was that although most Grade 3 Mathematics teachers were provided with some form of initial training, most of the teachers felt that the quality of the courses was not up to standard, rushed, crammed into a short space of time, lacked practical demonstrations and was totally devoid of question-asking and answering sessions. (Paragraph 5.8. Theme 1 Category 1.1.) The Grade 3 Mathematics teachers commented not only on the poor presentation of the material but on the presenters who were constantly late, lacked language skills, were unprepared and rushed the course which leads to teachers being given information to read at home. (Paragraph 5.8. Theme 1 Category 1.2.)

Another main finding was that Grade 3 teacher's lack the basic pedagogical and content knowledge that they need to teach Mathematics in a way that learners understand, makes sense to the learners and invariably lead to better results. The researcher found that all the Grade 3 teachers possessed the relevant CAPS documents, but some teachers did not use them daily as they did not understand them. The Grade 3 teachers also lack the skills to be able to use the CAPS document in the way it is intended to ensure that effective learning takes place in Grade 3 classrooms. The researcher also observed that teachers did not know what was expected of them and when they did not understand what they were required to teach, they simply left out the section. In some cases, they only taught parts that they felt were important.

In some schools, the condition of the CAPS documents was shocking as they were badly faded copies which were not very legible. Teachers claimed that often the school was only given one original copy and when teachers moved classes, they took them with them and they got lost so new copies could not be made. School policy documents on how Mathematics should be taught were also outdated and teachers had to request them from the principals. The Grade 3 teachers did not possess their own copy of the school policy on Mathematics teaching. Teachers however expressed the desire to obtain more intensive training and showed the firm realization that professional development is necessary to teach effectively.

6.3.2 Teaching approaches and methods that Grade 3 teachers are familiar with and use to teach Mathematics in their classrooms

Most Grade 3 Mathematics teachers favoured the use of direct teaching using the textbook and the blackboard. The use of working in pairs and group work was very minimal, activities that were fun and allowed active participation from learners were seldom used and problem-solving activities were not used at all. Teachers also used memorisation of facts and procedures, drill and rote learning. Another finding was that Grade 3 Mathematics teachers were using a teacher-centred approach rather than using a learner-centred approach. Learners were not given the opportunity to be actively involved in lessons, did not talk about what they learned and did not ask or answer questions. (Paragraph 5.8.1. Theme 2 Category 2.1.)

6.3.3 Lesson plans used by Grade 3 teachers for the teaching and learning of Mathematics

Lesson plans were very minimalist and were incomplete, excluding activities for highflyers and learners with severe barriers to learning, devoid of group activities or opportunities where learners can develop critical thinking, reasoning, and problem-solving skills. They did not include assessment activities and were signed by the HoD's suggesting that the HoD's did not know what the lesson plans should include.

6.3.4 Assessment tasks set up by Grade 3 teachers, evidence of the learner's work and feedback to learners

The researcher found that assessment tasks were not moderated correctly as they did not contain a pre and post moderation tool. Learner's assessment tasks were not organised properly and formal assessment was not done regularly. The learners' books were not all marked and corrections were seldom done and feedback was rarely given to the learners. In some of the schools, the learners writing books are marked regularly, but the DBE workbooks are not marked as the teachers claim that they do the work with the learners on the board so no errors should occur. They also commented on the fact that they rarely get time to mark the DBE workbooks.

6.3.5 The Grade 3 Teachers understanding of the relevant theories that are required to teach Mathematics effectively

The researcher found that Grade 3 teachers lacked a deep understanding of social constructivism, behaviourism and connectivism and their deficit of basic knowledge in this regard prevented them from implementing these theories into their learning and teaching practices in Grade 3 Mathematics classrooms. (Paragraph 5.8.1. Theme 2 category 2.2.)

6.3.6 Challenges and successes of Grade 3 Mathematics teachers with regard to the teaching and learning of Mathematics in their classrooms

It was a general finding in all the schools that Mathematics classrooms lack teaching aids, apparatus, and resources. Teachers all complained about the lack of funds and stationery that prohibited them from doing their jobs effectively. The conditions of the classrooms were also found to be in disrepair, walls were peeling, and carpets were shabby and very dirty. Most teachers admitted to using their own salaries to buy what they need just so that they could get the work done. (Paragraph 5.8.3. Theme 3 Category 3.1.)

6.3.7 Overcrowded classrooms and discipline problems

A finding in all the Grade 3 classrooms was that the classrooms were overfull, and space was extremely limited. In most cases, teachers found it difficult to maintain discipline while teaching and assisting individual learners during the lessons was virtually impossible as the rest of the class then ran riot. Teachers admitted that they have spoken about this problem so many times, but the problem is never addressed. (Paragraph 5.8.3. Theme 3 Category 3.3.) The teacher-learner ratio in public schools should be 30:1 (Motshekga, 2012), but is currently at 40:1 or in some cases classes can contain 45-50 learners.

6.3.8 Learners who have social problems and severe barriers to learning

Whilst observing the Grade 3 Mathematics teachers in the three participating schools, it became apparent that poverty, social problems and learners who had severe barriers to learning were factors that impacted on the teaching and learning of Mathematics in Grade 3 classrooms.

Many Grade 3 learners could not read, lacked discipline, were neglected by parents, had language barriers and suffered from other barriers to learning, such as concentration problems, hyperactivity, memory problems, and physical handicaps, mental

and serious illnesses that prevented these Grade 3 learners from learning Mathematics. Foetal alcohol syndrome was very prevalent in many of the Grade 3 learners. It was also evident that these Grade 3 teachers lacked the skills to be able to teach Mathematics to these learners.

6.3.9 Lack of support from other stakeholders in schools and at the district level

One of the main findings in this empirical study was the fact that Grade 3 Mathematics teachers feel that they receive little or no support from the DBE, SGB's, principals and from the parents of the learners. It was, however, an important finding that HoD's did offer support regularly to the Grade 3 Mathematics teachers.

6.4 SUGGESTED STRATEGIES TO IMPROVE THE GRADE 3 MATHEMATICS TEACHERS PROFICIENCIES IN MATHEMATICS TEACHING

One of the most important findings in the empirical study highlighted the fact that teachers need to receive more extensive training and improve their knowledge and skills in the teaching and learning of Mathematics. Teachers requested training to be able to draw up lesson plans that were more effective and conducive to teaching Mathematics to all ability groups. A suggestion was made that all the Grade 3 teachers should convene on a weekly basis to discuss and plan together. Teachers also suggested that lessons should be planned with the CAPS objectives and aim in mind and teachers should use the CAPS documents to plan activities. The Grade 3 teachers also requested that pre planned lessons be provided to them by the DBE as then they would know exactly what to teach and not deviate from the CAPS document. They also stated that the assessment should be included in the lesson plans.

The Grade 3 teachers suggested using various methods and approaches to teach Mathematics and not to stick to just one method. Visiting other schools regularly may help them to find methods and approaches that work. The use of fun and creative activities where learners get to actively participate in lessons was also suggested as

a way to improve their teaching practices and the fact that problem-solving, practical activities and group activities should be done daily. The teachers also suggested that technology and media should be used to assist learners with various learning styles and abilities. Assessment should also be carried out on a continuous basis and be set up according to the CAPS documents. Learners should also be assessed daily using informal assessment.

6.5 SUCCESSES OF GRADE 3 MATHEMATICS TEACHERS WITH THE REGARDS TO TEACHING AND LEARNING OF MATHEMATICS

It was an overall finding in most of the schools that teachers were more vocal about the challenges that they faced in regards to the teaching and learning of Mathematics in Grade 3 classrooms, then they were about the successes that they have experienced in improving mathematical outcomes of Grade 3 learners. They did, however, admit that when they followed the guidelines that CAPS prescribed for the teaching and learning of Mathematics, they did receive better results in Mathematics and the learners were more disciplined in the classroom. The ANA statistics from 2011-2014 (when available) did show a slight improvement in the Mathematics outcomes in Grade 3, but further achievement cannot be confirmed or denied as after 2014 ANA ceased to exist. One school did, however, achieve better results by introducing an after-school study group that focused on Mathematics learning for learners that require additional assistance. After school clubs and intervention programmes also seemed to improve Mathematics outcomes in two of the schools that participated in the study. One of the schools commented that some of their Grade 4 learners received prices in the Mathematics League indicating that Grade 3 teachers are in fact contributing to positive outcomes in Mathematics in the higher grades. The researcher will now summarize the findings from both the literature review and the empirical study.

6.6 SYNTHESIS OF THE FINDINGS

Both the literature that was reviewed and the empirical study highlight factors that hamper the effective teaching of Mathematics in Grade 3 classes. According to both

sets of findings the harsh conditions that teachers teach in, the limited amount of support they receive, the limited amount of resources they have at their disposal, the type of learners they are expected to teach and the teachers themselves are responsible for the low level of achievement in Grade 3 Mathematics classrooms.

In both cases, evidence has been provided that confirm the fact that teachers lack knowledge and skills to be able to teach Mathematics effectively. They do not seem to know enough about the subject they teach and thus lack confidence and competencies to teach in a way that learners understand. It is a general finding that this knowledge deficiency leads to teachers using inappropriate teaching methods and approaches, favouring traditional methods that they are familiar with rather than using various methods and approaches that they are not sure of. The methods that are most favoured are talk and chalk, drill, rote and memorization of facts. Teaching approaches are teacher-centered, and teachers do not use the learner-centred approach or engage in group or problem-solving activities. Learning occurs in a passive way and learners are not given the opportunity to discuss what they have learned or to ask questions, they are passive in the learning process.

By reviewing the literature findings and the empirical findings from the study it is evident that teachers need more extensive training so that they will be able to teach with understanding, use various teaching methods and approaches that are effective, meet all the learning needs of the children in their classes and present lessons that actively engage learners and allow them to construct their own knowledge.

The literature review and the empirical study indicates that teachers do not always use the prescribed CAPS document daily as they do not understand it or find it difficult to teach certain concepts. What they do not understand or deem to be unimportant they leave out. Another finding was that teachers do not know how to plan their lessons around the CAPS document and some lesson plans are incomplete and lack practical and problem-solving activities. They also do not cater for all ability groups in the classroom as they do not include activities for highflyers or learners that have severe barriers to learning. Assessment is not carried out according to guidelines stipulated by CAPS and moderation is not done correctly.

Another finding that was included in both the literature and the empirical study is the fact that the workload of teachers has increased over the years and not decreased in the way that CAPS implementation intended. The curriculum is very vast and teachers have to rush to complete the curriculum on time. There is no time to teach and reteach concepts that learners do not understand and often topics are handled briefly without giving the learners time to understand the work.

The main challenges that have been highlighted by both the literature review and the empirical study that seem to hamper Grade 3 teachers' ability to teach Mathematics effectively, are limited or lack of resources and funds, failing infrastructures, overcrowded classrooms, lack of support and guidance for Mathematics teachers, teaching children with barriers to learning, social problems and a severe lack of discipline in schools. The fact that parents, SGB'S, SMT'S and principals are not committed to improving Mathematics outcomes in schools and limited support from the DBE also seems to add to the challenges that Grade 3 Mathematics teachers experience daily.

6.7 RESEARCH CONCLUSIONS

By studying the literature that was reviewed and the empirical findings it is evident that the challenges that are faced by Grade 3 Mathematics teachers are not isolated to one province or school but expand throughout South Africa. It was astounding to the researcher that such inadequacies occur as a norm and not as an exception to the rule.

One of the main findings in this study was the fact that Grade 3 Mathematics teachers are in serious need of more training (Momosa, 2010). This training should, however, be of high quality and be extensive in nature and not only teach knowledge and skills but allow teachers to take what they learn and practically implement it in their Mathematics classes. These training sessions should be more intensive than the training that Grade 3 teachers originally received for the implementation of CAPS (Armstrong, 2011) be continuous and reform the training of the existing teaching force (USAID, 2011). Training should be conducted over a longer period of time as short courses did not seem to improve the teacher's skills and knowledge (Armstrong, 2011).

Training should be measured by the quality and not by quantity as attending a vast amount of courses that are impractical and do not improve the knowledge and skills of the Grade 3 Mathematics teachers is pointless and just a waste of money (teach. Org, 2016). The way in which these training sessions are presented is also questionable (Singh, 2011) and the presenters themselves should be monitored more closely to ensure that after the course teachers have in fact learned something valuable that will allow them to teach Mathematics more effectively in their classrooms (Donald, Lazarus and Lolwana,2010). Training needs to increase Content knowledge, Pedagogical knowledge and help teachers develop skills to enable them to teach more effectively (Bjerede, 2012).

Follow-up training sessions need to be conducted and include continual support and supervision for Mathematics teachers (USAID, 2011). These courses should also train teachers to deal with discipline problems in overcrowded classrooms, to manage these classrooms more effectively and to teach learners with severe barriers to learning (Salend, 2011). Often teachers are not confident to teach such learners as they feel as if they lack specialized skills. Training will resolve the fact that teachers use incorrect approaches and methods to teach learners who suffer from barriers to learning and get rid of discipline problems that have a negative effect on teachers' practices (Venketess, 2011). There is a need to increase teachers principle and practical knowledge in teaching Mathematics (Department of Higher Education and Training, 2011).Teachers also need to be trained to use correct methods and approaches to teach Mathematics, how to plan effectively and to administer assessment according to the CAPS guidelines (Richard, 2013).Poverty and social conditions that learners live in seem to play a valuable role in how learners learn and the effects of these social inadequacies have a dire effect on teaching practices in Mathematics classrooms. This was partially prevalent in rural schools where learners came from poor communities where the economic conditions were very low (Akariand Bikranta, 2014). In such economic conditions learners seem to have extreme barriers to learning and without skills teachers cannot attend to their special educational needs (Motshekga, 2016).

Research findings also confirm that classrooms are overcrowded and the infrastructure of schools are not equipped to deal with such large numbers of learners(Mweru,2010) and teachers lack valuable skills which will enable them to teach such large numbers and maintain discipline at the same time (Herzallah, Nesane,2011. Teachers also cannot cope with having to teach learners in Mathematics classes that have severe barriers to learning (Nel and Tlale, 2015). Lack of resources, teaching aids, textbooks, funds, stationery, and apparatus seem to be major challenges that occur in all Government Schools (Panthi, Belbase (2017); Kamla-aj (2011); Motsheka, (2011); Mdutshane (2014); Peter, (2014); Nyawira (2015).

It was also a finding that emerged from this study that the teacher's workloads have become more extensive after the implementation of CAPS (Clipa, Boghear, 2011) and teachers feel overwhelmed by the amount of work they now have and new demands that are placed on them as their educational roles have expanded to accommodate educational reform.

This study also indicated that Mathematics teachers in Grade 3 feel neglected in their endeavours to teach Mathematics in circumstances that are anything but ideal and receive little or no support from parents (Akariand Bikranta, 2014), SGB'S, SMT'S and the Department themselves, resulting in teachers being left to their own devices and not teaching Mathematics in an effective way (Holbom, 2013).

The researcher also came to the conclusion that although some of the underlying reasons for underperformance in Grade 3 Mathematics classes are currently being addressed (Spaull, 2013) many important issues are being ignored due to financial constraints and economic conditions that exist in South Africa today. The blame for the education crisis that thus exists in schools throughout South Africa (Spaull, 2013) rests on the shoulders of all stakeholders and more will have to be done to improve how teaching and learning of Mathematics occur in Grade 3 classrooms.
The researcher will now discuss how the findings answered the main research question which was the following: To what extent do teachers in Daniëlskuil make use of various teaching approaches and what strategies can be suggested to empower their proficiency levels in Mathematics?

6.8 THEORIES THAT ENDORSE THE EFFECTIVE TEACHING AND LEARNING OF MATHEMATICS

From research, it can be deduced that Social-constructivism, Behaviourism, and Connectivism are theories that can be incorporated into Mathematics classrooms to ensure that learning occurs effectively (Schunck, 2012). But in order for teachers to be able to implement these theories effectively, they need to have a deep understanding of each one and know what methods or approaches will best serve to teach Mathematics (Schunck, 2012).

The literature review and the empirical study highlighted the fact that teachers do not know what theories endorse the effective teaching and learning of Mathematics nor did they know what theory to employ for what purpose of learning (Pritchard, 2014).

The research highlighted the following elements from each theory that promoted knowledge construction and effective learning and teaching in Mathematics classrooms.

6.8.1 Social constructivism

Social interaction is an important tool for learners to use, it generally promotes learning and allows the learners to construct their own knowledge by interacting with their immediate environment and with their peers (Pritchard, 2014). Language has to form part of how learners learn in Mathematics classrooms and should be given the opportunity to discuss their work, share ideas and make sense of what they have learned (Pritchard, 2014) discussion and dialogue are vitally important for intellectual development.

In Mathematics classrooms learning should occur through understanding and learners should be actively involved in Mathematics lessons and allowed to construct their own knowledge and understanding through inquiry and exploration (Kul, 2013). In Mathematics classrooms, collaborative learning is essential and can be achieved by allowing learners to work in pairs, groups or teams(Bhattacharjee,2015) and during

this group work activity, the learners should be exposed to activities that promote critical thinking, reasoning and problem-solving skills (Kok, Demirel, 2008). This process of learning should be centred on the learner and the teacher should become the facilitator and merely guide the learner while they actively learn (Bhattacharjee, 2015).

The cultural background and the experiences that learners bring to the classroom should also be taken into consideration when teaching Mathematics (Andrews, 2012) so it is vitally important to ensure that learning situations, environments, and tasks are related to real-life situations that the learners are familiar with (Killen, 2013). The previous knowledge of the learner how they construct new knowledge, their attitudes and beliefs should be taken into consideration when trying to teach Mathematics effectively (Bhattacharjee, 2015). Old outdated teaching methods of rote, drill, talk and chalk and memorisation of facts should be replaced with activities that allow the learners to solve everyday problems, make important deductions, use various methods and approaches, talk about what they have learned and construct knowledge in their own way (Donald et al., 2010). Teachers should no longer simply tell the learners what to learn, what methods to use and what procedures to follow, but allow learners to get to the answer on their own. The knowledge that is acquired in this way is often retained much longer than the knowledge that is simply transferred from the teacher to the learner (Vilardi and Rice 2014).

6.8.2 Behaviourism

In a Mathematics classroom, it is important that discipline is maintained and the negative behaviour of learners can be modified by teaching, training, and tutoring (Pritchard, 2014). Operant conditioning can be used to change the inappropriate behaviour of Mathematics learners and ensure that appropriate behaviour continues. Learners should realize that all actions have consequences and their attitudes towards Mathematics and how they behave in the Mathematics classroom with either lead to failure or success (Schunck, 2012). The attitude of the teacher in a Mathematics classroom can cause either negative or positive feelings towards Mathematics and learners with often imitate the feelings of the teacher. Teachers who are positive

about Mathematics, promotes the love of the subject and demonstrates a deep understanding of Mathematics teaching will encourage their learners to also have the same outlook, and will achieve better results than a teacher who is negative and makes their learners afraid of Mathematics (Browne, 2013) Confident and competent teachers also seem to produce learners of the same caliber. Mathematics teachers should thus model the type of attitudes and positive behaviour that they wish to receive from the learners in their classrooms (Killen, 2013).

A Mathematics teacher should also use intervention programmes and scaffolding to assist learners who are struggling to learn Mathematics (Pritchard, 2014). The environment that the Mathematics teacher creates for the learner to learn in, should be an environment where the learner feels safe and secure and not afraid to make mistakes. Learners in Mathematics classrooms should be encouraged to construct their own knowledge, think critically and make sense of their own learning processes. The environment that a teacher thus creates for mathematical learning can have a definite effect on how the learners learn (Pritchard, 2014).

6.8.3 Connectivism

In Mathematics classrooms, learners should be given the opportunity to learn and make connections from their prior experiences and interaction with other learners in the classroom (Garcia Ferreira, 2014). These vital connections are formed when a learner works in a group towards a shared goal which is usually to solve a problem. Group work in Mathematics learning is vitally important as new knowledge can be constructed through the network of other learners (Garcia Ferreira, 2014). Learning in a Mathematics classroom should be managed by the learners and learners should be autonomous in their learning processes. They should be offered ample opportunities where they are able to interact with their peers and gain knowledge from the people around them.

The Mathematics teacher needs to teach learners skills that will enable them to connect different sources of information together, make connections between various

fields, ideas, and concepts (Siemens, 2004). A Mathematics teacher can use Connectivism in the Mathematics classroom to ensure that learning occurs effectively in group work and to maintain appropriate discipline in the classrooms when this group learning activity is used (Sahin, 2012). These theories are important for the teaching and learning of Mathematics and Mathematics teachers need to know what each theory entails and how it can be used to ensure that effective learning and teaching transpire in Mathematics classrooms (Schunck, 2012). The next sub-heading that will be discussed is the Proficiency levels of Grade 3 Mathematics teachers.

6.8.4 The proficiency levels of Grade 3 Mathematics teachers

Research has allowed the researcher to come to the conclusion that Grade 3 Mathematics teachers have relatively low proficiency levels in Mathematics teaching. This seems to be because of their lack of training and pedagogical knowledge. One of the main findings in this research study was that Grade 3 teachers lack the knowledge they require to teach Mathematics effectively and because of their lack of knowledge lack confidence as they are not sure what to teach, how to teach or in what ways their learners teach (Taylor, 2011). They also did not seem to know enough about the learners in their classrooms or enough about the subject they are expected to teach (Carnoy, 2011). Due to their own lack of knowledge they did not encourage the learners in the classroom to ask questions as they were afraid that they would not be able to answer the questions that the learners asked (Carnoy, 2011) and found setting the scene for effective Mathematics daunting as they tried to teach concepts that they themselves did not understand (Langsberg, Krüger, Swart, 2016). It was also a finding that because these teachers lacked the knowledge they couldn't intervene in the mental processes of their learners and establish what they learn and in fact how they do it (Langsberg, Krüger, Swart, 2016). It was also the main finding that when these teachers got confused with the content they were expected to teach; they start using the textbook or DBE to teach the learners. They also seemed to rush through content that they did not understand or felt was too difficult to explain to the learners.

Another important finding was that Grade 3 Mathematics teachers did not know how to vary their approaches to Mathematics teaching and did not use alternative approaches or methods to teach concepts that the learners did not understand (Woolfolk, 2013). They also seemed to teach in a disconnected way which was not aimed at creating learner understanding, but more to teach the facts and procedures to the learners (Ali, 2016). The Grade 3 teachers also seemed to avoid group work, problem-solving activities and practical teaching in their classrooms, favouring the use of direct teaching where they explained, and the children listened. The researcher also observed that when Grade 3 teachers explained a concept to the learners that they couldn't understand they did not use other methods to try and ensure understanding but became frustrated and moved on to the next concept. The next section will deal with the findings regarding the challenges that are experienced by Grade 3 Mathematics teachers and successes that they have had in the teaching and learning of Mathematics in Grade 3 classrooms.

6.9 RESEARCH FINDINGS FOCUSING ON CHALLENGES

The findings were that teachers lack resources, teaching aids, apparatus and stationery to be able to teach their learners effectively. These teachers also experienced challenges while teaching Mathematics as their classrooms were crowed and could not maintain proper discipline while teaching (Thompson, 2012). The classrooms were also in a shocking state, carpets were dirty, walls were peeling, and some had windows missing.

Other challenges that were observed were the fact that the teachers did not know how to cope with children with severe barriers to learning, language barriers and social problems that affected the children in their classrooms (Thompson, 2012). The Grade 3 teachers also indicated that a lack of support from various stakeholders is a major factor that prohibits them from doing their jobs effectively (Killen, 2013).

Lack of effective training and pedagogical knowledge was also some of the challenges that were highlighted. The Grade 3 teachers also indicated that their workload has increased dramatically, and they have little time for their families as they take

their administration work home as they cannot complete it in school time. The researcher also observed that many learners in Grade 3 couldn't read and this was also a major challenge for the Grade 3 teachers.

6.10 SUCESSES EXPERIENCED BY GRADE 3 TEACHERS IN REGARD TO MATHEMATICS TEACHING AND LEARNING.

The main finding in this regard was that by establishing Mathematics intervention programs, and study groups and after school Math's clubs, outcomes in Mathematics has improved. Some of the Mathematics teachers also stated that when they used the CAPS guidelines to teach Mathematics, they achieved better results. Participating in Mathematics Leagues and by using apparatus to teach has also improved Mathematics teaching and learning. Where ANA statistics were available the researcher could also deduce that Mathematics outcomes have improved from 2011-2014. The researcher will now name some of the strategies that could improve the proficiency levels of Grade 3 Mathematics teachers.

6.11 SUGGESTIONS AND STRATEGIES THAT CAN IMPROVE GRADE 3 MATHEMATICS TEACHERS PROFICIENCIES

One of the main suggestions in this regards was that teachers should be given more extensive training so that they can improve their Content Knowledge, Pedagogical Knowledge and develop skills that will enable them to teach more effectively (Armstrong, 2011). They should also receive training on lesson planning, assessment, how to use CAPS document effectively and to vary their methods and teaching approaches and skills to teach learners with barriers to learning.

According to Teach.Org (2016), professional development for teachers should be a high priority and each district should ensure that enough time is set aside, an ample number of development hours per year for teachers. This professional development can assist teachers to improve their teaching practices, knowledge, ability, and skills. Teachers need this professional development as they deal with many unfamiliar issues in the curriculum and if not correctly trained and left to their own devices, leading

to counter proactive behaviour that is not conducive to quality learning or teaching(Seale,2012). Unless teachers are properly trained problems in public schools will not diminish, but become progressively worse. These development sessions should be effective and aim to improve the current practices of teachers, but unfortunately one of the main findings in this research study points to the fact that most teachers complain about the quality of training they have attended, amounting to being very ineffective to improve teachers' knowledge and skills(Mcgill,2013). Training that is truly effective seems to be exceptionally rare.

Another reason that professional development is essential for Mathematics teachers is the fact that only a small percentage of teachers who are qualified to teach Mathematics do, while others choose to teach subjects that they did not specialize in. This then leaves a gap as teachers who are unqualified now have to step in and teach Mathematics will little or no Mathematical knowledge at all (Simkins,2010). Without professional development and training Mathematics teachers will continue to teach using inappropriate teaching methods and approaches, teach facts and procedures without understanding and continue to receive the same dismal results in Mathematics as they have achieved in the past(Tucker,2013).

The integration of technology into Mathematics may also improve the proficiencies of both Mathematics teachers and the learners they teach (Downes, 2010) combining both technological approaches and professional development may empower Mathematics teachers to be more confident, up to date on how learners learn and construct knowledge and to improve their current ways of teaching Mathematics (Mhlolo, 2013). The researcher will now discuss the overview of the framework that was used to conduct this research study.

6.12 OVERVIEW OF THE FRAMEWORK USED FOR THE RESEARCH STUDY

The framework that was used for this chapter included an introduction as to how the researcher obtained the findings for this research study. It includes a summary of the literature that was reviewed on Mathematics teaching and learning in Grade 3 and a summary of the empirical study that was obtained through conducting face-to-face

interviews with Grade 3 Mathematics teachers, non-participation observation and document analysis.it also includes a synthesis of all the findings that occurred throughout the research study and conclusions that are researched by conducting this research study.

This chapter then allows the researcher to defend their research findings by discussing the sub-questions that were formulated to answer the main research question. This chapter also includes a discussion on how Mathematics awareness can be created in schools. Lastly, the limitations of the research study were highlighted, and recommendations were made that could lead to further research studies on effective Mathematical teaching and learning in Grade 3 classrooms. The chapter is brought to a close by the conclusions that were reached from the review of the literature and the empirical findings that emerged from the research study itself. The next section will focus on how to create Mathematical awareness in schools, teachers, and learners.

6.13 HOW TO CREATE MATHEMATIC AWARENESS IN GRADE 3 LEARNERS AND ENCOURAGE EFFECTIVE LEARNING AND PARTICIPATION IN MATHEMATICS LESSONS

Learners need to be taught the importance of Mathematics outside the classroom (Louw, DuToit, 2010). Due to the fact that learners find it very difficult to grasp certain concepts, the burden needs to be lessened by creating an environment where learners not only feel confident to try new things but also to take risks, ask questions and learn effectively (Zwiers, Crawford, 2011). Learners should feel that the environment they are in is not intimidating or cause them feelings of anxiety, and can freely talk about their discoveries and thought processes, increase their need for discovery and gain answers to why certain things work in Mathematics (Zwiers, Crawford, 2011). The Mathematics teacher also needs to assist learners to acquire new knowledge in Mathematics, utilize new technology in Mathematics classrooms and provide feedback to learners so that they can do corrections and learn from their mistakes (Boaler, 2013).

Mathematics teachers also need to show their learners what the real purpose of Mathematics is and to ensure that this purpose extends beyond the constraints of Mathematics classrooms (Kitchen, 2016). Unfortunately, in today's day and age learners are not taught this purpose and merely think of their Mathematics experience as just learning a skill that will represent a Grade on a report card (Kitchen, 2016). Mathematics needs to be taught in a way that helps learners to understand the world around them and be able to use Mathematics effectively in businesses worldwide. Learners need to encourage to learn Mathematics at an early age so that they can use the skills in later life to be successfully employed. According to Kitchen (2016), Mathematics is required in almost any job in the global world.

Teachers need to develop Mathematics awareness by creating real-world and purposeful experiences in their classrooms, effectively encouraging affective engagement and assisting learners to move away from the attitude of Mathematics being boring or irrelevant and engage learners on a level that is cognitively effective, creating opportunities for learners to become confident and experience success. Succeeding in Mathematics at an early age will ensure that learners become aware of the central role of Mathematics in life beyond the school (Sparrow, 2005). Teachers need to ensure that all Mathematics lessons are interesting and allow for the development of knowledge, skills, and understanding, with the new-found knowledge learners will be able to make valuable connections between Mathematics that are learnt in school and Mathematics that is used in the outside world. A more positive attitude in Mathematics will ensure that learners become more motivated and willing to learn (Mata, 2012).

A good way to promote Mathematics awareness is the use of game-based engagement which teachers' learners' new Mathematical concepts in a way that is fun and leads to a more positive attitude towards Mathematics (Bragg, 2007). Teachers can also promote Mathematical awareness in learners by modelling positive attitudes and allowing learners to feel that anyone can do Mathematics. Meaningful and exciting Mathematics lessons that incorporate all ability levels and cater for all the diverse learning styles in a Mathematics classroom, occurring in an environment that is rich in Mathematical language, can be instrumental in altering the learners' perceptions

towards Mathematics and make them want to learn and achieve success in this subject (Mata,2012).

6.14 MATHEMATICAL AWARENESS SHOULD ALSO BE PROMOTED AND CONVEYED TO OTHER STAKEHOLDERS IN SCHOOLS

Awareness and good school performance in Mathematics cannot simply be left up to the teachers but requires a joint effort by all the stakeholders in a school (Vikas, 2019). The SGB's of schools should take responsibility for both the teachers and learners results in Mathematics and should get on board to ensure that intervention programmes are put in place to promote Mathematics learning and the need for better results in this subject (Garland, 2014). They are also responsible for talking to the community and making the parents aware of the challenges that teachers are experienced with regards to Mathematics teaching and ask for the parents to become more active in the education of their children (Garland, 2014). This active participation may be as little as developing an interest in the outcomes that their children are obtaining or as much as assisting with Mathematics homework at home. Teachers also need to find ways to actively engage these parents and ensure that they become more prominent in their children's Mathematical learning and education as a whole. At any school, the principal sets the tone for success in Mathematics and therefore needs to be on board to ensure that an assertive effort is made to create Mathematics awareness in their school (Garland, 2014). Together with the SBG, SMT, teachers, and learners, a programme can be created to improve Mathematics teaching and learning and make everyone aware of the importance of Mathematics.

The SBG, SMT, the teachers and the principals themselves need to share responsibility for student learning, be accountable for student performance and be committed to promote learning of Mathematics in schools (Water, 2009). Although teachers are prepared to try and improve Mathematics outcomes in South African schools, they are just not able to do it alone, principals, therefore, need to share this goal and with the help of their SGB'S monitor learning goals and determine the needs of Mathematics teachers and the learners they teach (Water, 2009).

6.14.1 Creating Mathematical awareness in teachers

One of the biggest problems that that prevalent with regards to underachievement in Mathematics, is the teaching methods, approaches and practices that Mathematics teachers use in classrooms. (Spaull, 2013). It has been a recommendation that this needs to change if Mathematics outcomes are to improve, but how are these teachers expected to change their practices if they do not know that the manner that they are teaching in is incorrect? According to Spaull (2013), teachers become complacent and develop a resistance to attempts to reform Mathematics teaching, as they are under a false conception that they are doing a good job. Principals and H.O.D's need to ensure that Mathematics teachers know what to teach and how to teach it and ensure that if teachers lack knowledge that they are retrained.

Principals, SMT'S and SGB's should thus join forces and support teachers, emphasizing the fact that Mathematics is a very important subject in schools and without this subject, the learner will not be employable in the future. Mathematics teachers need to increase their own awareness and knowledge of the subject to be able to create awareness in the learners they teach. Teachers should also be held accountable for the learning that occurs in their Mathematics classrooms, they should be constantly monitored and evaluated and offered support and guidance in their teaching and learning processes (Dufour Mattos, 2013). According to Ball,2016) Mathematics awareness in teachers can be provoked by guiding teachers towards making positive changes and thus ensuring that all children in Mathematics classrooms receive a quality education and thrive and learn effectively.

6.7.2 Operationalizing student, schools and teacher awareness in Mathematics teaching and learning

The first link in the complex chain of Mathematics awareness and improvement is directly linked to the principal of the school. The principal has to demonstrate a deep commitment to Mathematics learning and should ensure that in conjunction with the SGB, action plans are put in place to ensure that effective Mathematical learning transpires in their school (Davidson, 2015).The school principal should have a shared vision in regards to Mathematical teaching and learning and demonstrate leadership skills, that will inspire and ensure that his or her teachers see the need for change and give their commitment to act as change agents, in the teaching and learning of Mathematics (Davidson, 2015). Principals need to mobilize their staff to build up their teaching capacities and monitor and support teachers as they promote Mathematical awareness in their respective classrooms (Darling-Hammond, 2012). Principals should also ensure that teachers teach in environments that are supportive and offer assistance and guidance when it is required of them and help teachers to adopt a broader systematic view to how and what they teach (Palmer, 2014).

The SGB'S of the school who form the second link in the chain should also take responsibility to set learning goals, aims, and objectives for Mathematics teaching and teach (Brown, 2016). According to Young (2017), Governing bodies need to lead to school towards improvement and strong skills in SGB members can turn around underperformance in schools. The governing bodies need to set targets and achievement objectives for Mathematics and then review the progress and framework in the specialised light of progress. They too have to support the teachers in their school and ensure that teachers have the resources they need to do their jobs effectively. They also need to spend time on communicating the purpose and importance of Mathematics learning to other shareholders, such as the parents of Mathematics learners, and obtain a genuine commitment from the community to get on board with projects that promote quality Mathematical teaching and learning.

The next link in the chain is the teachers of Mathematics. Teachers need to create mathematical awareness by emphasizing the importance of Mathematics that exists

outside the classroom (Kitchen, 2016). Mathematics teachers should also help the learners in their classes to understand and describe the world around them and should base their lessons on real-life situations where skills can be used to solve problems that the learners can relate to. Learners should be taught that Mathematics is all around them and any job that they wish to acquire in the future requires the use of Mathematics. Teachers can also create Mathematics awareness by talking the language of Mathematics fluently, giving learners the opportunity to practice and master Mathematical learning and by adapting their teaching practices to accommodate all learners in their classrooms. Teachers also have to ensure that they are confident in their Mathematical teaching, adapt their resources for teaching, ensure that all learners are accessing the Mathematics curriculum without anxiety and work towards developing each learners' potential in the classroom (Panaoura, 2014). Teachers also have to model a positive attitude towards Mathematics and make sure that learners are aware that anyone can do Mathematics.

The next link in this chain is the learners themselves who must be taught Mathematics. They should be made to see the central role that Mathematics has beyond what they learn in school (Sparrow, 2008) and understand why it is important for future employment and success (Kitchen, 2016). Learners also need to change their attitude towards the learning of Mathematics, be more motivated and willing to learn. Learners should be made to understand that Mathematics is not just a skill that leads to a Grade on a report card, but a skill that will open up a thousand doors to them in the job market. Almost every job that is available requires the use of Mathematics (Kitchen, 2016). Learners should be presented with purposeful learning experiences that will move them away from the attitude that Mathematics is difficult and boring and replace it with a desire to discover, inquire and explore, ensuring that the more they learn, the more they will, in fact, want to learn (Gardini, 2016).

The last link in this complex chain is the parents that have to be actively engaged and informed about the key Mathematics skills that their children learned school, teachers should show them everyday activities that can help to improve their children's Mathematica skills. They should also be provided with practical ways to support their chil-

dren at home and be kept up to date on their children's Mathematical progress (Panaoura, 2014). The parents of Mathematics learners should also show commitment to their child's learning and ensure that they do their part to promote Mathematical awareness and the importance thereof in their homes.

It is apparent from the above that all stakeholders in schools should be committed to promote Mathematics awareness and ensure the effective teaching and learning of the subject.

6.15 LIMITATIONS

One of the limitations that the researcher encountered was a language barrier during the interview process. The Grade three teachers that were interviewed were not English speaking and due to the fact that the interview was conducted in English, most of the questions had to be translated into Afrikaans. This was quite difficult for the researcher as the responses had been translated exactly as they were uttered by the respondents, so as not to change the meaning of the participant's responses. One of the schools that the researcher originally earmarked for this research study, had to withdraw as their Mathematics lessons were conducted in Tswana and the teachers couldn't translate the information into English. Another limitation was that some of the respondents were afraid to say anything negative in the interviews as they felt uneasy about what negative repercussions their answers could have on their job security. This amounted to a contradiction of the interview responses and what was actually happening in their classrooms.

In some schools, the availability of ANA statistics and policies on mathematical teaching was a limitation, as documents weren't available due to computers being stolen or not operational. In one school the main server had been stolen so no physical documents were available. In such cases, the researcher had to rely on the integrity of the principal and accept their word for the improvement in Grade 3 Mathematics which eligibly occurred from 2011-2014. One of the schools did not write the ANA exam in 2014 due to Unions that prevented their teachers from administering this test. School policies on teaching Mathematics were outdated and not freely available, in

some cases the researcher had difficulties in obtaining these documents. The researcher will now explain the recommendations that could be made to both schools and teachers to improve the teaching and learning of Mathematics in Grade 3 classrooms.

6.16 RECOMMENDATIONS

6.16.1 Recommendations to schools and the Department of Basic Education

Teachers need more training to improve their Content knowledge, Pedagogical knowledge and skills to be able to teach Mathematics more effectively. This training should, however, be intensive and enough time should be set aside to ensure that teachers can raise concerns and ask questions these sessions should also be more focused on the practical implementation of lessons and help the teachers to deal with problems that hamper their teaching like discipline. Teachers should also be taught how to teach learners that have severe barriers to learning. Various methods and approaches for mathematical teaching should be demonstrated to teachers so that they can perfect methods that will meet the needs of all the learners in their classrooms. Mathematics teachers in Grade 3 also need to be taught about the various theories that endorse the effective teaching and learning of Mathematics.

This training needs to be presented by presenters that are energetic, have a good command of language and can present in a way that is interesting to the catered audience. Presenters should also be punctual and come to sessions well prepared. The principals, SBG, SMT'S and the parents of the learners have to become more involved in the Mathematical learning of the children in the school. More support and guidance should be given to the teachers by all the relevant stakeholders to ensure that effective Mathematics teaching and learning takes place in Grade 3 classes. Cleaners should be employed by the Department to ensure that the environment that learners have to learn in are clean and do not present health problems. Carpets are in a terrible state and are incredibly dirty. The toilets at the schools that I visited were also in a shocking state and were not clean or hygienic.

The challenges that Grade 3 Mathematics teachers experience like overcrowded classes, discipline problems, lack of resources, failing infrastructures and lack of funds should be addressed and a solution needs to be found. The workload of teachers should also be addressed. Action plans should also be put into place for teachers to become more competent in regard to teaching children with severe barriers to learning. Specialists, Phycologists and Social workers should also be called in to address social problems that affect how learners in Grade 3 learn.

6.16.2 Recommendations to teachers

Teachers need to develop their Mathematics knowledge and skills and teach in a way that learners understand. Approaches and methods of teaching Mathematics need to be varied and teachers need to address their teaching practices. They need to include problem-solving activities in their Mathematics teaching lessons and allow children to partake in cooperative learning activities. Mathematics teachers need to study the ten approaches for teaching Mathematics to improve their teaching practices and use the prescribed CAPS documents for teaching, lesson plans and assessment.

Teachers also have to examine their own attitudes towards Mathematical teaching and learning and model more appropriative behaviour, use scaffolding and intervention programmes to assist struggling learners and create an environment that is conducive to effective Mathematics learning. Feedback should also be given to learners regularly; learner's books should be marked, and corrections should be done in Mathematics classroom. There is also a very big demand for reading programmes that can assist Grade 3 learners who cannot read. Teachers should also prepare themselves better and ensure that planning is done properly including all the learners in the classroom, highflyers, and learners with barriers to learning. Teachers also need to stick to time on task and ensure that learners are assisted with pacing.

6.17 SUGGESTIONS FOR FURTHER RESEARCH

As this research study was only conducted in various schools in Daniëlskuil, in the Northern Cape Province, the researcher suggests that further studies should be done

in other towns and provinces to determine if the views and challenges of Grade 3 Mathematics are applicable to only this province, or if the problems that occur manifest themselves in all provinces of the Education System. The participants that participated in this study were only Grade 3 teachers, but it can be suggested that further research needs to be conducted on other grades to establish if the problems exist due to the caliber of Grade three teachers who are presently teaching Mathematics or if Mathematics teachers in all grades problematic.

Further research needs to be conducted on the type of training that Mathematics teachers receive and if it is sufficient for building up knowledge bases, increasing teacher's capacities and skills development or is it implemented in a way that is ineffective and further contributing to the underperformance in Grade 3 Mathematics classrooms. Research should be conducted to establish whether training is addressing the needs of the Mathematics teachers or is it too theoretically based without considering the practical issues that go hand and hand with teaching Mathematics in Grade 3 in this century.

Further research should also be conducted on the roles that other stakeholders play in the effective teaching and learning of Mathematics and what can be done to ensure that they contribute to the improvement of teaching and learning of Grade 3 Mathematics. The level of support they offer should also be a point for further research and if they, in fact, are providing Grade 3 teachers with the resources and tools they need to do their jobs effectively. The roles and responsibilities of all stakeholders in the teaching and learning of Mathematics should be researched further to establish accountability.

6.18 CONCLUSION

Many people put the blame of underachievement in Mathematics squarely on the shoulders of the teachers, but accountability is far broader. Failure of an education system cannot be blamed on one group of individuals but should be shared by all the relevant shareholders responsible for the effective teaching and learning of Mathematics (Price, 2014). If each shareholder does their part, then and only then can the

education system show any signs of improvement (Doozie, 2015). Evidence shows that the root causes of underachievement in Mathematics are starting to be addressed (Spaull, 2013) but this process is time-consuming that changes conditions in schools very slowly. Conditions even appear to worsen with time.

One of the main findings in this research study is that teachers lack Content Knowledge, Pedagogical knowledge, knowledge of various theories for effective Mathematical teaching and learning, and skills to be able to teach Mathematics effectively (Spaull, 2015). These teachers are in urgent need of high-quality training that is intensive and will improve their knowledge, develop their skills and help them to teach in a more effective manner, improve their attitudes towards Mathematics and arm them with tools that will produce quality Mathematics learning in Grade 3 classrooms (Misibi and Mchunu, 2013).

Increasing the teacher's skills and knowledge is an important requisite for educational reform, but teachers are not given the skills or expertise they require to teach Mathematics effectively (Misibi, 2013). All teachers should thus be developed, trained and retrained to ensure that they remain up to date with every changing field, allow teachers to become lifelong learners and learn new and effective teaching methods that will appeal to all learners in Mathematics classes (teach.org, 2016). They should also be supported by the Department, governing bodies and senior management teams, including the principal who should be a front runner in ensuring progress in learner achievement and outcomes (Price, 2014). Parent involvement is essential, and parents should express interest in their children's Mathematical learning and find ways to assist their children at home (Young, 2017). Accountability and commitment in Mathematics thus need to be a joint venture and not a sole journey of the teacher.
The methods and teaching approaches that are applied by Mathematics teachers are not varied enough and thus not all learners get the benefit of learning in their own way (Louw and Du Toit, 2010). No one method of teaching can teach all the learners in a Mathematics classroom, so methods should be switched up to ensure that if one method does not teach succeed, another method can be used. The use of old traditional teaching methods also needs to be replaced by co-operating learning and problem-solving activities (Killen, 2013). Teachers need to replace their traditional

teacher-led approaches for approaches that are more learner-centred and ensure that learners are actively engaged in each activity that they teach (Mhlolo, 2013). In order for this to happen teachers will have to alter their own attitudes towards Mathematics and ensure that a shift in mind-set occurs; this will not only improve their own teaching practices, but motivate learners to learn and achieve success in Mathematics (Pritchard, 2014).

The lack of resources, failing infrastructure, lack of funds, lack of training, lack of skills to teach learners with barriers to learning, the workloads of teachers, discipline problems, overcrowded classrooms and a lack of general support has been highlighted as challenges that Grade 3 teachers feel hamper them from teaching Mathematics effectively. A classroom that is filled beyond its capacity with not enough learning materials can never be seen as a learning environment where learners will be able to teach effectively (King, 2017). In this research study, it was evident that often teachers have to buy the basic things that they need to teach. This, in the researcher's opinion, is unacceptable as no teacher should have to worry to provide the most basic resources that they need to teach effectively. This gap simply can be bridged by allocating necessary resources to under-resourced schools and ensuring that maintenance is done effectively in schools, providing funds were necessary to build more classrooms and improving the working conditions of teachers (Pota, 2019). Discipline problems in classrooms leave teachers feeling demotivated and drained. New policies towards discipline make classroom management very difficult if not impossible. The abolishment of corporal punishment has led to teachers losing control of their class. Stress is thus a factor that the teacher experiences due to not being able to cope with children who are unruly and undisciplined (Van Veen, 2011). Many would agree that corporal punishment is inhumane, but in the opinion of the researcher it has value.

To summarize these conclusions teachers should stick to time on task, provide quality education to their Mathematics learners, teach towards understanding and be accountable for their teaching practices and the results their learners achieve. They should also be present in their classrooms and invariably do what they are paid to do and that is taught. In order to do their jobs effectively, they should be provided with

resources, trained correctly and offered on-going support and guidance. If they are given the tools they need to do their jobs effectively, they will provide quality teaching in their Grade 3 Mathematics classrooms. It should, therefore, be a joint venture to improve the outcomes of Mathematics teaching in Grade 3 and if each shareholder does their part and commits to improving outcomes and teaching practices in classrooms, half the battle is already won, add some support and guidance from the DBE and resources into the mix and you have a definite recipe for success.

Finally, the purpose of this chapter was to conclude the study with a summary of the literature review and empirical investigation. Based on the finding of both, recommendations were made for the improvement of the teaching of Mathematics in South African primary schools with special reference to selected schools in Daniëlskuil town, Northern Cape Province.

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APPENDIX A: PARTICIPANT INFORMATION SHEET.

Date: 2018

Title: Exploring Foundation Phase Mathematics teachers 'use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa.

Dear Prospective Participant,

My name is Katherine Anne Douglas and I am doing research under the supervision of Dr A, S Mawela a lecturer in the Department of Curriculum and Instructional Studies towards a Master of Education Degree at the University of South Africa. We are inviting you to participate in a study entitled: *Investigating teaching approaches employed by Grade 3 Mathematics teachers in selected primary schools in Daniëlskuil Township, Northern Cape Province.*

WHAT IS THE PURPOSE OF THE STUDY?

This study is expected to collect important information that could empower the proficiencies of teachers with regard to Grade 3 Mathematics teaching approach. This study aims to Investigate Mathematics teaching approaches that can be employed in teaching Grade 3 learners in South African primary schools. This study will explore scholarly literature about the specific theories and approaches that foreground the teaching of Mathematics in primary schools. The researcher intends to find out whether Mathematics primary teachers are empowered to teach Grade 3 Mathematics learners. Furthermore, investigation of the perceptions of Mathematics primary teachers on the use of different approaches in teaching Mathematics will be conducted. Despite that, the challenges and success experienced by teachers when teaching Grade 3 Mathematics learners will be explored. And strategies that can en-

hance teachers' proficiency in teaching Mathematics in Grade 3 classes will be suggested. Collected data from this study may be used to inform the DBE on implementing appropriate Grade 3 Mathematics teaching approaches.

WHY AM I BEING INVITED TO PARTICIPATE?

Convenient purposive sampling technique was employed to sample you as a participant. You are invited on the basis of the school that is closer to the researcher. You are also invited because the researcher believes that you have rich in knowledge of teaching Grade 3 Mathematics. It is the researchers believe that your Mathematics teaching experience will add value to this study. Kindly be informed that the researcher obtained your contact details from the Headmaster of your school.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

You are expected to respond to the face-face semi-structured interview questions. For the purpose of gathering information, a tape recorder will be used to record our conversation, which will later be transcribed. During the interview, you will be expected to respond to questions that are in line with Confirmation of signing the consent form; Teachers demographic information; Mathematics teaching approaches; Challenges and successes that you experience when teaching Mathematics, and Strategies to enhance teachers' proficiency towards teaching Mathematics. Despite the face to face interviews, follow up interviews regarding document analysis pertaining to the teaching of Mathematics will be conducted.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

The researcher does not anticipate any harm or negative consequences for you as a participant in this study. However, if any unforeseen harm or negative consequences may take place, such, will be reported to the relevant stakeholders such as UNISA Ethics Committee through a written report.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Confidentiality will be maintained at all times and as a participant, you have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. You may also remain anonymous and no one will be able to connect you to the answers you give. Your answers will be given a code number, or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. The researcher will be the transcriber of the information that is given, and no external coder will be used. This anonymous data may be used for other purposes, such as a research report, journal articles and/or conference proceedings. In the case of data that is used for other purposes the study may be submitted for publication, but individual participants will not be identifiable in such a report.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard, in the supervisor's office, and or at the researcher's home for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Information will be destroyed if necessary, by shredding hard copies or electronic copies will be permanently deleted

from the hard drive of the computer through the use of a Windows Data Wiping, software designed to permanently delete data from a computer.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

No payment or reward will be offered, financial or otherwise for participating in this research study.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the CEDU RESEARCH ETHICS, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Katherine Douglas at 0766609515 or email 35829710@mylife.Unisa.ac.za. The findings are accessible for three years. Should you have concerns about the way in which the research has been conducted, you may contact the researcher's supervisor Dr A.S. Mawela at 012 429 4381, or e-mail at mawelas@unisa.ac.za

Thank you for taking the time to read this information sheet and for participating in this study.

_____ _____

(Insert signature) Date

APPENDIX B: CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ _____ (participant name), confirm that the person asking the researcher's consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that the researcher's participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that the researcher's participation will be kept confidential unless otherwise specified.

I agree with the recording of the questionnaire/ interview.

I have received a signed copy of the informed consent agreement.

Participant Name and Surname (please print)

_____

_____ _____

Participant Signature Date

Researcher's Name and Surname (please print)

_____

_____ _____

Researcher's signature Date

APPENDIX C: SEMI-STRUCTURED INTERVIEWS QUESTIONNAIRE

Starting time of Interview: _____

Date: _____

Ending time of Interview: _____

Interviewer: _____

Interviewee: _____

Confirmation of signing the consent form

The researcher will read the below information:

I am Katherine Anne Douglas and would like to know if you have read and signed the consent form as a participant of this research study. Please indicate by saying yes or No before we can proceed with this interview. There are four main questions that you are requested to respond to.

Question 1: Teachers demographic information

1. Please indicate your names, gender and school name
2. For how long have you been working as a teacher?
3. Would you please indicate your highest qualification?

3.1. Have you received any training on how teach Mathematics using CAPS document?

4. If yes, state the organizer, duration and how informative the training was.

Question 2: Methods and or approaches used in teaching Mathematics

2.1. Please indicate the subjects and Grade that you are teaching.

2.2. What teaching methods or approaches are you familiar with?

2.3. Are there any other teaching methods or approaches that you think are most suitable for teaching and learning of Mathematics? If your answer is yes, please mention them.

2.4. There are theories that are commonly used in teaching and learning of Mathematics. In your own words, how would describe the following teaching and learning theories in Mathematics:

a) behaviourism

b) social constructivism

c) connectivism.

2.5. Which of the theories do you apply when teaching Mathematics in the classroom and why?

Question 3: Challenges and successes experienced by teachers in regards to the teaching of Mathematics.

3.1. Do you have the relevant CAPS document for the teaching of Mathematics?

3.2. According to your knowledge are you competent to use these documents to teach Mathematics in your classroom?

3.3. Do you follow the guidelines of the CAPS document daily to teach? Mathematics in your classroom? Substantiate your answer.

3.4. In your opinion are you confident when teaching Mathematics? Please explain Your answer.

3.5. What challenges do you experience with regards to the teaching of Mathematics in your classroom?

3.6. Has the implementation of CAPS had any beneficial effects on your teaching of Mathematics? Explain your answer.

3.7. In most of the South African schools, overcrowding, and lack of resources are some of the factors that hinder the proper teaching and learning of Mathematics. Do you think that these factors have an effect on you regarding the implementing CAPS in your Mathematics classroom?

3.8. What other factors cause challenges in your classroom with regards to the the teaching of Mathematics?

3.9. What do you think could be the implications of not teaching Mathematics to

learners?

3.10. What are your personal views on the teaching of Mathematics? Explain your answer.

3.11. What support do you receive from other teachers in regards to the teaching and learning of Mathematics.

3.12. In your view, if all teachers in your school use CAPS to teach Mathematics, what would be the benefits to:

(a) to the learners,

(b) the school, and

(c) the community as a whole

Question 4: Strategies to enhance teacher's proficiency in the teaching of Mathematics.

4.1. In your view do teachers need more training to be able to implement CAPS effectively when teaching Mathematics? Please elaborate.

4.2. Considering the benefits of implementing CAPS into your Mathematics classrooms what recommendations would you make to your head of department, deputy principal and or principal, regarding:

a) lesson planning,

b) teaching methods or approaches, and

c) how to assess learners

4.2. Who are the other stakeholders that you think should be involved to enhance teachers' proficiency in Mathematics teaching and learning. Support your answer

4.3. In your opinion, what are your needs in order to the implement CAPS for effective teaching and learning of Mathematics. Explain your answer.

Thank you for your time and informative responses.

APPENDIX D: DOCUMENT ANALYSIS GUIDE

Name of teacher observed:

……

Code name or pseudonym:

……

A Grade of teacher:

……

Qualifications of the teacher:

……

Years of experience…….

Document	**Findings and comments**
1. Does the teacher have the Curriculum and Assessment Policy document (CAPS) of Mathematics?	
2. Does the school have a Mathematics school-based policy?	
3. Is there any evidence of Mathematics lesson plans in teacher's file?	
4. Do lesson plans indicate different teaching approaches used during teaching and learning?	

5. Is there any evidence of assessment activities indicated in the lesson plans?	
6. Is there any evidence of expanded opportunities to address below average, average and gifted learners in the lesson plans?	
7. Is there any evidence of moderation of lesson plans by HoD?	
8. Does the teacher have annual or quarterly assessment plan?	
9. Does the teacher's file have any evidence of meetings attended as part of teacher development?	
10. Is there any evidence of the recording of learners' performance?	
11. Does the teacher's file contain any evidence of teacher's intervention strategies to improve learners' performance?	
12. Does the school have the school-based Annual National Assessment 2011-2014 grades stats performance, and what is the recorded annual pass rate per Grade?	

APPENDIX E: REQUISITION LETTER (NORTHERN CAPE DBE)

P.O Box 41
Daniëlskuil
8410

……

The HoD
North-Cape Department of Education
Private Bag X2044
8410

Dear Sir/Madam

APPLICATION: REQUEST FOR PERMISSION TO CONDUCT AN EDUCATIONAL RESEARCH

My name is Katherine Anne Douglas and I am doing research under the supervision of Dr A, S Mawela a lecturer in the Department of Curriculum and Instructional Studies towards a Master of Education Degree at the University of South Africa. We are inviting you to participate in a study entitled: *"*Exploring Foundation Phase Mathematics teachers 'use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa".

The purpose of this study is to collect information regarding teachers' views on the teaching and learning of Mathematics in grade 3 classrooms. Three (n=3) primary schools with the total number of five (n=5) teachers will be purposefully sampled to participate in this study. Participants are expected to respond to the face-face semi-structured interview questions, which will be followed by non-participatory observation, and end with documents analysis. For the purpose of gathering information, a

tape recorder will be used to record the researcher and participant conversation, which will later be transcribed.

Participating in this study is voluntary and participants are under no obligation to consent to participation. Participants will be given the consent form to read and sign before participating. They are at liberty to withdraw at any time and without giving a reason. There are no attached promises or benefits for the participants and participation in the study is voluntary. The researcher does not anticipate any harm or negative consequences for you as a participant in this study. However, if any unforeseen harm or negative consequences may take place, such, will be reported to the relevant stakeholders such as UNISA Ethics Committee and the circuits through a written report.

Participants names will not be recorded anywhere, and no one will be able to connect participants to the answers you give. Answers will be given a code number, or a pseudonym and participants will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. A report of the study may also be submitted for publication, but individual participants will not be identifiable in such a report.

Hard copies of participants' answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet at the supervisor office for future research or academic purposes; electronic information will be stored on a password-protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. If necessary, hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme.

This study has received written approval from the Research Ethics Review Committee of the CEDU research ethics, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish. If you would like to be informed of the final research findings, please contact Katherine Douglas at 0766609515 or email

35829710@mylife.unisa.ac.za.The findings are accessible for three years. Should you have concerns about the way in which the research has been conducted, you may contact Dr AS Mawela at 0124294381 or email: mawelas@unisa.ac.za

Hoping that you find this in order.

Yours faithfully
Katherine Douglas

…… ……..
Signature Date

APPENDIX F: REQUISITION LETTER (SCHOOL)

P.O Box 41
Daniëlskuil
8410

……..
The School Principal

Dear Sir/Madam

APPLICATION: REQUEST FOR PERMISSION TO CONDUCT AN EDUCATIONAL RESEARCH

My name is Katherine Anne Douglas and I am doing research under the supervision of Dr. A, S Mawela a lecturer in the Department of Curriculum and Instructional Studies towards a Master of Education Degree at the University of South Africa. We are inviting you to participate in a study entitled: *"*Exploring Foundation Phase Mathematics teachers 'use of different teaching strategies in Grade 3, in Daniëlskuil, in South Africa.*"*

The purpose of this study is to collect information regarding teachers' views on the integration of environmental education themes in CAPS subjects at school. Five (n=3) secondary schools with the total number of twenty (n=5) teachers will be purposefully sampled to participate in this study. Participants are expected to respond to the face-face semi-structured interview questions, which will be followed by non-participatory observation, and end with documents analysis. For the purpose of gathering information, a tape recorder will be used to record the researcher and participant conversation, which will later be transcribed.

Participating in this study is voluntary and participants are under no obligation to consent to participation. Participants will be given the consent form to read and sign before participating. They are at liberty to withdraw at any time and without giving a reason. There are no attached promises or benefits for the participants and participation in the study is voluntary. The researcher does not anticipate any harm or negative consequences for you as a participant in this study. However, if any unforeseen harm or negative consequences may take place, such, will be reported to the relevant stakeholders such as UNISA Ethics Committee and the circuits through a written report.

Participants names will not be recorded anywhere, and no one will be able to connect participants to the answers you give. Answers will be given a code number, or a pseudonym and participants will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. A report of the study may also be submitted for publication, but individual participants will not be identifiable in such a report.

Hard copies of participants' answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet at the supervisor office for future research or academic purposes; electronic information will be stored on a password-protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. If necessary, hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme.

This study has received written approval from the Research Ethics Review Committee of the CEDU research ethics, UNISA. A copy of the approval letter can be obtained from the researcher if you so wish. If you would like to be informed of the final research findings, please contact Katherine Douglas at 0766609515 or email 35829710@mylife.unisa.ac.za. The findings are accessible for three years. Should you have concerns about the way in which the research has been conducted, you may contact Dr AS Mawela at 0124294381 or email: mawelas@unisa.ac.za

Hoping that you find this in order.

Yours faithfully

Katherine Douglas

…… ……..

Signature Date

APPENDIX G: PERMISSION TO CONDUCT RESEARCH.

(DISTRICT)

Northern Cape
Department of Education
ZF Mgcawu District
2 JG Smith Street
Progress
8801

Private Bag X891
UPINGTON
8800
Republic of South Africa

Tel: 054 337 6300
Fax: 054 337 6393
Web:ncdoe.ncpg.gov.za

DEPARTMENT OF EDUCATION

Enquiries: Mr. L.C. Sehako
christosehako@gmail.com / fax2mail: 0867244226
0825244266 /0533131354/0533132839
CM & OFFICE HEAD PMG

To: The Principal
SGB

Dear Sir / Madam

APPLICATION: REQUEST FOR PERMISSION TO CONDUCT AND EDUCATIONAL RESEARCH

An application for conducting an investigation in teaching approaches employed by grade 3 Mathematics teachers in selected primary school in Danielskuil Township(Kgatelo Pele Municipality) ,Northern Cape to be done by Ms.Katherine.Anne.Douglas is granted.

I therefore humbly urge that she be given the necessary support and cooperation.

Yours Sincerely

MR .L.C. SEHAKO
CM & OFFICE HEAD PMG
10/10/2018

NOORD-KAAP ONDERWYS DEPARTEMENT
DIE DISTRIKHOOF PRIVAATSAK X891
UPINGTON 8800
2018 -10- 10
THE REGIONAL HEAD PRIVATE BAG X891
UPINGTON 8800
NORTHERN CAPE EDUCATION DEPARTMENT

APPENDIX : H

APPENDIX :

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2018/09/12

Ref: 2018/09/12/35829710/02/MC
Name: Mrs KA Douglas
Student: 35829710

Dear Mrs Douglas

Decision: Ethics Approval from 2018/09/12 to 2021/09/12

Researcher(s): Name: Mrs KA Douglas
E-mail address: 35829710@Mylife.Unisa.ac.za
Telephone: +27 76 660 9515

Supervisor(s): Name: Dr AS Mawela
E-mail address: mawelas@unisa.ac.za
Telephone: +27 12 429 4381

Title of research:

Investigating teaching approaches employed by grade 3 Mathematics teachers in selected primary schools in Danielskuil Township, Northern Cape Province

Qualification: M. Ed in Curriculum and Instruction Studies

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 2018/09/12 to 2021/09/12.

*The **low risk** application was reviewed by the Ethics Review Committee on 2018/09/12 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.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

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 **2021/09/12**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2018/09/12/35829710/02/MC** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Dr M Claassens
CHAIRPERSON: CEDU RERC
mcdtc@netactive.co.za

Prof V McKay
EXECUTIVE DEAN
Mckayvi@unisa.ac.za

University of South Africa
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