

**STRENGTHENING TEACHER SUPPORT TO LEARNERS EXPERIENCING
DYSCALCULIA IN GRADE 3**

by

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South Africa

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PRETORIA

March 2020

DECLARATION OF AUTHENTICITY

I, Kayla Haarhoff, declare that this dissertation, titled

“Strengthening teacher support to learners experiencing dyscalculia in Grade 3”

to be my original work. All the sources I have consulted have been acknowledged and included. This dissertation submitted in partial fulfilment for the degree Magister Educationis at the University of Pretoria was not previously submitted for a degree at any other university.

Signature

Date

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This Ethics Clearance Certificate should be read in conjunction with the Integrated Declaration Form (D08) which specifies details regarding:

- Compliance with approved research protocol,
- No significant changes,
- Informed consent/assent,
- Adverse experience or undue risk,
- Registered title, and
- Data storage requirements.

ETHICS STATEMENT

Kayla Haarhoff has obtained, for the research described in this work, the applicable research ethics approval.

I declare that I have observed the ethical standards required in terms of the University of Pretoria's "Code of Ethics and the Policy Guidelines for Responsible Research".

Signature

Date

DEDICATION

I dedicate this research to my late grandmother, Wanda Eloff, thank you for believing in me when I forgot how to.

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ABSTRACT

Results from the Trends in International Mathematics and Science Study (TIMSS) and the Annual National Assessment (ANA) provide insight into the notion that learners' skills and knowledge of mathematics are poor. These results indicate an imperative need to improve learners' competencies in mathematics. Therefore, this qualitative study aimed to strengthen teacher support to learners experiencing dyscalculia in Grade 3. The identification and support of these learners are imperative to enhance their participation in society in later years (Taylor, Anselmo, Foreman, Schatschneider & Angelopoulos, 2000; Steele, 2004). When dyscalculia is addressed, these learners can be supported through different support systems, which in turn will help to minimise the difficulties they experience (Steele, 2004; Dowker, 2009; Gold & Richards, 2012; Machaba, 2013).

This study comprehensively investigated the support that teachers need to ensure that these support systems can be implemented. To this end, the study's primary research question "How can teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?" guided the data generation process as semi-structured interviews with Grade 3 teachers were conducted. To answer this question, the following sub-questions were asked:

- What strategies will strengthen teacher support to learners experiencing dyscalculia?
- How do teachers support learners experiencing dyscalculia?
- What resources do teachers need to support learners experiencing dyscalculia?

Grade 3 teachers who took part in the study provided their understanding of the challenges associated with strengthening teacher support to learners experiencing dyscalculia and identified various factors within the classroom that challenge their daily teaching of learners with mathematical learning difficulties. Some of the factors include: learners experiencing mathematical anxiety; too many formal evaluations required by the curriculum; insufficient time dedicated to the teaching and learning of mathematics; and that the language of learning and teaching (LoLT) differs from

learners' home languages. They, furthermore, provided recommendations on what kind of support they need and raised their readiness, confidence and comfort levels to teach these learners successfully. In conclusion, it was recommended that teachers need to receive more and sufficient training and development opportunities to successfully support learners with dyscalculia; an awareness needs to be created regarding different policies and the implementation of these policies to support these learners; and lastly, different resources, such as the time provided for teaching and learning, need to be addressed.

ABSTRAK

Resultate van die TIMSS en die ANA bied insig in leerders se vaardighede en kennis van wiskunde. Hierdie resultate bewys dat dit uiters swak is en dit dui op 'n noodsaaklike behoefte om leerders se vermoë in wiskunde te verbeter. Daarom was die doel van hierdie kwalitatiewe studie om onderwyserondersteuning te versterk aan Graad 3 leerders wat *dyscalculia* ervaar. Die identifisering en ondersteuning van hierdie leerders is noodsaaklik om hul deelname in die samelewing in later jare te verbeter (Taylor, Anselmo, Foreman, Schatschneider & Angelopoulos, 2000; Steele, 2004). As daar aan *dyscalculia* aandag geskenk word, kan hierdie leerders deur verskillende ondersteuningstelsels ondersteun word en die probleme wat hulle ervaar, kan tot die minimum beperk word (Steele, 2004; Dowker, 2009; Gold & Richards, 2012; Machaba, 2013).

Die ondersteuning wat onderwysers benodig om te verseker dat ondersteuningstelsels geïmplementeer word, was breedvoerig ondersoek. Vir hierdie doel, het die primêre navorsingsvraag van die studie "Hoe kan die kennis en vaardighede van onderwysers versterk word om sodoende Graad 3 leerders met *dyscalculia* te ondersteun?" die studie gelei in die proses van data generering waarin semi-gestruktureerde onderhoude met Graad 3 onderwysers gevoer is. Om hierdie vraag te beantwoord, was die volgende sub-vrae gevra:

- Watter strategieë sal onderwyserondersteuning aan leerders met *dyscalculia* versterk?
- Hoe ondersteun onderwysers leerders wat *dyscalculia* ervaar?
- Watter hulpbronne benodig onderwysers om leerders wat *dyscalculia* ervaar te ondersteun?

Graad 3 onderwysers wat aan die studie deelgeneem het, het hulle eie begrip van die uitdagings verbonde aan die versterking van onderwysondersteuning aan leerders wat *dyscalculia* ondervind geïdentifiseer. Hulle het ook verskillende faktore in die klaskamer geïdentifiseer wat die daaglikse onderrig van leerders met wiskundige leerprobleme die meeste uitdaag. Sommige van die faktore sluit in:

leerders wat wiskundige angs ervaar; te veel formele evaluasies soos vereis deur die kurrikulum; onvoldoende tyd toegeken aan die onderrig en leer van wiskunde; asook dat die taal van leer en onderrig verskil van leerders se huistale.

Hulle het ook aanbevelings verskaf oor watter soort ondersteuning hulle benodig, en hulle het hul eie gereedheid, vertrouwe en gemak bespreek ten opsigte van hierdie leerders se suksesvolle onderrig. Ten slotte word aanbeveel dat onderwysers meer en voldoende opleidings- en ontwikkelingsgeleenthede moet ontvang om leerders met *dyscalculia* suksesvol te ondersteun; daar moet bewustheid geskep word rakende die verskillende beleide en die implementering daarvan om hierdie leerders te ondersteun. Laastens, moet verskillende hulpbronne aangespreek word, soos die tyd wat vir leer en onderrig benodig word.

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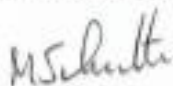
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CERTIFICATE OF EDITING

To whom it may concern,

This letter confirms that the master's dissertation titled *Strengthening Teacher Support to Learners Experiencing Dyscalculia in Grade 3* by Kayla Haarhoff was proofread and edited by All-done Editing Services.

The document was edited for grammar, punctuation, spelling, overall style and consistent use of South African English spelling conventions. Technical editing of figures, tables and table of contents, list of figures and list of tables was also done. All amendments were tracked using Microsoft Word's "Track Changes" feature, and consequently, the author had the option to accept or reject each change. A complete edited copy was provided, but the final decisions as to which changes to implement, rested with the author. The list of references was not edited.



LIST OF ABBREVIATIONS

ANA	Annual National Assessment
ATP	Annual Term Planning
BA	Bachelor of Arts
CAPS	Curriculum Assessment and Policy Statement
CBMoTD	Concerns-Based Model of Teacher Development
CCK	Common content knowledge
CD	Curriculum differentiation
CI	Curriculum implementers
DBE	Department of Basic Education
DoE	Department of Education
FAL	First Additional Language
FP	Foundation Phase
GCIS	Government Communication Information System
HED	Higher Education Diploma
HoD	Head of Department
HSRC	Human Sciences Research Council
KCS	Knowledge of content and student
KCT	Knowledge of content and teaching
LD	Learning difficulties
LoLT	Language of Learning and Teaching
MLD	Mathematical learning difficulties
NASET	National Association of Special Education Teachers
PCK	Pedagogical content knowledge
PGCE	Postgraduate Certificate in Education
PSRIP	Primary School Reading Improvement Programme
SCK	Specialised content knowledge
SMK	Subject matter knowledge
TIMSS	Trends in International Mathematics and Science Study
UNESCO	The United Nations Educational, Scientific and Cultural Organization
WP6	Education White Paper 6 – Special Needs Education: Building an Inclusive Education and Training System
ZPD	Zone of Proximal Development

KEYWORDS

Dyscalculia, Grade 3, Strengthening teacher support.

COLOUR CODED SYSTEM

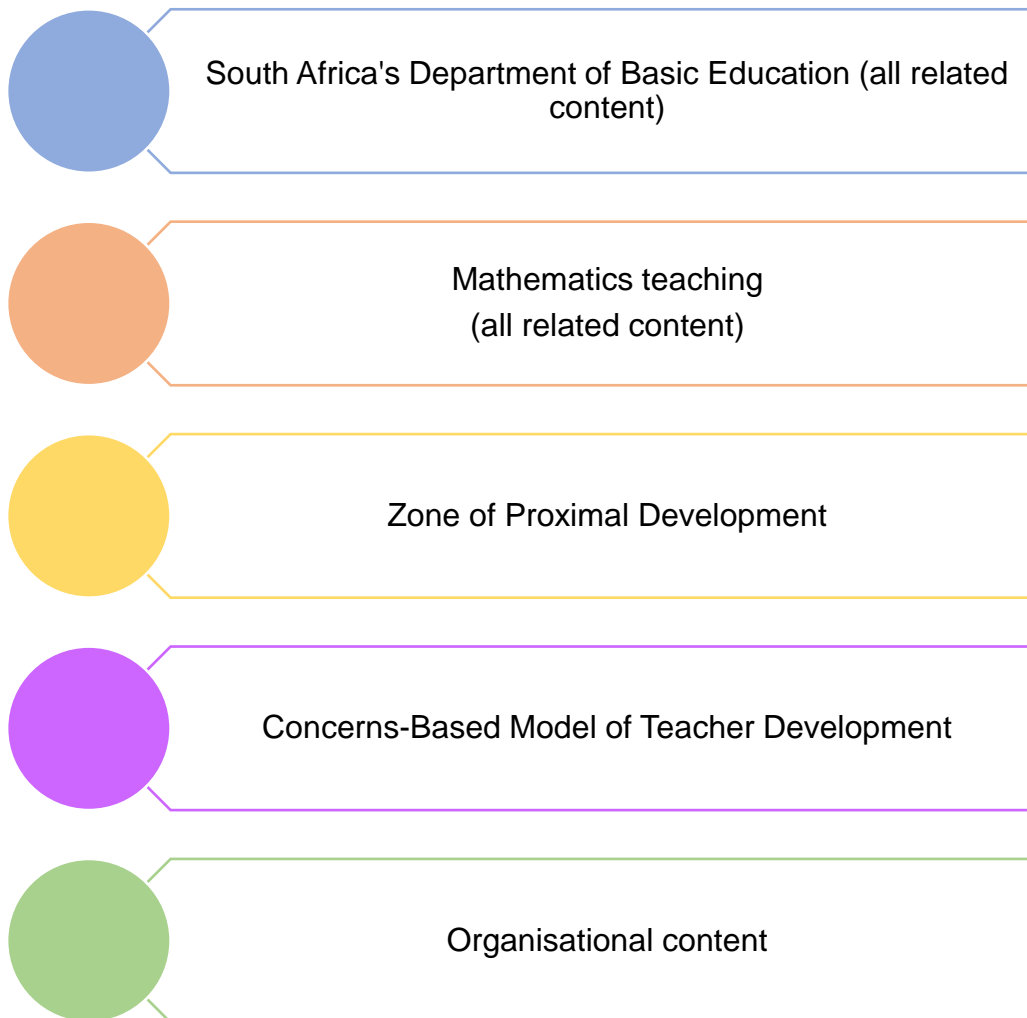


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CHAPTER 1: GENERAL OVERVIEW

1.1 INTRODUCTION TO THE STUDY

Mathematics is a required subject in education to ensure that human society can function effectively (Sa'ad, Adamu & Sadiq, 2014; Jojo, 2019). It enables people to be active participants in diverse communities (Naudé, 2014; Wriston, 2015; Almerino, Etcuban, De Jose & Almerino, 2019). This imperative life skill is used to enhance lifestyles in order to participate in commercial activities, construct, and create art or even to be a participant in sport because mathematics can be used in all situations of life by everyone (Naudé, 2014; Wriston, 2015; Van de Walle, Karp & Bay-Williams, 2016). The application of mathematics in people's daily lives promotes the development of numeracy skills (Dednam, 2011; Naudé, 2014).

Competency in basic mathematical skills and knowledge is, however, a global educational predicament. This statement is confirmed by the Trends in International Mathematics and Science Study (TIMSS), as it states that learners in countries such as South Africa, Morocco (North Africa), New Zealand, France and the United Arab Emirates experience difficulties in acquiring basic mathematical skills and knowledge (Mullis, Martin, Foy & Hooper, 2015). Wium and Louw (2012) and Naudé (2014) further state that children must develop the skills of numeracy so that learners can better understand the community they live in.

Foundation Phase (FP) teachers have the imperative task of enabling learners to become numerate (Department of Basic Education [DBE], 2011a; Naudé, 2014) and in the century we are living in, learners need to experience mathematics as a relevant activity that will help them to become active participants in society (Dednam, 2011; Van de Walle *et al.*, 2016). However, many learners experience difficulties when it comes to acquiring basic mathematical skills (Hornigold, 2015; Engelbrecht, 2016; Bornman & Rose, 2017).

Van der Walt, Maree and Ellis (2008); Ndlovu (2011); and, Siyepu (2013) believe that mathematical underperformance is caused by factors such as not having

appropriate support materials for learners and inadequate teacher support. However, the reason for poor performance in mathematics could also be due to dyscalculia (Butterworth, 2005). Dyscalculia, according to Hannell (2013); Emerson and Babbie (2015); Hornigold (2015); and, Hudson (2016), is defined as the difficulty learners experience in obtaining mathematical skills.

These skills include, for example, learners' counting skills which are impaired; they experience difficulty with arithmetic; abstract concepts of time-telling (Vaidya 2004); basic calculations; studying multiplications; using a calculator; estimating answers; working memory; working with money and when the learner shows a constant and paramount barrier in mathematics (Hornigold, 2015; Bornman & Rose, 2017). According to Shalev, Auerbach, Manor and Gross-Tsur (2000); Bird (2009); Hannell (2013); Emerson and Babbie (2015); and, Hudson (2016), approximately 5% of learners experience dyscalculia. Jaya and Geetha (2009) and Henderson (2012) state that 6% to 7% of learners experience dyscalculia.

Hannell (2013) believes that teachers should approach teaching learners experiencing dyscalculia by assessing what they already know on the topic of mathematics. Furthermore, Hannell (2013) continues by stating that learners experiencing dyscalculia experience difficulties with fundamental mathematics, such as having number sense, recognising and estimating quantities and mental mathematics. Jaya and Geetha (2009) state that teachers need to be trained to be able to support learners experiencing learning difficulties (LD), such as dyscalculia.

Teachers face many challenges when it comes to teaching mathematics (Naudé & Meier, 2014). Some of these challenges include having to teach learners from diverse backgrounds with different mental and physical abilities, "personalities, attitudes, behaviours, cultural differences, gender differences and learning styles" (Naudé & Meier, 2014:28). Teachers also do not know how to support learners with dyscalculia as explicated by Miundy, Zaman and Nordin (2017). For the purpose of this study, dyscalculia is used as an umbrella term to encapsulate all MLD that learners could experience. The term 'dyscalculia' can therefore be used interchangeably with the term 'MLD'.

The FP plays an important role for learners to acquire basic mathematical skills (Charlesworth & Lind, 2013; Machaba, 2013; Clements & Sarama, 2014; Harris & Petersen, 2019). The acquiring and development of these skills has become an important topic of discussion amongst various role players such as teachers, parents, policymakers, resource material developers and politicians (Charlesworth & Lind, 2013; Claessens & Engel, 2013; Machaba, 2013; Clements & Sarama, 2014; Harris & Petersen, 2019). In line with the National Development Plan (NDP) 2030, the DBE has put an action plan in place that emphasises the importance of schooling in the FP and aims to increase the number of Grade 3 learners that meet the minimum requirements of language and numeracy proficiencies (DBE, 2015). The diagrammatic representation in Table 1.1 below indicates the aim of the DBE, regarding Goal 1 towards the realisation of schooling for 2030.

Table 1.1: Diagrammatic representation of Goal 1 as set out by the Action Plan (DBE, 2015)

GOAL 1 2019 – 2030	DBE developed the ACTION PLAN TO 2019: TOWARDS THE REALISATION OF SCHOOLING 2030 in response to quality schooling for all South Africans		
	to increase the percentage of Grade 3 learners that should perform at the required literacy level according to the ANAs		to increase the percentage of Grade 3 learners that should perform at the required numeracy level according to the ANAs
	2019	2024	2029
	75%	90%	95%

As seen in Table 1.1 above, the action plan of 2030 is to increase the percentage of learners that should perform on the required Grade 3 literacy and numeracy levels. The DBE aims for the learner percentage to be at 75% in 2019 and to increase with 20% by 2020. However, recent studies (Dunphy, 2009; Kruger, 2011; Charlesworth & Lind; 2013; Rademeyer, 2014; Steyn, 2014; van der Merwe, 2014) have questioned the effectiveness of teaching and learning of mathematics both in South Africa and internationally.

1.2 RATIONALE FOR THE STUDY

As a former teacher at an educational centre, I have first-hand experience of what it is like to teach learners experiencing learning difficulties, particularly when it comes to acquiring the necessary skills and content knowledge of various subjects, especially numeracy and literacy. However, there is one learner who was in my

class that always comes to mind. The learner was in .Grade 3 at the time. The learner obtained 80% in every subject, except in mathematics. Every day, the learner tried to grasp a new mathematical concept that had been taught in class the previous day. Even the simplest of mathematical tasks consumed a lot of the learner's time to complete. The learner's immense barrier to acquiring important mathematical concepts led to the researcher's interest in investigating dyscalculia. My passion for mathematics and children's learning necessitated the need to investigate what support teachers can give to children to help them overcome dyscalculia.

There have also been various studies conducted that strengthened my drive to research the topic. Jaya and Geetha (2009) suggest that teachers do not receive appropriate training to support learners experiencing LD. In a study conducted by Miundy *et al.* (2017), it was found that 85% of teachers are unaware of what dyscalculia entails. It is evident that there is limited literature available on how teachers can support learners experiencing dyscalculia as stated by Fuchs, Fuchs, Powell, Seethaler, Cirino and Fletcher (2008); Hornigold (2015); as well as Miundy *et al.* (2017). Therefore, this study attempted to provide information on how teachers can support these learners, especially in the South African context. This study discussed strategies that can be implemented that specifically address the improvement of teacher support for learners experiencing dyscalculia. It also provided teachers with strategies to enhance the teaching and learning of mathematics.

1.3 BACKGROUND AND CONTEXT

The FP plays an important role for learners to acquire basic mathematical skills (Machaba, 2013; Charlesworth & Lind, 2013; Clements & Sarama, 2014; Harris & Petersen, 2019). The acquisition and development of these skills have become an important topic for discussion amongst various role-players including teachers, parents, policymakers, resource material developers and politicians (Machaba, 2013; Charlesworth & Lind, 2013; Claessens & Engel, 2013; Clements & Sarama, 2014; Harris & Petersen, 2019).

Globally, research (DeAngelis, 2012; Rhodes & Beneicke, 2013, Mader, 2017, Skaalvik & Skaalvik, 2018, García & Weiss, 2019, Beteille, 2019) has indicated that teacher support is not on the level it is supposed to be due to various factors. Mader (2017) and García and Weiss (2019) are of the opinion that inadequate levels of teacher support are caused due to poor teacher training. Skaalvik and Skaalvik (2015) advocate that a lack of teacher support causes teachers to experience unnecessary stress. Therefore, the authors (Mader, 2017; García and Weiss, 2019) proposed that effective teacher training should be implemented to strengthen teacher support. Furthermore, DeAngelis (2012) is of the opinion that teachers should not only receive more training opportunities, but should also be supported by their community as well as having more hands-on experiences. This study therefore contributes to the growing body of research regarding the strengthening of teacher support, specifically in a South African context, to learners experiencing dyscalculia.

In South Africa, the DBE has been undertaking nationwide standardised examinations (Annual National Assessment [ANA]) since 2010 to evaluate and diagnose the challenges experienced by learners in mathematics (DBE, 2014). This intervention aimed to strengthen mathematics teaching and learning to improve the quality of teaching, learning and assessment (DBE, 2014). The ANAs provide an overview of the average percentage scores in literacy and numeracy obtained by Grade 3 learners in South Africa. In Table 1.2, the average percentage scores are visually presented for the different provinces in South Africa.

Table 1.2: Average percentage scores of South African Grade 3 learners in literacy and numeracy (DBE, 2011:20)

	Grade 3	
	Literacy	Numeracy
Eastern Cape (EC)	39	35
Free State (FS)	37	26
Gauteng Pretoria (GP)	35	30
Kwazulu-Natal (KZN)	39	31
Limpopo (LP)	30	20
Mpumalanga (MP)	27	19
Northern Cape (NC)	28	21
North West (NW)	30	21
Western Cape (WC)	43	36
South Africa (SA)	35	28

An alarming 30% average was obtained for numeracy by learners in the Gauteng province, which is the research area of this study. Moreover, 28% was obtained as an overall national average in South Africa. This revealed that the quality of basic education is not on the level that it should be and that learners in less-privileged environments are the most at risk (DBE, 2010). However, the DBE compiled a summary of learners' mathematical achievements in 2012, 2013 and 2014, which provided evidence that the average percentage score of Grade 3 learners' was improving. Table 1.3 provides a summary of these scores:

Table 1.3: Summary table for mathematics achievement in 2012, 2013 and 2014 (DBE, 2014:9)

Grade	Mathematics average percentage mark		
	2012	2013	2014
1	68	60	68
2	57	59	62
3	41	53	56

Nevertheless, the increased scores still indicate a reduction in the learners' percentage scores (DBE, 2014) from Grades 1 to 3. In Grade 1 the 2014 average national percentage in mathematics was 68%, in Grade 2 it fell to 62% and in Grade 3 a mere 56% was observed. According to the DBE (2014), a summary of findings, learners were experiencing difficulties in specific areas such as word problems; data handling; money problems; number patterns; adding and subtracting; fractions; and position and direction.

In addition to these findings, the Human Sciences Research Council (HSRC, 2016) found that South African learners' achievement remains unequal to that of other countries because only one-quarter of learners in quintile¹ one, two and three schools performed higher than the minimum level of competency. This was determined by the TIMSS, which is an international assessment that evaluates teaching and learning of mathematics and science, to improve the quality of

¹ In South Africa, schools are divided into five different quintiles (McLaren, 2017). The National Norms and Standards for School Funding (NNSSF) ranks all the schools in the country into these quintiles according to the "income and wealth of the community that surrounds the school" (McLaren, 2017:65). According to McLaren (2017), quintile one, two and three schools do not pay any fees whereas quintile four and five do. The rankings of schools are used to promote equal opportunities for all learners to engage in quality learning opportunities, according to McLaren (2017).

education (Mullis, Martin, Foy & Hooper, 2015). However, the TIMSS conducted in 2015 revealed that there has been an improvement in Grade 8 South African learners' scores between 2011 and 2015. Nonetheless, the Minister of Basic Education in 2016, Angie Motshekga, stated that this improvement is futile and that South Africa should not think that this indicates significant progress. Motshekga (2016) further emphasised that there is an issue in the teaching and learning of mathematics and that it requires immediate intervention. Moreover, an analysis provided by the DBE (2012) indicated the shocking statistics that a mere 36% of an estimated 900 000 Grade 3 learners in the nine provinces of South Africa scored above 50% in a mathematics paper.

For this reason, in the South African context, mathematical underperformance continues to be a concern (Machaba, 2013; Siyepu, 2013). This is after a report delivered in 2008 by former Minister of Higher Education, Naledi Pandor. According to her report, only 35% of children in South Africa could execute basic numeracy skills (Pandor, 2008).

1.4 PROBLEM STATEMENT

Results from the ANA and TIMSS and other findings (Pandor, 2008; Machaba, 2013; Siyepu, 2013) reveal that South African learners' mathematical knowledge and skills are not on the standard required for their age groups. This infers that the teaching of mathematics is in desperate need of improvement, especially in the FP. For this reason, teacher support must be strengthened to learners, especially those experiencing dyscalculia in Grade 3.

1.5 THE PURPOSE OF THE STUDY

Results obtained from the TIMSS and the ANA provide information that the competency of learners' knowledge and skills of mathematics is poor. These results suggest that there is an imperative need to improve learners' competencies in mathematics. Therefore, it is crucial to find strategies that will strengthen teacher support in the teaching of mathematics to learners experiencing dyscalculia. The purpose of this study is to primarily strengthen teacher support learners experiencing dyscalculia in Grade 3. The study is guided by the following statement

of Engelbrecht (2016:275): “An increasing number of South African learners are experiencing difficulties in acquiring and applying mathematical knowledge, concepts and skills”. It is evident in the previous statement that South African teachers are in dire need of support to promote the performance and comprehension of learners in mathematics.

1.5.1 Aims of the Study

The study aimed to identify how teachers’ knowledge and skills of supporting learners with dyscalculia can be strengthened.

The specific objectives of this study are to:

- Identify strategies to support teachers in teaching learners who experience dyscalculia
- Identify how teachers support these learners who experience dyscalculia
- Identify possible resources or the lack of resources in the classroom to support these learners who experience dyscalculia

1.6 RESEARCH QUESTIONS

This study was guided by the following research questions:

1.6.1 Primary Research Question

How can teachers’ knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?

1.6.2 Secondary Research Questions

- What strategies will strengthen teacher support to learners experiencing dyscalculia in Grade 3?
- How do teachers support learners experiencing dyscalculia?
- What resources do teachers need to support learners experiencing dyscalculia?

The researcher acknowledges it can only be understood how teachers are supporting learners with dyscalculia that one can begin to consider how to support the teachers. This study was therefore guided by two primary research directions

namely how Grade 3 teachers support learners experiencing dyscalculia and how can teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened. Nevertheless, the research still primarily aimed to identify how teachers can be supported.

1.7 CONCEPT CLARIFICATION

Throughout the study, I will refer to the important concepts as explicated in my title. These concepts are clearly explained and defined in this section.

1.7.1 Strengthening Teacher Support

The term above is explained by separating the two main concepts, 'strengthening' and 'teacher support'.

The term 'strengthen' is defined as the action of reinforcing or making something stronger, according to the Waite (2007b) and the Oxford South African Concise Dictionary (2010b).

The term 'teacher support' is two-fold in nature as explained by Tennant *et al.* (2015). Firstly, it refers to the emotional support (Tennant *et al.*, 2015) that teachers provide to learners, which is explained as enthusiasm and engagement with the learners in a respectful and caring way (Kunter, Klusmann, Baumert, Richter & Voss, 2013; Lazarides, Gaspard & Dicke, 2019). Secondly, it refers to instrumental support which not only includes the provision of extra learning support materials or additional time to complete tasks (Tennant *et al.*, 2015) but also refers to the number of adaptive explanations teachers provide, responding in a constructive and patient way to errors and the pace of learning (Kunter *et al.*, 2013; Lazarides *et al.*, 2019).

In this study, 'teacher support' refers to strengthening instrumental teacher support in learners' acquisition and understanding of basic mathematical skills, particularly learners experiencing dyscalculia. Teachers have the most significant impact on student learning (Tennant *et al.*, 2015; Stronge, 2018) which means that they can contribute to the successful learning and acquisition of mathematical concepts. Wentzel, Battle, Russell and Looney (2010) also state that the role of teacher support plays an imperative role in maintaining learners' academic interest.

1.7.2 Learners

Waite (2007a) and the Oxford South African Concise Dictionary (2010a) define a learner as an individual that is acquiring content knowledge of a specific subject or skills from another individual or through self-study. For this study, the individual refers to an FP learner in Grade 3; the subject is mathematics; and skills refer to the understanding of mathematical concepts. The term 'learner' and 'student' are used interchangeably.

1.7.3 Dyscalculia

Dyscalculia can be explained as a barrier for learners to obtain mathematical skills (Hannell, 2013; Emerson & Babbie, 2015; Hornigold, 2015; Hudson, 2016). Emerson and Babbie (2015) state that dyscalculia is a neurological impairment and indicates that the main deficit is the ability to process numbers. This LD might be caused by developmental, visual perceptual, social, economic or emotional factors (Emerson & Babbie, 2015). For the purpose of this study, dyscalculia is used as an umbrella term to encapsulate all MLD that learners could experience.

1.7.4 Grade 3

In the South African educational context, the first four fundamental years of formal schooling is known as the FP phase (New & Cochran, 2007:1219). The FP consists of Grades R to 3, as indicated by the DBE (2010a). Learners in this phase could, according to the National Education Policy Act No 27 of 1996 (Constitution of the Republic of South Africa, 1996), be between the ages of 5 and 10 years old. For this study, the FP will only include Grade 3, normally learners who are 9 years old.

1.8 RESEARCH METHODOLOGY

Research methodology is defined as the steps a researcher employs to solve a research problem by Kothari (2004). In the next section, I will elucidate the rationale behind the specific method(s) that were used in this study. Each research strategy is supported by an explanation.

1.8.1 Qualitative research approach

For the direction of this study, a qualitative methodological approach was employed. Liamputtong (2010) and Nieuwenhuis (2016a) state that qualitative research is socially oriented and naturalistic, which supports the significance of comprehending the subjective experiences of individuals. This research study is threefold and social in nature, and it will focus on meaningful interpretations.

Firstly, it aims to discover and understand how the participants' knowledge and understanding of dyscalculia can be strengthened so that they can support learners. Secondly, it requires the participants to identify and discuss possible challenges in supporting learners with dyscalculia and lastly, it aims to identify possible resources the participants need to support these learners.

1.8.2 Research Design

A research design is a “plan or blueprint” of how a researcher plans to conduct research (Mouton, 2001:55). In qualitative research, one of the modes of inquiry includes case studies (Maree, 2016). The research design that was implemented in this study was a case study and made use of purposive sampling. The aim of a case study, according to Mouton (2001:149), is to provide “in-depth descriptions” of a few cases and it is usually qualitative. The limitations of this type of study are that it cannot be generalised, the data analysis and generation procedure could take up a lot of time and non-standardised measurement is used (Mouton, 2001).

According to Creswell and Poth (2018), this involves detailed exploration within multiple cases. The researcher has examined several cases to understand the similarities and differences between the cases (Creswell & Poth, 2018).

However, Mouton (2001:150) also states that it provides “high construct validity”, in-depth and meaningful comprehension, and enables the establishment of a “good rapport” with participants. Qualitative research is required when there is little known about an area of research (Liamputtong, 2010) and, therefore, is a good fit for this study, as strengthening teacher support to learners experiencing dyscalculia has not necessarily been transcribed for public use, both nationally and internationally.

The research design of this study, including the paradigm, research approach and type of research, is discussed in Chapter 3.

1.8.2.1 Research process

The research process followed is described in Table 1.4 (adapted from Van Heerden, 2012:14; Swanepoel, 2016:13):

Table 1.4: The research process used in the study (adapted from Van Heerden, 2012:14; Swanepoel, 2016:13)

CHAPTER 1: GENERAL OVERVIEW				
Primary research question		Secondary research questions		
How can teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?		1.	What strategies will strengthen teacher support to learners experiencing dyscalculia in Grade 3?	
		2.	How do teachers support learners experiencing dyscalculia?	
		3.	What resources do teachers need to support learners experiencing dyscalculia?	
CHAPTER 2: LITERATURE REVIEW				
The essence of MLD	Identification of MLD in the FP	Quality of teachers teaching mathematics in the FP	Causes of poor mathematical skills and comprehension	Strategies to support teachers to help learners experiencing dyscalculia
CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY				
Paradigmatic assumptions		Research design and selection of participants		Ethical considerations
Interpretivist paradigm		Case study Purposive sampling		Informed consent Confidentiality and anonymity Role of the researcher
Qualitative data generation techniques		Qualitative data documentation techniques		Qualitative data analysis and interpretation

<ul style="list-style-type: none"> • Face to face interviews with teachers • Observation • Document analysis • Reflective journal entries 	<ul style="list-style-type: none"> • Verbatim transcripts • Verbatim translations 	Thematic analysis: <ul style="list-style-type: none"> • Transcribing • Reading through the data • Identifying keywords and themes • Interpreting the data
CHAPTER 4: FINDINGS AND RECOMMENDATIONS OF THE STUDY		
Theme 1	Theme 2	Theme 3
Teachers' knowledge of supporting learners experiencing dyscalculia in Grade 3	Factors that limit teacher support to learners experiencing dyscalculia in Grade 3	Nature of support needed to strengthen teacher support to learners experiencing dyscalculia in Grade 3
CHAPTER 5: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS		
Findings and conclusions		
Implementing themes and sub-themes to guide the findings		
Comparing results to literature and answering research questions		
Recommendations and limitations		

1.9 SELECTION OF PARTICIPANTS

Stratified purposive sampling was used for this study. According to Patton (2002 cited by Nieuwenhuis, 2016b), this type of sampling selects a group that is reasonably homogenous but displays variations on a specific case. Furthermore, according to Maree and Pietersen (2016), stratified purposive sampling is very accurate in representing the population. For this study, nine participants would be recruited, ascribing to the following criteria: (i) A practicing Grade 3 teacher; (ii) with at least five years' experience of teaching; (iii) where dyscalculia or MLD is apparent in the Grade 3 class; (iv) with English or Afrikaans as the language of learning and teaching (LoLT); and (v) in the Gauteng area.

1.10 DATA GENERATION

'Data collection' is a popular term used to describe the process of how researchers obtain data (Bryman, 2016), however, this term implies that the data is already established and only needs to be collected, whereas the term 'data generation' implies the researcher has purposefully arranged a situation in which "intelligible" questions have been posed where data can be "generated and captured" (Goldkuhl,

2019:577). The researcher chose to make use of the term 'data generation' rather than 'data collection' because the situations (interviews and observations) in which meaningful data were produced were arranged by the researcher (Goldkuhl, 2019). Even though the observations were conducted, the researcher decided not to include any data that stemmed from the observations since it was not substantial enough for inclusion in the study due to the limited time in each class. Nine participants were recruited, and multiple data generation methods were employed. Yin (2014) proposes the use of various data generation methods to enable the researcher to employ triangulation (see section 3.3.5.2 *Triangulation*). The researcher involved multiple cases to yield in-depth descriptions and explanations (Creswell & Poth, 2018).

1.10.1 Data Generation Process

Ethical approval was obtained from the University of Pretoria (Appendix A) as well as the DBE. Data generation was conducted over three months in four phases. The first phase consisted of contacting various schools to take part in the study. Many schools could not accommodate the researcher and the process was delayed. Nevertheless, as soon as four schools had been successfully contacted, the contact details of a Grade 3 teacher were provided to me. I then contacted the practising Grade 3 teacher by explaining my study in-depth and agreeing on a specific day to meet for the first time. Not all the teachers could meet before the data generation process commenced, and I only met with some teachers for the first time on the day of their classroom observation. Consent was obtained from all the participants that were identified, as well as the respective principals of the schools that had been identified. Secondly, a Mathematics lesson was observed on a specific day and at a specific time that best suited the teacher. The observations took place in the teachers' classroom at the participating schools. During phase three a semi-structured interview was conducted with each teacher at a time, location and day that best suited their needs. The interviews also took place in the respective teachers' classrooms. This ensured that the participants did not have to travel to another location, and that participation was not a financial expense to the participants. In Phase 4, all the data was documented and analysed.

1.10.2 Data Generation Methods

The researcher used observations; semi-structured interviews; document analysis, such as teachers' planning; the Curriculum Assessment and Policy Statement (DBE, 2011b); Guidelines for Inclusive Teaching and Learning (DBE, 2010b); National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom (DBE, 2011b); as well as the Education White Paper 6 (WP6) – Special Needs Education: Building an Inclusive Education and Training System (Department of Education [DoE], 2001); and a reflection journal as the data generation methods. The researcher observed as a participant-observer and, thus, observed from a member's viewpoint and influenced what was observed (Flick, 2009). Semi-structured interviews were used to enable the researcher to ask open-ended questions as well as to make use of probing for clarification (Nieuwenhuis, 2016b). Jupp (2006) argues that an interview represents a meeting or dialogue between people where personal and social interaction occurs, but that in research an interview refers to a two-way dialogue in which the interviewer asks the participant questions to generate data and learn about ideas, beliefs, views, opinions and behaviour of the interviewee. After each visit, the researcher made use of a reflection journal to document any observations, discussions or ideas that were not discussed in the observation or the interview. These entries were used to look for any discrepancies or similarities in the data, as well as to reflect on the process of data generation.

1.10.3 Research Context

According to the World Health Organisation (2013), schools are potential spaces in which positive change can be implemented. Primary schools were the focus of this study, and the only criteria for the selection of the schools were that they had to be in the Tshwane South district and have English or Afrikaans as the LoLT.

1.11 DATA ANALYSIS

Thematic analysis was used for this study. The thematic analysis identifies, analyses, organises, describes and narrates themes within large sets of data (Braun & Clarke, 2006 cited by Nowell, Norris, White & Moules, 2017).

During the process of data analysis, the researcher followed the following six steps (Creswell, 2014; Kuckartz, 2013) which is explored in-depth in Chapter 4:

Step 1: Transcribing and highlighting important passages.

Step 2: Identifying the main themes.

Step 3: Coding within main themes.

Step 4: Identifying sub-themes.

Step 5: Coding within sub-themes.

Step 6: Analysis and presentation of findings.

1.12 METHODS TAKEN TO ENSURE VALIDITY AND RELIABILITY

In qualitative research, certain criteria are used to confirm the trustworthiness of a study by means of credibility, transferability, dependability, and confirmability (Nieuwenhuis, 2016b). Implementing these criteria adds value to qualitative data.

Table 1.5 explains the four aspects of trustworthiness, as described by Nieuwenhuis (2016b), and outlines how I ensured trustworthiness in my study:

Table 1.5: Four aspects of trustworthiness (Nieuwenhuis, 2016b) and its relevance to the study

Aspect of trustworthiness	Description	How it was maintained throughout the study
Credibility	Credibility informs the quality, integrity and reliability of data and of researchers, which is upheld by precise data generation methods and analysis (Nieuwenhuis, 2016b).	The researcher ensured credibility in this study by sharing the generated field notes with the participants to ensure that the information is correct and that any errors can be rectified. According to Nieuwenhuis (2016b), the participants must shape the findings of the study to eliminate possible bias, therefore, the researcher made use of triangulation. Triangulation maintains the confidentiality of participants and ensures precise transcripts (Nieuwenhuis, 2016b).
Transferability	Transferability allows researchers to link aspects of their research and eliminates generalised assumptions (Nieuwenhuis, 2016b).	Transferability was increased by being aware of how typical the participants and the context in which the data generation takes place are (Nieuwenhuis, 2016b), and this was implemented through the sampling process by

		using FP teachers teaching Grade 3 learners in a school in the Gauteng area.
Dependability	Dependability maintains the reliability and precision of the data being generated (Nieuwenhuis, 2016b).	This study made use of consistent data generation and analysis strategies, reflective assessment and a precise criterion.
Confirmability	The participants need to shape the findings of the study to eradicate any possible bias or alternate interests (Nieuwenhuis, 2016b).	Confirmability was maintained by demonstrating how the data generated correlated with the research findings. This was done by drawing comparisons between participant responses and fairly interpreting the data without any bias.

1.13 ETHICAL CONSIDERATIONS

All ethical principles, as stipulated by the Ethics Committee of the University of Pretoria, were upheld throughout this study. These principles include the voluntary participation of all participants – letters were used to obtain informed consent from the participants. Ethical principles such as honesty, informed consent, privacy and confidentiality, described by Burton and Bartlett (2009), were implemented in this study.

The researcher obtained ethical clearance from the DoE to conduct the study in public schools in the Tshwane area. After the researcher obtained permission to commence the study, school principals of different public school were contacted and permission was obtained to conduct the necessary data generation at their respective schools with the allocated Grade 3 teachers. The study included nine Grade 3 teachers as participants. Interview and observation questions (Appendices F & G) were prepared and were used during the interviews and observations conducted with the participants. During the interview and observation, several ethical considerations were considered. Firstly, all participants were assured that their participation was voluntary. Secondly, the interviews were recorded with the

consent of the participants and all interviewees were assured of their right to privacy and anonymity (Cohen, Manion & Morrison, 2007).

The researcher, furthermore, adhered to the guidelines, as set out by Farrell, Sherratt and Richardson (2016) which state that all information gathered in the study should be treated with confidentiality and participants should be kept anonymous. This ensured that the participants could not be linked to any specific information. The researcher communicated and clarified their opportunity to discontinue and withdraw from the study at any time, with no consequences whatsoever. The personal information and identity of the participants were kept anonymous at all times. The researcher used pseudonyms to transcribe the participants' views and to report the findings.

1.14 SUMMARY

This chapter gave an overview of the research rationale, the problem statements and the questions that will guide the research. An important background that will guide the literature was provided, along with a summarised version of the research methodology. The main ethical considerations of the study were also discussed.

CHAPTER 2: LITERATURE REVIEW

"Mathematics is considered as part and parcel of human thought and logic, and integral to attempts at understanding the world and ourselves. We know that mathematical knowledge is fundamental, but alas, it is poorly taught in elementary schools and ultimately mathematical performance remains down to mark leading towards lower ability of individuals in accordance with their actual abilities" (Jameel & Ali, 2016:124).

2.1 INTRODUCTION

Chapter 1 introduced MLD with specific reference to dyscalculia, provided the aims of the study, the crucial background to the study, as well as the purpose of the study. Furthermore, the questions that will guide the study were considered and a brief introduction of the conceptual framework was given. Chapter 2 provides a structured analysis of literature relating to strengthening teacher support to learners experiencing dyscalculia. The study is based on the application of different backgrounds and will aim to provide literature about a theoretical, contextual and conceptual background. The theoretical background comprises of Vygotsky's zone of proximal development (ZPD) and The Concerns-Based Model of Teacher Development (CBMoTD) which led to a conceptual framework implemented in the study. The contextual background focuses on relevant educational policies and practices. The chapter concludes by presenting the conceptual background which covers important aspects of how to strengthen teacher support, which highlights approaches to teaching mathematics and evaluating teaching to improve the comprehension of basic mathematical skills of learners who experience dyscalculia.

2.1.1 The Essence of Mathematical Learning Difficulties

MLDs in the FP are influenced by various factors. These factors include aspects, such as mathematical anxiety, incompetent mathematics teachers and inadequate mathematical teaching and learning materials (Van der Walt, Maree & Ellis, 2008; Ndlovu, 2011; Siyepu, 2013; Sa'ad *et al.*, 2014). Nevertheless, it could also be due to dyscalculia (Butterworth, 2005). The latter is defined as a difficulty to obtain mathematical skills (Emerson & Babbie, 2015; Hudson, 2016). As mentioned in Chapter 1, dyscalculia was employed as an umbrella term to encapsulate all MLD that

learner's experience. Individual learners have their attributes, which include different physical abilities, emotional and social intelligence and cognitive competencies. Therefore, the teaching of Grade 3 mathematics needs to be inclusive so that all learners, irrespective of their skills, can attain success.

2.1.2 Identification of Mathematical Learning Difficulties in the Foundation Phase

The early identification and diagnosis of learners who experience dyscalculia are crucial so that different support systems can be put in place to minimise the difficulties that learners experience so that they can become active participants in society (Taylor, Anselmo, Foreman, Schatschneider & Angelopoulos, 2000; Dowker, 2009; Gold & Richards, 2012; Machaba, 2013).

However, teachers should not label these learners as it could have major negative outcomes (Gold & Richards, 2012; Machaba, 2013; Samkange, 2015). Identifying learners with LD in the FP can have a major positive impact on these learners' chances of success (Taylor *et al.*, 2000; Dowker, 2009; Gold & Richards, 2012; Machaba, 2013). Taylor *et al.* (2000) and the Government Communication Information System (GCIS, 2018/9) further adds that by identifying learners who experience barriers to mathematical learning in the FP, they are more likely to develop to their full potential.

The early identification of dyscalculia is further supported by Steele (2004:75) who opines that it will provide a "foundation for later learning" and promote academic success. Steele (2004:75) adds that it will also prevent the development of "secondary difficulties" such as feelings of irritation and nervousness. It could also have socio-economic benefits such as lowering the costs on society that might be needed at a later phase if these learners are not identified at an early stage as explained by Steele (2004) and Machaba (2013).

Moreover, if learners with dyscalculia do not receive early intervention, other problems might accompany their LD such as not completing their schooling career, having behavioural difficulties and developing other academic difficulties (Gold & Richards, 2012; Machaba, 2013; Samkange, 2015). All the reasons previously mentioned,

therefore, provide a crucial view of why learners must receive early intervention if they experience dyscalculia.

2.1.2.1 Explanation of dyscalculia

According to Dednam (2011), there are learners in almost every classroom that will experience LD. In this regard, it is important to note that, when a learner experiences difficulty with one specific skill such as numeracy, the term “specific learning difficulty (SpLDs)” is used (Hudson, 2016:12). According to Ramaa and Gowramma (2002); Karande (2008); Jaya and Geetha (2009); Henderson (2012); Hudson (2016); and, Bornman and Rose (2017), one of the most common SpLDs is dyscalculia. When learners experience barriers to obtain mathematical skills, the term ‘dyscalculia’ is used (Hannell, 2013; Emerson & Babbie, 2015; Hornigold, 2015; Hudson, 2016). Learners experiencing dyscalculia may experience difficulties when it comes to obtaining certain mathematical skills, but they may be gifted in other skills (Hornigold, 2015; Bornman & Rose, 2017).

Miundy *et al.* (2017:236) believe that there are different types of dyscalculia and that a person could either have one type or a combination of types. These types are (1) *verbal dyscalculia*, which is when a learner experiences a verbal difficulty to name numbers, symbols and amounts; (2) *lexical dyscalculia*, which is when a learner experiences difficulty reading symbols; (3) *graphical dyscalculia*, which is when a learner experiences difficulty writing symbols; (4) *operational dyscalculia*, which is when a learner experiences difficulty doing calculations and doing mathematical operations; (5) *ideognostic dyscalculia*, which is when a learner has difficulty doing mental maths and understanding calculations; (6) *practognostic dyscalculia*, which is when a learner has difficulty calculating, differentiating between and making associations between objects and figures.

2.1.2.2 The cause of dyscalculia

As previously stated, dyscalculia may be caused by developmental, visual perceptual, social, economic or emotional factors (Emerson & Babbie, 2015). The developmental factor is caused by the damage to a certain area of the brain (Träff, Olsson, Östergen & Skägerlund, 2016). If a learner is experiencing dyscalculia about the developmental

factor, the term developmental dyscalculia (DD) is used. The exact cause for DD is still unknown (Bornman & Rose, 2017), however, according to Hannell (2013); Hornigold (2015); and, Bornman and Rose (2017:178), it may be caused by the “dysfunction of areas in the brain”. Other literature suggests that it is affected by genetics (Hornigold, 2015; Hudson, 2016), expectant mothers drinking alcohol whilst pregnant (Hornigold, 2015; Bornman & Rose, 2017) or working memory (Hornigold, 2015).

According to the National Association of Special Education Teachers (NASSET, 2017), signs of visual perceptual deficits include poor motor coordination; restlessness; poor handwriting; reversal and inversion of numbers; cannot write answers on paper; poor understanding of time and space; and, test scores that do not reflect learner’s ability. Pieters, Desoete, Roeyers, Vanderswalmen and Waelvelde (2012) propose that these factors might be caused by either a deficit or insufficient development. Social factors include aspects such as poverty and emotional factors include features such as mathematical anxiety (Emerson & Babbie, 2015).

According to Emerson and Babbie (2015), dyscalculia is not a disease, therefore, it cannot be cured. However, learners experiencing this LD can be supported successfully by utilising different strategies to meet the demands necessary to improve their numeracy skills (Miundy *et al.*, 2017; Emerson & Babbie, 2015; Bird, 2009). It is imperative to note that dyscalculia only affects the skills that need to be acquired for numeracy, it does not affect mathematics as a whole (Emerson & Babbie, 2015). However, Emerson and Babbie (2015) further add that many of the fundamental skills of numeracy can be linked to other areas of mathematics.

2.1.2.3 The effect of dyscalculia on learners

As mentioned previously, mathematical skills affected by dyscalculia are, for example, when learners’ counting skills are impaired; they experience difficulty with arithmetic; abstract perceptions of time-telling; basic calculations; studying multiplications; using a calculator; approximating answers; working memory; working with money and when the learner experiences a constant barrier in mathematics (Hornigold, 2015; Bornman & Rose, 2017).

Furthermore, learners experiencing dyscalculia, according to Hannell (2013), often work at a slow pace and make many mistakes, which has a direct impact on the quality and quantity of their work. Moreover, Machaba (2013) believes that when learners experience difficulties in mathematics in the FP, it could lead to challenges later on in their school career. Other skills affected by dyscalculia are, according to De Castro, Bissaco, Panccioni, Rodrigues and Domingues (2014:7), the inability to visualise “groups of objects” within a larger group; comparing smaller and bigger objects; verbalising “sequences of numbers”; comprehending mathematical signs; completing simple sums; and comprehending the importance of “numerical representations”.

In a survey conducted in the United Kingdom, as explained by Emerson and Babbie (2013), it was found that learners who experience difficulties in mathematics were more likely to be affected by unemployment, experience depression and get into trouble with the law. According to Machaba (2013:6) and Craig (2018), if learners do not develop mathematical literacy, they might experience difficulties in becoming economically independent and developing “entrepreneurial skills”. Furthermore, it can lead to learners having low self-esteem and being unable to do basic things such as counting money (Machaba, 2013).

2.1.2.4 Experiences of teachers in supporting learners experiencing dyscalculia

Teachers may initially have a negative attitude to supporting learners due to factors such as little exposure to LD as well as prevailing social attitudes about LD (Engelbrecht, Green, Naicker & Engelbrecht, 2007). In a study conducted by Lumadi (2013), it was found that teachers display mixed feelings towards the support of learners with LD. The teachers that displayed positive attitudes required certain aspects to be in place before they would implement it. These aspects included appropriate teacher to learner ratio and good infrastructure (Lumadi, 2013). Furthermore, teachers opted for further education and training to successfully support these learners (Lumadi, 2013).

Mavuso (2014) found a correlation between teaching experience and positive attitudes toward the support of learners, where teachers with more years of experience were

positive and teachers with less experience found it to be a difficult and tedious task. Brady and Woolson (2008) think that teacher training plays a big part in teachers' attitudes toward supporting learners. Furthermore, teachers that display higher levels of self-efficacy tend to attribute learners' difficulties more to their teaching than to external factors (Brady & Woolson, 2008).

2.2 CONCEPTUAL BACKGROUND

It is imperative to note that this study's conceptual framework is two-fold in nature. Firstly, a theoretical background was viewed from the perspective of successfully supporting learners, and secondly, the focus was on teachers and the requirements necessary to support them. The researcher used Lev Vygotsky's Zone of Proximal Development (ZPD) and Fuller's Concerns-Based Model of Teacher Development (CBMoTD) as a framework to strengthen teachers' knowledge and understanding of dyscalculia so teachers can support learners in the FP. The Concerns-Based Model of Teacher Development (CBMoTD), which was developed by Fuller (1969) identifies three stages of teachers' concerns. These three stages should be viewed as a general movement that progresses from one stage to the next (Fuller, 1969; Conway & Clark, 2003). This model aims to identify and eradicate teacher concerns regarding the successful implementation of a mathematics curriculum (Franey, 2016; Veldsman, 2018).

The ZPD is a strategy proposed by Lev Vygotsky that can be implemented by teachers teaching mathematics to learners experiencing dyscalculia. The learners should be directed through the teachers' instruction, demonstration and practical examples to a point where mathematical competency can be achieved. The ZPD should in return allow teachers to see and understand how their teaching impacts a learner's understanding of mathematics. This will influence teachers' teaching strategies in mathematical teaching using scaffolding, to guarantee that learners successfully understand mathematical concepts and that they can use mathematical skills.

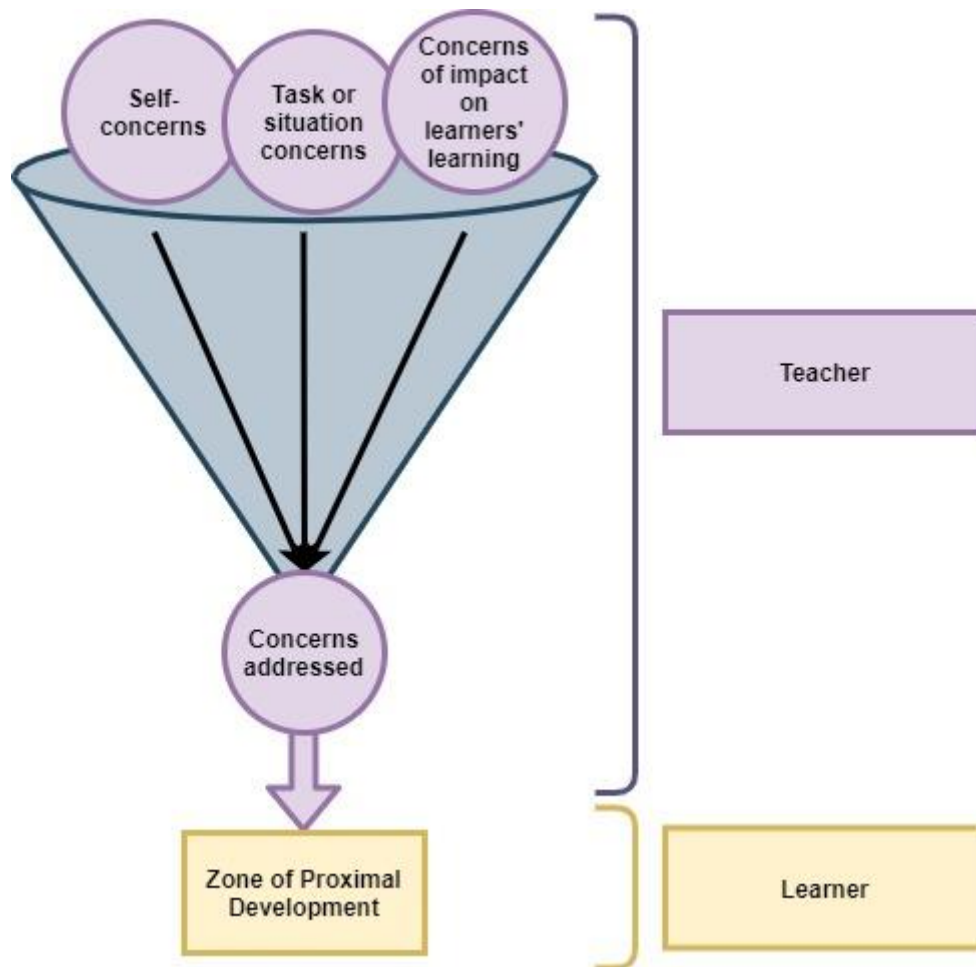


Figure 2.1: A visual representation of the conceptual framework used in this study

Figure 2.1 visually represents the theoretical framework used in the study. The CBMoTD focuses on teachers' concerns experienced in the teaching and learning environment. These concerns are separated into three categories (Fuller, 1969). These stages are self-concerns, tasks/situational concerns and the concerns that teachers have regarding their impact on learners. These three stages, indicated at the top of the funnel in Figure 2.1, need to be evaluated and analysed to identify possible concerns and what progress can be made to address these concerns. The concerns are only related to the teacher. When these concerns have been addressed and solutions have been identified, the learners' learning starts to play a role because the teacher will only be able to support the learner effectively and successfully when his or her concerns have been addressed. The learner will now be able to reach the ZPD (Vygotsky, 1987) with the support of the teacher.

The researcher chose these two frameworks to guide the study due to the value they add in identifying how teacher support can be strengthened and the effect thereof on the learners. The CBMoTD ensured that challenges and concerns that teachers face could be identified and thematised. It provided the researcher with insight as to different aspects that might influence these concerns and how to address it. The CBMoTD focused on the teachers and the support they need. The ZPD, however, focused on the learners and their learning. It guided the study to identify how learners can be supported that experience difficulties in order for them to develop to the best of their ability. It ensured that strategies to support learners experiencing dyscalculia could be identified. The combined implementation of these two frameworks therefore provided information pertaining to teachers as well as learners, how teacher support can be strengthened and learners' mathematical skills and comprehension who experience dyscalculia can be enhanced.

2.2.1 The Concerns-Based Model of Teacher Development as Part of a Conceptual Framework

The first conceptual underpinning of this study focuses on the different phases of concerns that teachers face in teaching mathematics to learners with difficulties. Conway and Clark (2003) state that researchers who implement the CBMoTD usually adopt this model for various reasons, one of them being due to the need for adaptive teaching. Since the aim of this study is to support teachers to enable them to successfully facilitate the learning process of learners experiencing dyscalculia, this model best supports this study. Fuller's (1969) model can be seen as a successful theoretical model since it is continuously used to evaluate the progression of teacher concerns. Vermunt (2009) and Veldsman (2018) explain concerns that teachers experience as features that they need to gain knowledge about aspects that relate to teaching that they are not adequately proficient in or aspects of teaching that teachers dislike. Conway and Clark (2003) agree with this statement but indicate that these concerns should be conceptualised to counterbalance them with positive features, such as hope.

This research aimed to provide a contextual view of the concerns teachers experience that inhibit their teaching. These concerns were highlighted in the data analysis and

findings of the study (Chapters 4 and 5). Furthermore, possible recommendations on how these concerns should be addressed were discussed (Chapter 5).

The three stages are discussed in the following section by integrating it into the initial context of this study:

Self-concerns encapsulates how teachers view themselves, which is not influenced by how the learners perceive them or their teaching. One of the questions that arise in this section is ‘Do I know how to teach mathematics?’ When teachers do not know how to teach mathematics, it will have a negative impact on learners’ acquisition of mathematical skills and understanding. The study aims to find out if the teachers have any concerns related to themselves and whether these might negatively impact on learners’ acquisition of mathematics.

Tasks or situation concerns focus on the daily responsibilities of a teacher (Veldsman, 2018). Questions that arise are ‘Am I equipped with sufficient resources for this class?’; ‘Do I understand the pedagogical content and subject matter knowledge?’ and ‘Have I successfully planned for this lesson?’ The daily responsibilities of a teacher should be set out in the planning of the teacher in Grade 3. If a teacher experiences concerns related to these responsibilities it might cause uncertainty of how to start a lesson, how to support the learners with the materials provided and how and why to elaborate on a specific concept.

Concerns of impact on learners’ learning include teachers’ abilities to support learners in reaching their full potential (Fuller, 1969). Questions that could be asked are ‘Can I successfully support the learning of learners with mathematical learning difficulties?’ and ‘Do I know how to support learners that experience mathematical anxiety?’ Literature has shown that teachers face various challenges when it comes to supporting learners with dyscalculia and if a teacher has a concern regarding the successful implementation of support, this will affect learners’ acquisition.

2.2.2 Zone of Proximal Development as Part of a Conceptual Framework

The ZPD is defined by Vygotsky (1978:86) as: “The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers”. Vygotsky (1978) is, therefore, of the opinion that a more knowledgeable other should provide learners with mathematical learning opportunities by supporting them, using tools and the ZPD to scaffold the learning process. The words ‘adult’ and ‘other’ in the two previous citations were used to refer to a qualified teacher. Scaffolding takes place when a teacher models how a task must be completed and then progressively shifts the responsibility to the learners (Christmas *et al.*, 2012).

Scaffolding is also defined as the interaction between qualified teachers and learners in a problem-solving activity or when the teacher controls certain elements of an activity that the learner might find too difficult (Wood, 1988 and Bruner & Ross, 1976 in Attarzadeh, 2011). Scaffolding is further explained as support that is provided to a learner who is unable to complete a task independently (McGee & Ukrainetz, 2009). Through this process, teachers can identify and implement support needed for the learner to internalise the skills and concepts (McGee & Ukrainetz, 2009). Muhonen, Rasku-Puttonen, Pakarinen, Poikkeus and Lerkkanen (2016) opine that scaffolding enables learners to construct ideas that they would not necessarily have had independently, but that they think they would have recognised on their own. Furthermore, Attarzadeh (2011) adds that this permits the learner to focus on the tasks that are within his or her range of competence. Vygotsky² (1987 cited in Christmas, Kudzai & Josiah, 2012), emphasises the importance of interaction and how interaction with more knowledgeable individuals will facilitate learners’ knowledge and comprehension. This process is called “mediation” (Christmas *et al.*, 2012:372). For this study, mediation will refer to peer teaching.

² The researcher realises that some of the sources in this study consulted is bygone. However, Mooney (2013: 96), supports the use of foundational theories by stating: “the foundational theorists of our field gave us such direction in understanding the developmental needs of young children that they are not diminished or discredited by changes in society or knowledge that force us to make adaptations to their original work”.

Figure 2.2 is used to visually represent the ZPD. It is important to note that one level of assisted learning becomes the next level's unassisted learning (Schwieter 2010). For this reason, learners experiencing dyscalculia can be assisted until they no longer require assistance in that specific topic or activity anymore.

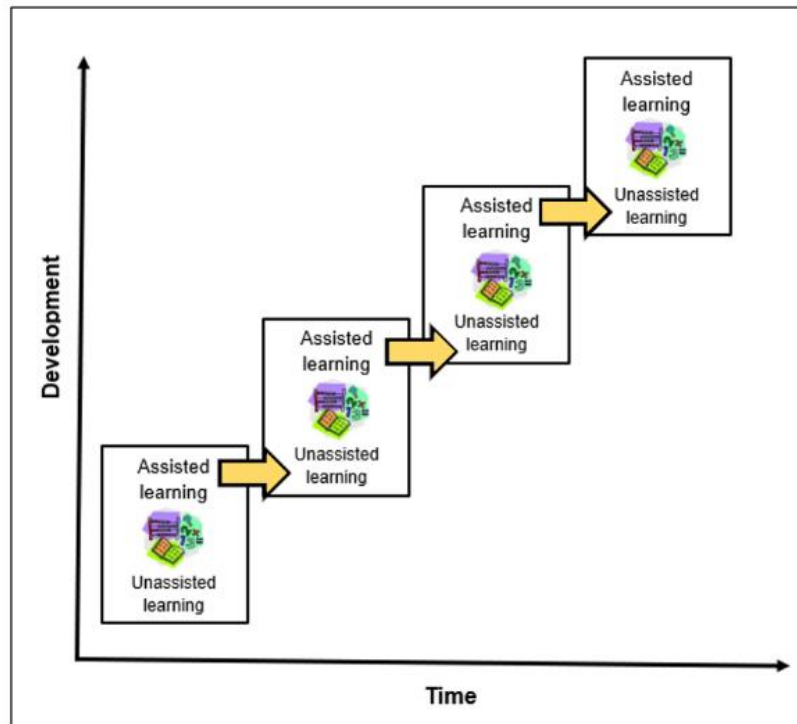


Figure 2.2: Developmental progression in a mathematical learner's ZPD through scaffolding (Adapted from Schwieter, 2010:33; Swanepoel, 2016)

As seen in Figure 2.2, as time passes, there is a progression in the developmental levels of the learner. As learners become more competent with the help of the teacher, they can move to other skills or comprehension that they want to acquire and master. Learners will be enabled to move from a low level of competency to a higher level of competency through scaffolding if the teacher provides the learner with adequate guidance and support. The ZPD is, therefore, suitable and applicable to a mathematical teaching environment.

2.3 CONTEXTUAL BACKGROUND

In the following section, different policies of mathematical teaching and learning are discussed.

2.3.1 Curriculum and Assessment Policy Statements for the Foundation Phase

The current curriculum in the FP is the CAPS. One of the general aims of CAPS is to ensure that learners can gain and apply knowledge and skills that are relevant to their own lives (DBE, 2011a). CAPS in the FP is divided into three subjects, namely: Languages, Mathematics and Life Skills. According to the DBE (2011a), FP mathematics consists of five content areas. These are *Numbers, Operations and Relationships*; *Patterns, Functions and Algebra*; *Space and Shape (Geometry)*; *Measurement*; and *Data Handling (statistics)* on which the DBE suggests Grade 3's should spend 58%, 10%, 13%, 14% and 5% respectively. The weighting of these content areas is visually represented in Table 2.1:

Table 2.1: Weighting of content areas (DBE, 2011a:10)

Content area	Grade 3
Numbers, Operations and Relationships	58%
Patterns, Functions and Algebra	10%
Space and Shape (Geometry)	13%
Measurement	14%
Data Handling (Statistics)	5%

It is evident in the aforementioned table that in Grade 3 the most important content area is Numbers, Operations and Relationships. This could indicate that teachers should spend most of the time supporting learners to become competent in this content area.

2.3.2 National Curriculum Statement - Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom

The guidelines for responding to learner diversity in the classroom through CAPS is embedded in the WP6 (DoE, 2001). In July of 2001, the DoE published WP6, which aims to promote equality, non-discriminatory principles and the maximum participation of all learners in the South African educational system (DoE, 2001). The guidelines were designed specifically for all role-players within the education system to support the successful implementation of classroom differentiation (CD) to respond to learner diversity in classrooms (DBE, 2011b). CD is explained as a way of thinking about learning and teaching in new and different ways so that all learners are included (DBE,

2011b). It includes different levels to ensure the successful implementation of CD (DBE, 2011b). It focuses on differentiating the curriculum content, the learning environment, as well as the teachers' teaching methods (DBE, 2011b). The curriculum content refers to what teachers teach and what learners are expected to know, understand and implement; the learning environment is the place or setting where learning occurs; and teaching methods refer to learning materials and modes of presentation such as scaffolding and flexible grouping (DBE, 2011b). Curriculum content refers to what teachers must teach and what the learners are expected to gain from it. This refers to the CAPS curriculum that is currently implemented in South Africa. The learning environment refers to the place or the setting where learning occurs, in this study, this refers to the Grade 3 classroom. Moreover, teaching methods refer to how the teacher presents the curriculum by making use of the learning environment, learning materials and different ways of presentation.

2.3.3 Guidelines for Inclusive Teaching and Learning

These guidelines aim to provide all learners, irrespective of their differences and difficulties, with accessible classrooms that are conducive to their learning (DBE, 2010). It presents teachers with information on different barriers to learning and all relevant aspects related to it, as well as how to support learners to overcome these barriers (DBE, 2010). Dyscalculia is briefly mentioned in these guidelines with no specific support structures, and it is only recommended that a new policy implementing straddling be developed for learners experiencing this barrier (DBE, 2010). Straddling is defined as when a learner works towards obtaining assessment standards from more than one grade due to LD (DBE, 2011b).

2.4 QUALITY OF TEACHERS TEACHING MATHEMATICS IN THE FOUNDATION PHASE

2.4.1 Teacher Training

The GCIS (2018/9), along with Maharajh, Nkosi and Mkhize (2016), state that to improve curriculum delivery, it is imperative that teachers have access to high-quality learning and support materials and to guarantee that they can use it. Furthermore, the GCIS (2018/9) opines that the DBE gives teachers excellent printed and digitised materials for support and crucial tools needed to teach effectively. The DBE, in

partnership with the National Education Collaboration Trust, have, furthermore, provided teachers in the FP, across all provinces, with a Primary School Reading Improvement Programme (PSRIP) implemented by the National Education Collaboration Trust, to improve learners' imperative skills of language and numeracy (GCIS, 2018/9). The reading programme supports teachers by enabling them to improve their quality of teaching and learners' learning (PSRIP in line with the DBE Strategic Plan, 2016). Furthermore, the programme aims to improve learner achievement, promote active citizenry and employ democratic practices (PSRIP in line with the DBE Strategic Plan, 2016).

Successful and sufficient teacher training in mathematics is of the utmost importance because it has a direct influence on learners' acquisition of mathematical skills (Machaba, 2013; Ashraf, Ashraf, Saeed, Gulzar, Shah, Azhar, Bukhari, Ilyas & Anam, 2015). Teachers need to be trained effectively and efficiently to be able to teach mathematics and to support learners with mathematical LD because they are agents of change (Johnson, Shúilleabháin, Ríordáin & Predergast, 2019). This incredible and crucial responsibility will directly affect learners' progress and development. For this reason, the study undertaken by the researcher is of imperative importance.

It is important to investigate what support is currently being given to South African teachers teaching the FP because it has a direct impact on learners' progress. As mentioned, teachers are agents of change, and if sustainable and successful training of teachers could be implemented, it will have a "cause and effect" reaction on learners' progress because the progress of each learner is influenced by a teacher.

In a study conducted by Jameel and Ali (2016), they found that some teachers who teach mathematics did not receive proper training in mathematics. The researchers indicated that school management either lacked funding or that they mismanaged it. Furthermore, they indicated that some mathematics teachers do not provide learners with enough practical examples that are innovating and exciting, which in turn negatively influence learners' views of mathematics (Jameel & Ali, 2016).

According to the Centre for Development and Enterprise (CDE, 2011), teachers are trained through either initial or in-service training initiatives. Initial training is provided

by public and private tertiary institutions and the government is supplying out-of-school students with bursaries to encourage their enrolment at universities (CDE, 2011). Furthermore, the CDE (2011) provides insight into the current quantity and quality of South African teachers by proving the following imperative facts:

- Too few teachers are trained in mathematics.
- Teachers teach poorly because of ill-developed training and development initiatives.
- South African learners' achievement is very poor in terms of mathematical performance compared to other countries.

The following quote of the CDE (2011:26) provides a detailed look at the current training of teachers in South Africa: "...one of the main reasons South African schools are performing so badly maybe the poor training of teachers, particularly in specialised subjects such as maths..." This statement is concurred by Lai, Sadoulet and De Janvry (2011); Harris and Sass (2011); and, Fuje and Tandon (2018) who believe that teacher training has a direct influence on learners' performance. Furthermore, the poor performance of teachers has a direct negative influence on the achievement of learners (CDE 2011).

2.4.1.1 Pedagogical Content Knowledge and Subject Matter Knowledge

Pedagogical content knowledge (PCK) and subject matter knowledge (SMK) form the foundation for teachers' instructional practices in their classrooms (Ball, Thames & Phelps, 2008). Teachers' knowledge of PCK is viewed as a crucial factor in learners' mathematical performance (Lee, 2010, McCray & Chen, 2012, Venkat & Spaul, 2015). Teachers who lack a fundamental understanding of mathematical teaching and learning cannot "bring the productive pedagogical transformations of knowledge that are required for teaching into view" (Venkat & Spaul, 2015:129).

PCK is the concept that explains that teachers need to have adequate knowledge of the content of mathematics and how learners learn this content (Bausmith & Barry, 2011; McCray & Chen, 2012). According to Lee (2010); and Kaino and Moalosi (2013), there is a definite correlation between teachers' PCK and their quality in teaching

mathematics. However, in a study conducted by Lee (2010), it was found that teachers possess better PCK of only certain categories in mathematics. Kaino and Moalosi (2013) support this statement by stating that teachers lack adequate PCK as well as comprehending the nature of mathematical problems and that this is due to a lack of efficient teacher training (Zuber-Skerritt, 1992; Kaino & Moalosi, 2013). Furthermore, in a study conducted by Venkat and Spaul (2015), it was found that 79% of South African teachers teaching a specific grade had PCK below that specific grade.

In addition to PCK, SMK also forms a crucial part in the teaching of mathematics and has a direct influence on learners' mathematical understanding and achievement (Ball *et al.*, 2008; Hannula, 2018; Lee, Capraro & Capraro, 2018). SMK focuses on the knowledge of mathematical conceptual facts and syntactic aspects (Rollnick & Mavhungu, 2016; Lee *et al.*, 2018).

Figure 2.3 explains the difference between mathematical PCK and SMK. SMK encapsulates common mathematical content knowledge; knowledge at the mathematical horizon, as well as specialised mathematical content knowledge. PCK focuses on knowledge of mathematical content; learners; teaching and curriculum.

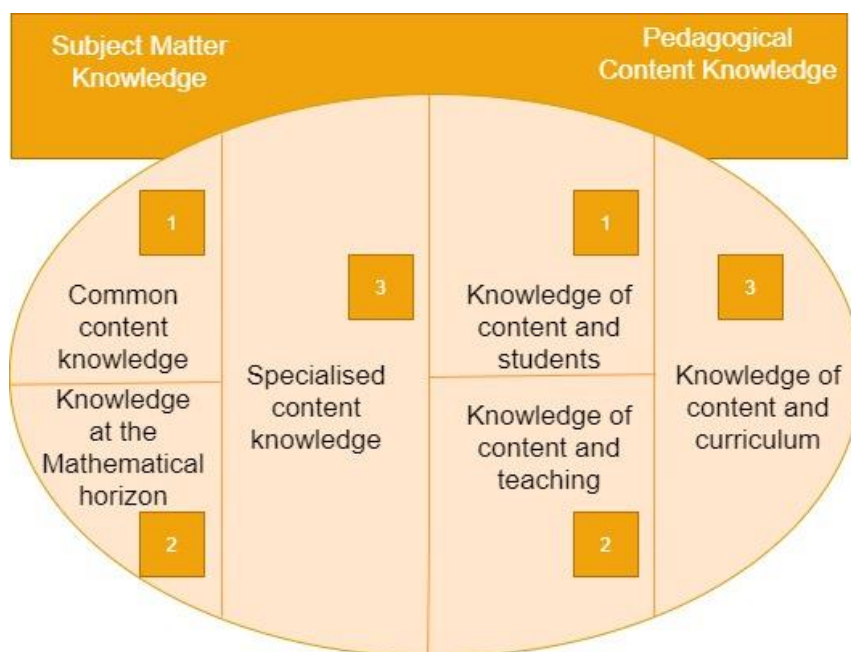


Figure 2.3: Model of mathematical knowledge for teaching (Ball *et al.*, 2008)

The different aspects of the figure will be discussed in detail as explicated by Ball *et al.* (2008):

- 1) **Common content knowledge (CCK)** is the knowledge and skills used in settings that do not only include teaching. As an example, a Grade 3 teacher should be able to do basic calculations without any errors. However, **knowledge of content and students (KCS)** is knowledge of how students might perceive and interact with the mathematical content. As an example, teachers should know which equations Grade 3 learners might find too challenging.
- 2) **Knowledge at the mathematical horizon** is defined as an awareness of how different mathematical topics are related to each other in the curriculum. As an example, a Grade 3 teacher should know how and why there is a need to lay the foundation of a specific mathematical concept for what will come in the later grades. Whereas **knowledge of content and teaching (KCT)** is the knowledge of SMK and PCK. As an example, a Grade 3 teacher should realise when learners need more clarification on a specific mathematical subject or topic.
- 3) **Specialised content knowledge (SCK)** is the knowledge and skills used in teaching. As an example, a Grade 3 teacher should know the whole scope of mathematical language associated with all basic calculations. While **knowledge of content and curriculum** is knowledge associated with SMK and the curriculum. As an example, Grade 3 teachers should know why and how certain Grade 3 topics are discussed and where it can be found in the CAPS.

2.4.1.2 Poor Understanding of Policy

When South Africa became a democratic country in 1994, a new “legislative framework for education” was introduced so that there could be no more confusion and difficulties to implement the curriculum (Nkambule & Amsterdam, 2018:1). The State of Literacy Teaching and Teaching in the Foundation Phase (National Education Evaluation & Development Unit, 2013) stipulates that educational districts and circuit officials should visit schools; conduct classroom observations; provide opportunities for educational document analysis; enable and provide support for professional development; and, provide feedback reports (Nkambule & Amsterdam, 2018).

However, according to Nkambule and Amsterdam (2018), legislation and policies merely provide a framework and only communicate intentions. The literature describes that the reality of teacher support is not what legislation and policy stipulate (De Clercq & Phiri, 2013; Van der Berg, Spaull, Wills, Gustafsson & Kotzé, 2016; Nkambule & Amsterdam, 2018). According to King-McKenzie, Delacruz, Bantwini and Bogan (2013), South African teachers have been overwhelmed by changes in policies and legislation. There were four curriculum reforms by the DBE between 1997 and 2012. CAPS was introduced in 2012, only a year after the National Curriculum Statements (NCS) was introduced in 2011 (Nkambule & Amsterdam, 2018).

According to Ferreira and Schulze (2014), teachers lack an understanding of what these policies entail. Maharajh, Nkosi and Mkhize (2016) opined that the reason for this is a lack of training, which results in multiple understandings of one policy thereby causing confusion.

2.4.1.3 Lack of Understanding on How to Implement the Policy

The lack of understanding of policies has a direct influence on the implementation of these policies. In a small-scale study conducted by Maharajh *et al.* (2016), the authors found that in the current South African context, policies are not successfully implemented. This is caused by the lack of training, resources and support from the DBE (Maharajh *et al.*, 2016). Additionally, teachers' negative views on the implementation and insufficient time is taken for implementation have also been found to contribute to this (Maggie, 2015; Hope, 2002). Hope (2002) and Maggie (2015) think that principals have a significant impact on the successful implementation of policy since they can take on the role of a motivator, initiator and communicator.

2.4.1.4 Lack of Resources

South African teachers lack the necessary resources, which has a direct influence on curriculum implementation (Badugela, 2012; Ntshaba, 2012; Maharajh *et al.*, 2016; Mbatha, 2016). Resources are defined as all material and non-material features that are required and contribute to the realisation of goals in educational environments (Usman, 2016). Adler (2000) divides resources into three categories which are supported by Van der Nest (2012) and Usman (2016). These are, as indicated by Adler (2000:210-211): (1) *human resources*, (2) *cultural resources*, and (3) *material*

resources. The efficient evaluation of these three categories can promote successful curriculum implementation (Maharajh *et al.*, 2016).

As seen in Figure 2.4, these three resources (material and non-material) are needed for successful curriculum implementation and the “administration of a school” (Usman, 2016:30). Within each of the resources, different aspects need to be identified and explained to fully comprehend how each contributes to the desired goal.

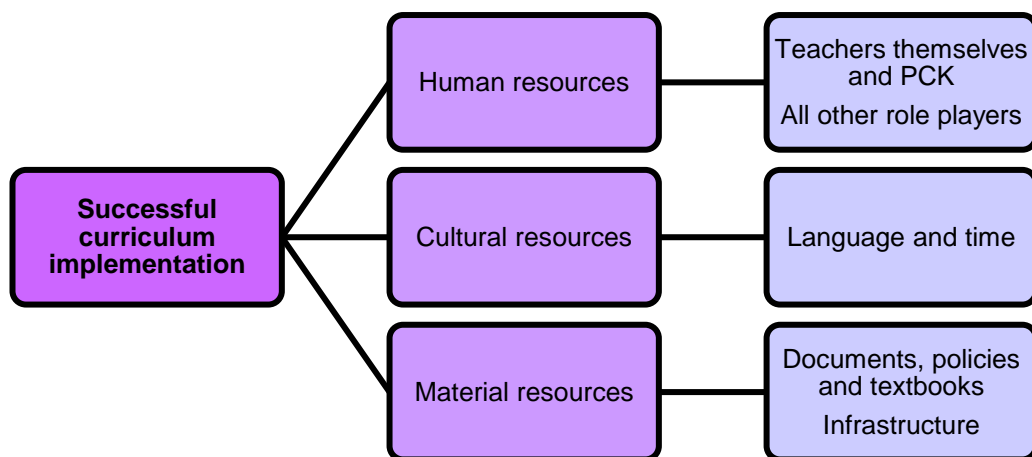


Figure 2.4: Resources that influence successful curriculum implementation (Adapted from Adler, 2000)

As seen in Figure 2.4 above, *human resources* are teachers themselves (concurrented by Runhaar, 2017) and their level of PCK, as indicated by Adler (2000). However, Usman (2016) argues that it includes more role players such as all support staff, parents, community members and other members of interest. These role-players should coordinate their activities and views to ensure that the main goal is attained (Usman, 2016). According to the Organisation for Economic Co-operation and Development (OECD, 2010), one of the main influences on the efficacy of teachers as human resources is pre-service training and professional development.

Cultural resources, or otherwise indicated as time resources by the OECD (2010), including the number of time learners have for learning activities and the size of the classroom. A link has been shown between the time learners are provided with to spend on learning activities and their performance (OECD, 2010; Usman, 2016). Adler (2000), furthermore, indicates that time resources also refer to the language of learning and teaching (LoLT) and first language.

Lastly, *material resources* refer to documents, policies and textbooks needed for successful curriculum implementation (Adler, 2000). Usman (2016) adds that it also includes the infrastructure of the teaching environment. The lack of proper material resources negatively influences the fulfilment of educational goals and the school's overall level of performance (OECD, 2010; Usman, 2016). Okendu (2012) asserts that human and material resources are the most important within the educational environment to ensure effective teaching and learning.

In this study, the focus was on teacher training, professional development and teachers' planning (which includes the use of time, documents, policies and textbooks). However, all three resources were integrated into other sections of this chapter. Human resources have been explained in terms of teacher training (section 2.4.1.4 *Lack of Resources*) and teachers' PCK and SMK in section 2.4.1.1 *Pedagogical Content Knowledge and Subject Matter Knowledge*. Mathematical material resources focused on teachers' poor understanding of policy (see section 2.4.1.2 *Poor Understanding of Policy*) and their lack of knowledge on how to implement these policies (see section 2.4.1.3 *Lack of Understanding on How to Implement the Policy*). The researcher acknowledges that dyscalculia often coexists with language acquisition (Andersson & Lyxell, 2007), therefore, this study focused on second language acquisition and time. The term "first language" refers to the first language that a child is exposed to that generally occurs without direct instruction and children are described as having an "innate predisposition" to acquire this language (Yule, 2006:149). Yule (2006) further proposes that there is a difference in the First Additional Language (FAL) and foreign language learning. For this study, the term 'FAL' is used to indicate a second language that a child wishes to or must master and that is spoken in the immediate community (Yule, 2006; Byers-Heinlein & Lew-Williams, 2013).

2.4.1.5 Lack of Support for Teachers

Most of the studies conducted in a South African context reveal that teacher support is careless, irrelevant and lacks successful implementation (Mashau, Steyn, Van der Walt & Wolhunter, 2008; Mahlo, 2011; De Clercq & Phiri, 2013; Nkambule & Amsterdam, 2018). This is the same position held in a study conducted more than two

decades ago by Jansen (1998:6) who stated that teacher support in South Africa is “uneven, fragmented, and, for many teachers, simply non-existing”. Shockingly, in recent literature, this statement is resonated by Van der Berg *et al.* (2016:26) who stated that in the majority of the current public education system “teacher support is far from adequate”. In a study conducted by Nkambule and Amsterdam (2018:8-9), it was recommended that more “curriculum implementers (CIs)” and “heads of departments (HODs)” should be employed, “curriculum workshops” for teachers should be provided during the school break and sustainable teacher support should be emphasised and implemented.

The lack of appropriate support and training has a negative influence on teachers’ knowledge and understanding of the mathematics curriculum. The then Minister of Basic Education, Angie Motshekga (2016) stated that mathematics teaching in South Africa is below standard and that teachers have a poor understanding of the mathematics curriculum. Furthermore, Taylor and Taylor (cited in The State of Literacy Teaching and Teaching in the Foundation Phase [National Education Evaluation & Development Unit, 2013]) showed that the total percentage scores of teachers in the Southern African Consortium for Monitoring Educational Quality (SACMEQ) mathematics test were an unimpressive 52% as seen in Table 2.2:

Table 2.2: Teacher percentage scores on the SACMEQ mathematics test (Taylor & Taylor in the National Education Evaluation & Development Unit, 2013:25)

Mathematical topic					Total
Arithmetic operations	Fractions, ratio and proportion	Algebraic logic	Rate of change	Space and shape	
67,15	49,68	46,51	42,30	56,44	52,39

The National Education Evaluation & Development Unit (2013) further adds that if teachers are unable to deliver the curriculum, then teachers’ knowledge must be strengthened. Furthermore, Cross, Woods and Schweingruber of the National Research Council of the United States (2009) state that FP teachers are not comfortable with the teaching of mathematics. If teachers experience difficulty in teaching the mathematical curriculum, they will lack an understanding of how to support learners with dyscalculia.

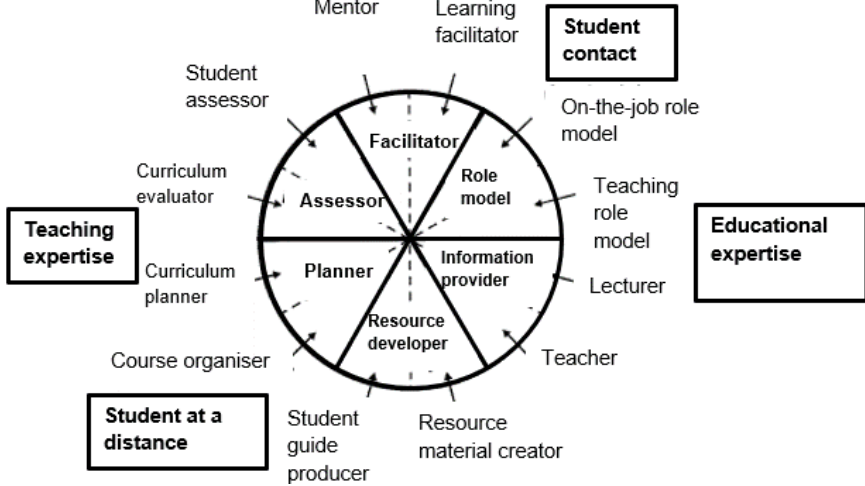
Apart from difficulties with legislation and policies, Feeney (2016) states that teachers sometimes suffer from having mathematical anxiety and that this could inhibit meaningful mathematical teaching. Mathematical anxiety is defined as having a fear of failing in mathematics and when this is experienced, the ability to transfer mathematical knowledge and skills is hampered (Engelbrecht, 2016). Moreover, McCray and Chen (2012), and Crawford (2018) found that teachers' dispositions toward mathematics have a direct impact on learners' learning. Crawford (2018) postulates that teachers have a strong dislike of mathematical teaching due to previous experience and the perception of their competence. Sometimes teachers experience resistance to teach mathematics because they might feel that they experience a lack of theoretical knowledge of mathematics, they experience a lack of support from role-players within the educational environment and lack the necessary time to teach and help students learning mathematics (Savina, 2009; Crawford, 2018).

2.4.1.6 Teachers' Planning

Teachers' planning is vital in addressing difficulties that learners might experience in mathematics (Superfine, 2008). Superfine (2008) furthermore, states that planning encapsulates the preparation and design of learning activities. Teachers' planning could be negatively affected by their feelings toward a subject and if teachers connect negative thoughts to mathematics it could limit their approach to successful planning (Edgington, 2004). Teachers should realise that planning and assessment are interrelated concepts and need to keep records of how learners receive the curriculum, to illuminate possible difficulties (Edgington, 2004).

Edgington (2004), furthermore, proposes that teachers need to consider the following when they plan for mathematical teaching and learning. Firstly, their intentions for learners' learning; secondly, they need to consider resources, equipment and their experiences; and lastly, they need to understand their role as a teacher. In Table 2.3, the three concepts mentioned in the previous sentence will be explained:

Table 2.3: Concepts that should be considered when teachers plan for teaching (Edgington, 2004)

<p>Teachers' intentions for learners' learning</p>	<p>CAPS proposes that FP teachers teaching mathematics should ensure that learners build specific aims and skills (DBE, 2011a). These include but are not limited to:</p> <ul style="list-style-type: none"> • Building awareness of how mathematics can be applied in different environments, such as environmental and economic contexts. • Developing an awareness of the correct mathematical language usage. • Developing a sense of number, which includes vocabulary, concept, calculation and application skills.
<p>Resources, equipment and experiences</p>	<p>CAPS recommends that the following examples of resources and equipment should be available in an FP class (DBE, 2011a):</p> <ul style="list-style-type: none"> • Objects for counting. • Number grid posters. • Play money. • Modelling clay. • Different shapes of different sizes. • Mathematical games. • A calendar for the current year. • A large wall clock (analogue). • Building blocks.
<p>Role of teacher</p>	<p>Harden and Crosby (2000) identified twelve roles of a teacher. The following figure identifies the six main roles of a teacher (Figure 2.5).</p>  <p>Figure 2.5: The twelve roles of a teacher (Harden & Crosby, 2000:336)</p>

In the next section, the six main roles as seen in Figure 2.5 above, are explained:

1. The teacher as facilitator

In this role, it is required that the teacher should possess a thorough knowledge of learners' development; be a keen observer of learners' learning; create safe, caring and suitable learning environments; and develop learners' emotional and social competence (Jalongo & Isenberg, 2012).

2. The teacher as a role model (the teacher as coach)

In this role, the teacher promotes the learning processes of learners. It includes portraying qualities such as being generous, lenient, passionate, approachable, inspirational, strict but respectful, accommodating but not controlling, and being without judgement or prejudice (Lunenberg, Dengerink & Korthagen, 2014:44). This role is further explained by Jalongo and Isenberg (2012) who state that this role promotes learners' development.

3. The teacher as an information provider

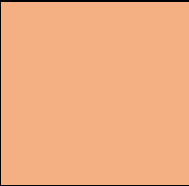
According to Harden and Crosby (2000), this either refers to lecturers or teachers. The lecturer role is taken on by teachers when they become teacher educators, which is very different from just being a primary or high school teacher (Lunenberg *et al.*, 2014). Nonetheless, this role will not be explored further since the main goal of the researcher is to identify the roles of Grade 3 teachers. Harden and Crosby (2000) explain the role of a teacher as an information provider as the context in which transmission as a teaching method is used that is relevant to the teaching of mathematics in this study.

4. The teacher as a resource developer

The teacher should plan for learners' different needs and abilities; the content applicable to the environment and age of the learners; a variety of experiences and activities that cater for a diverse group of learners; appropriate assessment should be planned; and planning should also include times of reflection (Jalongo & Isenberg, 2012).

5. The teacher as a planner

This is a specific professional role in which the teacher should plan the curriculum according to learners' development; the content of the curriculum; appropriate teaching strategies; diverse groups; and personal experiences of content and pedagogy (Jalongo & Isenberg, 2012).



6. The teacher as assessor

Harden and Crosby (2000) state that this role identifies a teacher's responsibility to plan and implement different educational programmes, to assess learners' learning and to assess the curriculum.

2.5 CONCEPTUAL BACKGROUND

In the following section, the causes of poor mathematical skills and comprehension, the identification of these skills and comprehension and strategies to support teachers with specific reference to dyscalculia as an MLD were discussed.

2.5.1 Causes of Poor Mathematical Skills and Comprehension

Research by various academics (Geary, 2011; Namkung & Fuchs, 2012; Jameel & Ali, 2016; Trusz, 2018) indicate that an immense amount of investigation has been conducted regarding the cause of poor mathematical skills and comprehension of these skills and knowledge associated with mathematics. This research includes the assessment of general skills such as working memory (Andersson & Lyxell, 2007) and intelligence (Maehler & Schuchardt, 2009). Working memory, as defined by Gathercole and Alloway (2004:2), is explained as a term that is used to describe the ability to “hold and manipulate” information in our minds for short periods. A study, conducted by Maehler and Schuchardt (2009) and Geary (2010), found that one of the main causes of poor mathematical skills and comprehension could be due to poor working memory.

Nevertheless, Geary (2010) further stated that a person cannot confirm that it is one or another reason and that research in this field is an ongoing process. The main aim of these studies is to establish whether there are specific cognitive deficits that are associated with dyscalculia. Nevertheless, Westwood (2004); Maehler and Schuchardt (2009); and, Petchimuthu, Sharma, Gaur and Kumar (2018) are among a few that affirm that learners with LD should not necessarily be associated with a low intelligence level. For this reason, teachers should receive proper and sufficient support and training to be able to successfully facilitate the learning process of learners that experience dyscalculia without labelling these learners as incompetent.

2.5.1.1 Mathematical Anxiety

A commonly cited author of mathematical anxiety is Mark Ashcraft (2002:181) who states that mathematical anxiety is “a feeling of tension, apprehension or fear that interferes with math performance”. Ashcraft (2002); Opheim (2013); and, Ramirez,

Hooper, Kersting, Ferguson and Yeager (2018) affirm that teachers can be an influential factor in learners' mathematical anxiety. Suárez-Pellicioni, Núñez-Peña and Colomé (2013) affirm that there is a negative correlation between mathematical achievement and mathematical anxiety which is now considered a social difficulty that requires intervention and support. Emerson and Babbie (2015) and Cropp (2017) continue by stating that mathematical anxiety could influence the development of dyscalculia. The previous statement is concurred by Bogdanova, Ginku, Bogdanova, Zueva, Malanchini and Kovas (2014), who also add that mathematical anxiety is linked to DD. However, Hornigold (2015) and Bornman and Rose (2017) argue with the latter by stating that DD is when a learner experiences difficulty in mathematics that originates from an impaired skill to obtain mathematical mastery, whilst pseudo dyscalculia is associated with mathematical anxiety which is caused by negative external factors such as inadequate teaching. For this study, DD encapsulates both these viewpoints.

2.5.1.2 External and Internal Barriers that Influence Mathematical Development

A growing number of South African learners are experiencing challenges in acquiring and applying mathematics. Learners can either experience extrinsic or intrinsic barriers to learning. If intrinsic barriers are understood and identified, extrinsic barriers can be minimised so that the existing barrier is not intensified (Engelbrecht, 2016). These barriers that learners can experience in the FP have been summarised in Figure 2.6:

Barriers that learners can experience in mathematics	
INTRINSIC	EXTRINSIC
<ul style="list-style-type: none"> • Memory loss • Difficulty to grasp ideas • Difficulty to solve mathematical problems • Difficulty to apply new knowledge to knowledge that is already known • Barriers in reading and language that influence mathematical problem solving • Barriers to orally express themselves • Barriers in written work • “Physical-sensory and/or psychosocial barriers” • Dyscalculia • “Right-brain hemisphere dominance” • Giftedness 	<p><u>Situations the teacher has control over:</u></p> <ul style="list-style-type: none"> • Inadequate knowledge of skills and concepts in mathematics • Inadequate passion and dedication to the field of mathematics • Inadequate understanding of why and how learners learn • Inappropriate teaching strategies • Failure to implement diversity • Absenteeism of teachers • Failure to show sensitivity to learners’ barriers • Failure to provide learners with extended opportunities that need it • Failure to provide learners with opportunities for reinstructing concepts and skills • Lack of interest • Failure to inspire and include learners • Too many formal evaluations • Failure to link mathematics to real-life situations <p><u>Situations the teacher has no control over:</u></p> <ul style="list-style-type: none"> • Constant changes in mathematics teachers • Poor teaching of mathematics teachers in prior grades or phases in school • No access to the LoLT • Constant absenteeism of learners • Learners frequently changing schools • Inadequate teacher and learning resources

Figure 2.6: Barriers that learners can experience in mathematics (Engelbrecht, 2016:289-301)

2.5.1.3 Language Barriers

Mathematics as a discipline has a specific mathematical register required for meaning-making and communication (Herbel-Eisenmann, Johnson, Otten, Cirillo & Steele, 2014). Learners’ proficiency in the mathematical register influences their mathematical proficiency (Riccomini, Smith, Hughes & Fries, 2015). This register includes “symbols, pictures, words and numbers” (Meiers & Trevitt, 2010:5). Mathematics is furthermore dependent on language for meaning-making (Schleppegrell, 2007; De Oliveira, 2011; Van de Walle *et al.*, 2016). In South Africa, there are eleven official languages and many different cultures as indicated by the GCIS (2017/8). The GCIS further states that, according to 2018 statistics, the most commonly spoken home language is isiZulu, followed by Afrikaans and then Sepedi. Naudé and Meier (2014) state that one of the main challenges of schools in South

Africa with the rich cultural diaspora is to support learners from these diverse backgrounds who have little proficiency in the LoLT. Klein, Bahnmueller, Mann, Pixner, Kaufmann, Nuerk, Wilcox and Heine (2013) think that learners' competency in language affects their performance in mathematics. Research indicates that children as young as two years old display an interest in their own culture and mother tongue as opposed to other languages and cultures (Arriaga-Sanz, Riaño-Galán, Cabedo-Mas & Berbel-Gómez, 2017).

Many learners attend schools where they have little understanding of the LoLT (Machaba, 2013; Mackay, 2014). According to Mackay (2014), the lack of teachers that can teach learners in their home language is one of the biggest challenges in South Africa. Therefore, learners are taught in an additional language which creates significant challenges (Mackay, 2014; Truxaw & Rojas, 2014). These include but are not limited to challenges experienced in acquiring academic language, asking meaningful questions, reasoning in a second language and personal feelings of worthlessness (Mackay, 2014; Truxaw & Rojas, 2014).

Some learners experience mathematics as "tedious, complicated, challenging or hard" due to various reasons, which include a lack of self-efficacy (Almerino *et al.*, 2019:482). The true reason behind learners' negative disposition towards mathematics is still unknown and requires more research (Almerino *et al.*, 2019). However, Ignacio, Nieto and Barona (2006) state that reasons could also include anxiety, rejection towards the subject, low achievement scores and low expectations of success. Ghazvini (2011) states that how learners perceive themselves has a substantial impact on their achievement. Therefore, when learners experience feelings of low self-efficacy, it affects their self-esteem. Self-esteem promotes the development of how people view their levels of competency and the value of their communities (Machaba, 2013; Mruk, 2013). Yilmaz, Altun and Olkun (2010); and Machaba (2013) further add that when learners perform poorly in mathematics, they do not receive the same praise as their peers who achieve higher marks. This has a negative effect on their self-esteem and they begin to perceive themselves as being incapable of doing mathematics (Yilmaz *et al.*, 2010; Machaba, 2013).

2.5.2 Strategies to Support Teachers to Help Learners Experiencing Dyscalculia

The researcher proposes that the following strategies could support teachers to help learners experiencing dyscalculia:

2.5.2.1 Exploring Differentiated Instruction to Foster Mathematical Teaching

The DBE (2011a) and Van de Walle *et al.* (2016) believe that every classroom has learners who have different abilities and come from different backgrounds, therefore, teachers have the imperative task to plan appropriate lessons and teach these learners, so that all these learners receive sufficient support and are challenged intellectually. Differentiated instruction is defined by The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2001); Engelbrecht (2016); and, Van de Walle *et al.* (2016) as strategies implemented by teachers to support all learners in a classroom that have these different abilities, needs, learning styles and come from different backgrounds. According to DBE (2011a), UNESCO (2001) and Engelbrecht (2016), this means that teachers should modify, change, adapt, vary, and extend teaching methodologies, teaching strategies, assessment strategies and the content of the curriculum according to the ability levels of learners in a class. However, UNESCO (2001) further states that differentiated teaching is viewed by some teachers as challenging because they lack the skills and knowledge to implement it.

2.5.2.2 Exploring Peer Teaching and Learning to Foster Mathematical Teaching

Peer teaching and learning are defined by Secomb (2006:703) as “a collaborative and co-operative teaching and learning strategy; learners are active equal partners, students are self-directed, share in interventions and actively participate in discussions and feedback”. From this definition, this study will define peer teaching and learning as a way for learners to become active participants within collaborative pairs to communicate and share a common goal. Peer teaching and learning is regarded as an effective and successful educational intervention (Secomb, 2006; Wang, 2016) and could be useful to support learners with dyscalculia (Fuchs *et al.*, 2002).

Teachers should promote and encourage opportunities for social interaction in educational environments so that learners can benefit and build on shared views (Freeman, 2010; Wang, 2014). More skilled learners are, therefore, able to support the learners that experience dyscalculia until they have mastered the necessary skills or understanding (Van de Walle *et al.*, 2016). Peer teaching and learning is, therefore, embedded in Vygotsky's sociocultural theory and can be used as a construct of Vygotsky's theory, namely, scaffolding (See section 2.2.1 *The Concerns-Based Model of Teacher Development as Part of a Conceptual Framework*).

2.5.2.3 Exploring Small Group Teaching to Foster Mathematical Teaching

Mills and Alexander (2013) and Engelbrecht (2016) promote the use of small group teaching by stating that learners will gain a deeper conceptual understanding of mathematics and build collaboration skills. Furthermore, it ensures that the maximum number of learners learn, increases their engagement, it improves their self-worth and promotes motivation (Engelbrecht, 2016).

2.5.2.4 Exploring Individual Teaching to Foster Mathematical Teaching

Individual teaching is explained as teaching that is teacher-led in a highly structured environment (Van de Walle *et al.*, 2016). Individual teaching focuses on decisions made during the mathematical problem-solving process so that learners can connect new knowledge with things they already know (Van de Walle *et al.*, 2016). Karp and Howell (2004 cited in Charlesworth & Lind, 2013) emphasise the importance of individualised teaching for learners who experience barriers to learning.

Van de Walle *et al.* (2016:133) proposes the following seven steps when using individualised teaching (Figure 2.7):

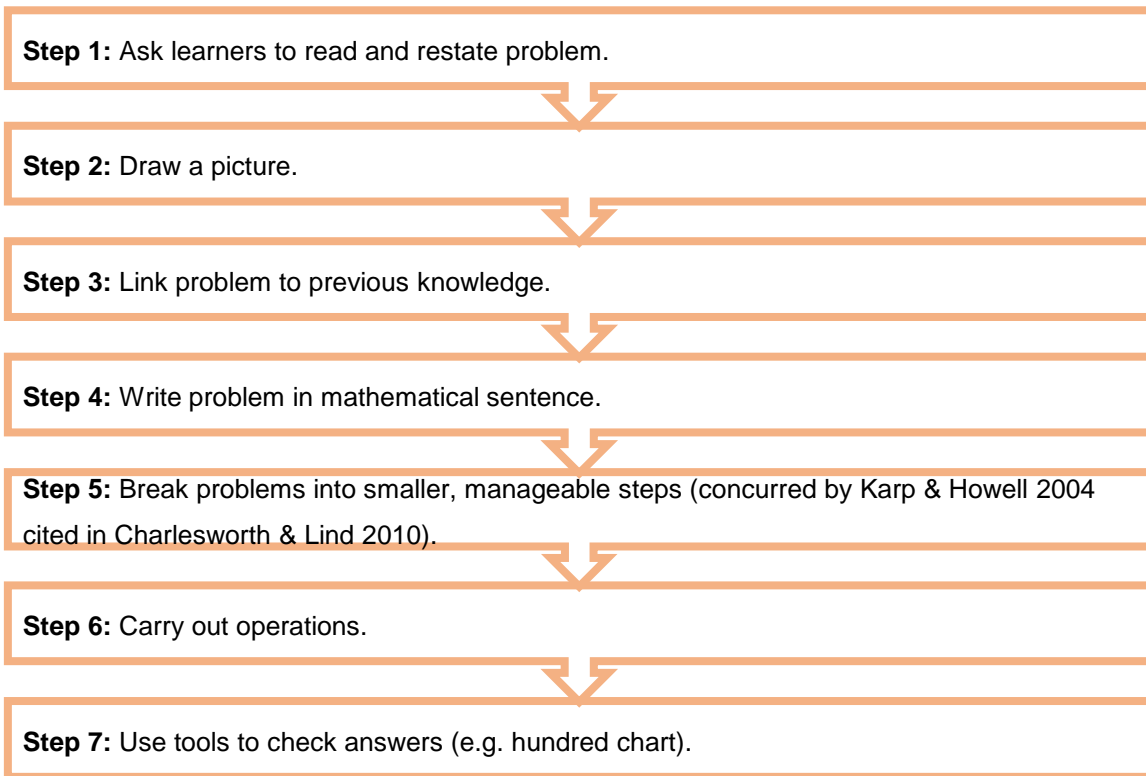


Figure 2.7: Steps to implement when using individualised teaching (Adapted from Van de Walle, 2016:133)

As seen above, seven steps are used to implement individualised teaching as proposed by Van de Walle (2016). The learners are first asked to read and restate the mathematical problem to ensure that they know what is expected of them. Next, the learners draw the problem visually to promote independent thinking. The knowledge or skills required is, furthermore, linked to previous knowledge or skills to write the problem in a mathematical sentence. Moreover, the sentence is then divided into smaller and more manageable steps and the operations are then carried out. Lastly, learners are required to test their answers by making use of different tools.

These seven steps are prompts and questions to ask learners that will guide and structure their entire learning process from start to finish. The teacher is expected to model these steps to the learners and should use terminology that the learner can understand (Van de Walle, 2016).

These seven steps are integrated into the following activity that was taken from Mathematics in English – Grade 3 Book 2 (DBE, 2019:79). These books are used to improve learners’ performance (DBE, 2019).

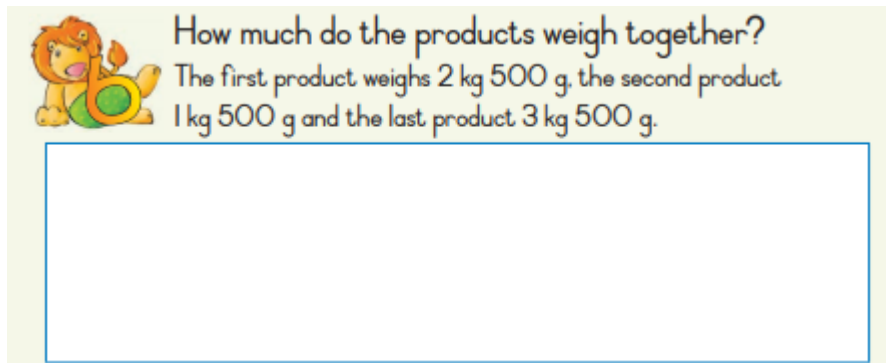


Figure 2.8: Question is taken from the DBE Thutong Mathematics in English book 2 (2019:79)

By implementing the above-mentioned seven steps in the mathematical question (Figure 2.8), the following can be done:

Step 1: Learners are asked to reread the question.



Step 3: This specific question is the very last question after seven preceding questions (DBE, 2019:78-79). This will, therefore, enable the learners to draw on previous knowledge to answer this specific question.

Step 4: $2 \text{ kg } 500 \text{ g} + 1 \text{ kg } 500 \text{ g} + 3 \text{ kg } 500 \text{ g} =$

Step 5:

$2 \text{ kg} + 1 \text{ kg} + 3 \text{ kg} =$ $500 \text{ g} + 500 \text{ g} + 500 \text{ g} =$ Therefore, the answer is ...	OR	$2 \text{ kg } 500 \text{ g}$ $+ 1 \text{ kg } 500 \text{ g}$ $+ 3 \text{ kg } 500 \text{ g}$ <hr style="width: 100%;"/> $=$
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Step 6:

$2 \text{ kg} + 1 \text{ kg} + 3 \text{ kg} = 6 \text{ kg}$	OR	$2 \text{ kg } 500 \text{ g}$
$500 \text{ g} + 500 \text{ g} + 500 \text{ g} = 1500 \text{ g}$		$+ 1 \text{ kg } 500 \text{ g}$
Therefore, the answer is 7 kg 500 g		$+ 3 \text{ kg } 500 \text{ g}$
		<hr/>
		$= 7 \text{ kg } 500 \text{ g}$

Step 7: Counters can be used, for example, big red counters can indicate kilograms and smaller blue counters can be used to indicate grams. The teacher will then have to ensure that the learner understands that two blue counters are equal to one red counter.

2.5.2.5 Exploring Games to Foster Mathematical Teaching

Shih and Su (2008) think that games are one of the most authentic ways in which knowledge and skills can be mastered. Games motivate learning, promote participation and enhance self-learning and problem-solving skills (Shih & Su, 2008). Talak-Tiryk (2010) and Nel, Engelbrecht, Swanepoel and Hugo (2017) contribute by stating that games also promote interaction and language development.

Martinson and Chu (2008) and Talak-Kiryk (2010) further add that playing games enable learners to think of strategies, consider substitutions and it also encourages their flexible thinking. Games also: promote creativity; individuality and higher-order thinking; make use of various intelligence such as reasoning, communication and visual stimulation; and promote reiteration, reinforcement, memorising and transferring (Talak-Kiryk, 2010). For these reasons, the use of games could be successfully implemented to support teachers to help learners experiencing dyscalculia.

2.5.2.6 Exploring Media to Foster Mathematical Teaching

For this study, media refers to different technologies used to promote the comprehension of mathematical content. These technologies, according to Van de Walle *et al.* (2016:15), refer to mathematical content accessed through “computers, calculators, and other handheld or tablet devices, computer algebra systems, online

digital games, internet-based resources, recording devices, interactive presentation devices, and spreadsheets". The Common Core State Standards Initiative for Mathematical Practice (2010) promotes the use of appropriate technological tools. Furthermore, the use of technology should form an imperative part of the tools used to support learners' acquisition of mathematical content and skills (Engelbrecht, 2016; Van de Walle *et al.*, 2016). Charlesworth and Lind (2013) and Engelbrecht (2016) believe that technological tools have endless patience and create an interactive learning environment, which will promote learners' learning. Moreover, in a study conducted by Adebisi, Liman and Longpoe (2015), the authors found that assistive technologies support the learning of children with LD.

2.5.2.7 Exploring Lesson Study to Foster Mathematical Teaching

The following statement by Booth and Coles (2017:14) plays an imperative role in this section:

"Rather than becoming overwhelmed with our sense of inadequacy, we need to be supported by the mentoring of strong colleagues and the professional development opportunities available in school, in our district, in books and journals, and in online communities".

The researcher proposes that lesson study (which is highlighted in the previous quote) should be implemented as a programme to support teachers so that they can successfully support learners experiencing dyscalculia, which could be an effective way to prepare teachers. Rock and Wilson (2005) define lesson study as regular meetings held between teachers to discuss the plan, execution, assessment and enhancement of a specific classroom lesson, which would be mathematical in this study. Therefore, lesson study is a way of mentoring teachers through discussions by experienced and novice teachers, it could also be implemented as professional development opportunities.

According to Stigler and Hiebert (1999 cited in Rock & Wilson, 2005), Japan has the most skilled and focused teachers because they make use of lesson study. Furthermore, the authors are of the opinion that eight steps need to be followed to implement lesson study successfully. These steps are integrated into the context of supporting learners experiencing dyscalculia: determining the barriers learners with

dyscalculia experience; planning appropriate lessons to support these learners; teaching and observing this lesson; assessing the lesson outcome and its result; reviewing this lesson; teaching and observing the reviewed lesson; reviewing again; and discussing the outcome.

2.5.3 Effective Mathematical Facilitators

Research has been conducted to inform mathematical facilitators what they can do or what needs to be done to ensure effective mathematics facilitation takes place (Elliot, Kazemi, Lesseig, Mumme, Carroll & Kelley-Petersen, 2009). One of the most important key factors of being an effective mathematical facilitator is to ensure that your teaching approach is learner-centred (Protheroe, 2007; Ono, Stols & Ragan, 2015). When teaching approaches are learner-centred it means that teachers view learning as something that is socially constructed and shifts the importance of learning to learners through promoting their learning and independent problem-solving (Sadler, 2012). This closely linked to the conceptual underpinning of Vygotsky, as discussed in section 2.2.1 *The Concerns-Based Model of Teacher Development as Part of a Conceptual Framework*.

CAPS (DBE, 2011a) does not necessarily focus on how mathematics should be taught but highlights the importance of the content that should be covered in Grade 3. Nevertheless, the general and specific aims of CAPS imply that teaching approaches are learner-centred (Stols *et al.*, 2015).

The following features of mathematic lessons are described as being key components to ensure successful learning (Lovitt & Clarke, 2011):

- Content containing various important mathematical topics is covered.
- Learner participation is encouraged.
- Different abilities are considered to ensure all children can learn.
- Various methods or approaches are implemented.
- Learning is learner-centred.
- Learners feel a sense of ownership.
- Mathematics should enable learners to make sense of the world.
- Technology is used effectively and appropriately.

- Learners should be able to draw connections between the concepts they acquire.
- Important mathematical aspects should be highlighted.
- Learner support should be identified.

In a study conducted by Stols *et al.* (2015), the researchers found that teachers are more prone to provide comments about positive aspects of lessons they present than to find fault. Ono and Ferreira (2010), therefore, recommend that lesson study should be practiced by teachers to ensure that teachers can reflect adequately and successfully. Furthermore, teachers' reflections should encapsulate their perceptions and the classroom environment, which will ensure that the reflection focuses on more than one perspective (Stols *et al.*, 2015).

2.6 SUMMARY

In this chapter, literature on strengthening teacher support to learners experiencing dyscalculia was explored in-depth. The contextual, conceptual and theoretical backgrounds were investigated to ensure a comprehensive understanding was gained. The theoretical background comprised of Vygotsky's zone of proximal development (ZPD) and Fuller's CBMoTD. These two theories were used to indicate the reason behind investigating certain aspects and topics of literature and led to the development of a conceptual framework. A few policies were used to provide a contextual background of the study as well as research pertaining to teacher training; teachers' PCK and SMK; teachers' understanding of policy; resources; and teacher support. This chapter also highlighted the causes and identification of poor mathematical skills and comprehension. Strategies to support teachers to help learners experiencing dyscalculia were also explored.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

In Chapter 2, an in-depth literature review was conducted of issues relating to the strengthening of teacher support to learners experiencing dyscalculia in Grade 3. Factors affecting the strengthening of teacher support to learners experiencing dyscalculia in Grade 3 were highlighted and further recognised that teacher support could be strengthened by identifying various strategies. The chapter, furthermore, focused on how the ZPD and the CBMoTD as conceptual underpinnings can promote teacher development and be implemented in order to support learners experiencing dyscalculia.

Chapter 3 focuses on the research methodology and design that was implemented to guide and support the data generation process with Grade 3 teachers and to establish a trustworthy evidence base for this study on strengthening teacher support to learners experiencing dyscalculia. Case study research was implemented as a research design and provided an overview of how the study was conducted. Specific research methods for data generation as well as analysis techniques are highlighted. Lastly, careful attention was given to adhere to ethical considerations and to ensure the researcher upholds the integrity of the study, which includes credibility and trustworthiness.

3.2 RESEARCH METHODOLOGY

The methodology is defined as “underlying principles of inquiry” and methods are explained as the specific procedures implemented to generate and analyse data (Wolcott, 2009:89). Hays and Singh (2012) further mention that methodology includes aspects related to the selection of a paradigm, the research questions, and suitable data generation approaches. Brundrett and Rhodes (2013) emphasise the importance of understanding the difference between methodology and methods as the definitions are often used interchangeably in research. It is, therefore, evident that an interpretive methodology guided this study and the methods to generate data were employed through interviews, observations and document analysis.

The methodology for this study is grounded in qualitative and interpretive research. The selection of the methodology was grounded in the researcher's understanding that the participants will provide information from their experienced views, encounters and perceptions in a subjective way (Brundrett & Rhodes, 2013). These views, encounters and perceptions are constructs of interpretive methodologies (Staller, 2010; Cooper & White, 2012). Brundrett and Rhodes (2013) postulate that an interpretivism is an approach that focuses on the subjective views of the participants that yield detailed descriptions.

This was applicable in the context of the study as the researcher was interested in obtaining the subjective views, experiences and interpretations of Grade 3 teachers. For this reason, the researcher conducted an in-depth literature study to identify what the quality of mathematics teaching is in classrooms. This was implemented through identifying which support structures were in place for teachers at the time by understanding how teachers perceive and experience it in their classrooms.

3.2.1 Research Sites and Participants

This section encapsulates the research site and the steps taken to select participants for this study.

3.2.1.1 Research Site

The research site in this study is of critical importance because the study will focus on strengthening teacher support to learners experiencing dyscalculia. Teacher support should be implemented within a school environment. Staller (2010) recognises that schools are part of qualitative inquiry since the participants can be observed from a natural environment. Teachers are responsible to support learners regardless of their differences, to ensure that teaching, learning and assessment are meaningful and promote learner success. Therefore, the research sites chosen for this study were schools in the Tshwane South district in Gauteng.

3.2.1.2 The Selection of Participants

Persuad (2010) provides a noteworthy definition of participants, by indicating that participants are individuals that are selected or that volunteer to participate in a specific research study. The participants for this study were practicing Grade 3, mathematics

teachers. Participants' contributions in this study were determined through non-probability sampling. Non-probability sampling means that the participants will not be selected randomly (Gobo, 2004; Persuad, 2010) and that the researcher will intentionally select the participants by implementing inclusion and exclusion criteria (Daniel, 2012). However, the participants were provided with adequate information regarding the aims and rationale of the study to enable them to provide informed consent without feeling coerced. Brundrett and Rhodes (2013) further state that nonprobability sampling involves samples that are easily accessible to the researcher but cannot be used to represent an entire population, and, therefore, is not generalisable.

Purposive sampling is a type of nonprobability sampling that was applied in this study. This type of sampling focuses on choosing participants through criteria that are relevant to the purpose of the study (Daniel, 2012). The sampling criteria for this study are discussed in the next section (section 3.3.1.3 *Sampling Criteria for Participants*). Moreover, purposive sampling is encapsulated in five steps that need to be taken to select the participants (Daniel, 2012). In Figure 3.2, the five steps are represented:

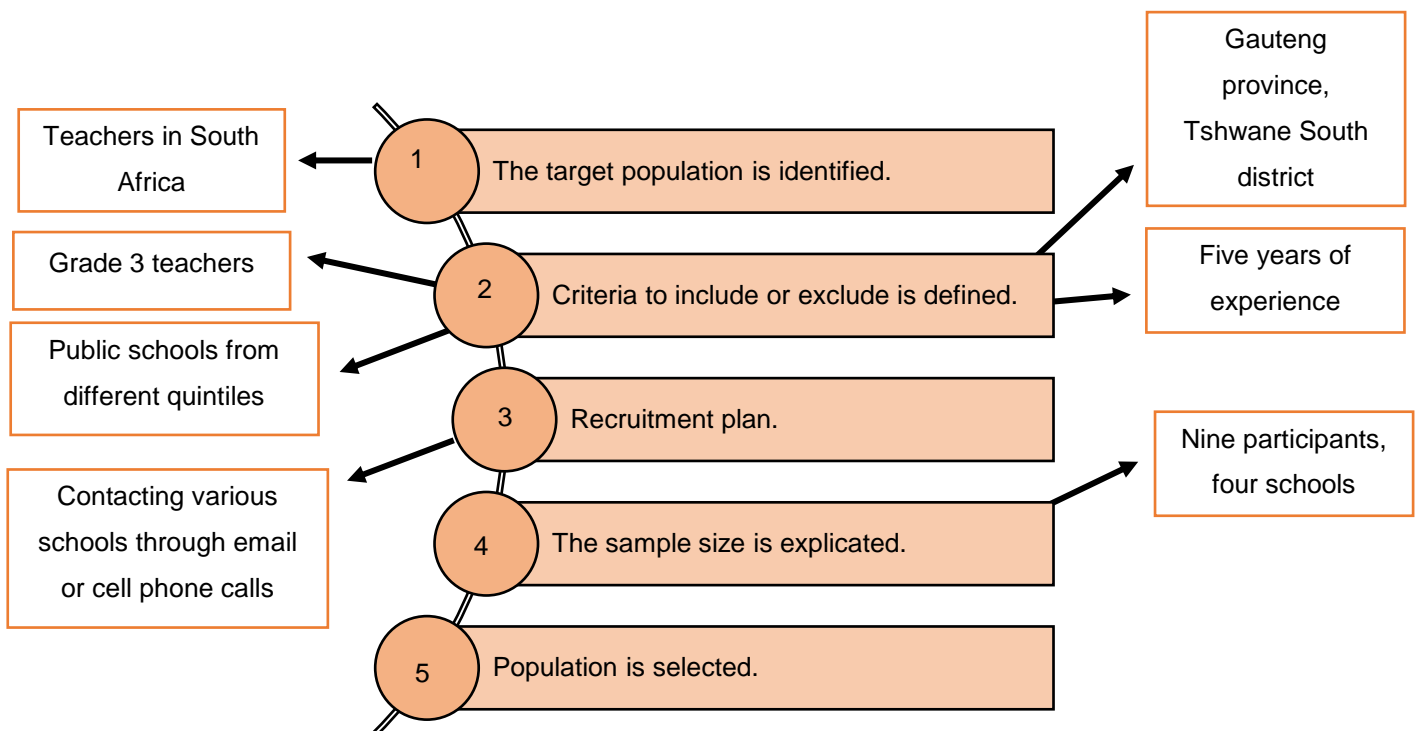


Figure 3.2: Five steps that need to be adhered to when selecting stratified purposive samples (Adapted from Daniel, 2012:7)

As seen in Figure 3.2 above, these five steps need to be applied when purposive sampling is applied. Within the context of this study, the steps can be integrated to provide a detailed picture of the thought processes of the researcher's methods.

The target population was teachers in South Africa. The inclusion criteria were implemented to reduce the size of the target population. The criteria stated that teachers must be practicing Grade 3 teachers with at least five years' teaching experience in the Tshwane South district from any quintile school. Different quintile schools in the Tshwane South District were contacted via email or cell phone calls and the principal of the school was contacted to get permission to approach the teachers who were to take part in the study. If the principal agreed, the rest of the inclusion criteria had to be met. A total of nine participants was identified for this study, and as soon as the researcher had identified and selected nine participants, the data generation process commenced. Nine participants were chosen to see how teacher support was implemented and affected the learning of learners experiencing dyscalculia.

3.2.1.3 Sampling Criteria for Participants

All participants that were selected for this study were practicing Grade 3 teachers teaching mathematics.

The following pre-selected criteria supported the selection of teachers:

- All teachers must have taught Grade 3 mathematics for at least five years.
- All teachers must be familiar with the Grade 3 Mathematics CAPS document.
- All teachers must know of the existence of dyscalculia.
- There must be learners experiencing dyscalculia or dyscalculia in the chosen teacher's class.
- Teachers must agree and give consent to participate in the study.

3.2.1.4 Sampling Criteria for Schools

Selecting schools should be as important as selecting participants to ensure a purposive sample, as postulated by Maree (2016). The following criteria supported the criteria for identifying participating schools:

- Schools within the Tshwane South district were selected.
- Public schools from any quintile were invited to participate.

- The principals of the selected schools were approached to take part and agreed that research could be conducted in their schools.

A purposive sample of nine teachers from Grade 3 from four different schools was selected. These teachers formed part of a homogenous sample that was teaching mathematics to Grade 3 learners at the time of the data generation. These teachers had to have at least five years' experience in teaching which implied that they should be knowledgeable on the content material of mathematics. The selection of different schools was implemented to research whether it played a role in teacher support, teacher knowledge or strategies that teachers use to support learners with dyscalculia.

It was important for the researcher to conduct individual interviews and observations to see how individuals specifically implement support in the mathematics curriculum content. Participants who felt reluctant to provide their views and opinions on dyscalculia and how to support learners with this were not judged and were comforted by the researcher that upheld anonymity and confidentiality. Having had participants in this intimate and secluded environment where research questions were structured to investigate specific information, supported them to gain confidence and express concerns and challenges that they might be experiencing.

3.3 AN INTERPRETIVIST PARADIGM

Research is guided by foundations to interpret the world; we call these paradigms (Cooper & White, 2012). Cooper and White (2012:15) further state that paradigms can be defined as being "a set of logically related assumptions, concepts, or principles that tend to guide our thinking and the important assumptions that we have about how the world functions".

Paradigms are influenced by their epistemological assumptions which mean each paradigm strengthens different versions of reality or knowledge within a particular research approach (Scotland, 2012). In qualitative research, epistemology refers to the degree to which it is believed that knowledge will emanate from the research process (Hays & Singh, 2012). Staller (2010) further adds that epistemology is used to initiate discussions about how we perceive the world.

An interpretivist paradigm was used in this research study to analyse how teachers perceive and experience the world (Liamputtong, 2010; Chilisa & Kawulich, 2012; Nieuwenhuis, 2016a). Willis (2007) and Thanh and Thanh (2015) state that an interpretivist paradigm accommodates various beliefs and versions of truths, tries to comprehend a specific context and affirms that reality is socially constructed. Furthermore, Mack (2010) adds that since interpretivism is socially constructed, it is not observed objectively from the outside but rather from within the teachers' own experiences.

For this reason, the participants in this study were practicing Grade 3 teachers. These teachers were able to provide information from their own experiences on how dyscalculia was addressed in schools at that time and the challenges they experience by supporting learners experiencing LD. Sceptics believe that since interpretivism is subjective, there were no stable grounds for judgement, however, a strength of this approach is that it yields rich and in-depth explorations and descriptions (Nieuwenhuis, 2016a).

Before meaning can be extracted from the previous sentences, it is imperative to understand how a research design is set out. In Figure 3.1, an overview of this chapter is provided to ensure that precise comprehension is acquired:

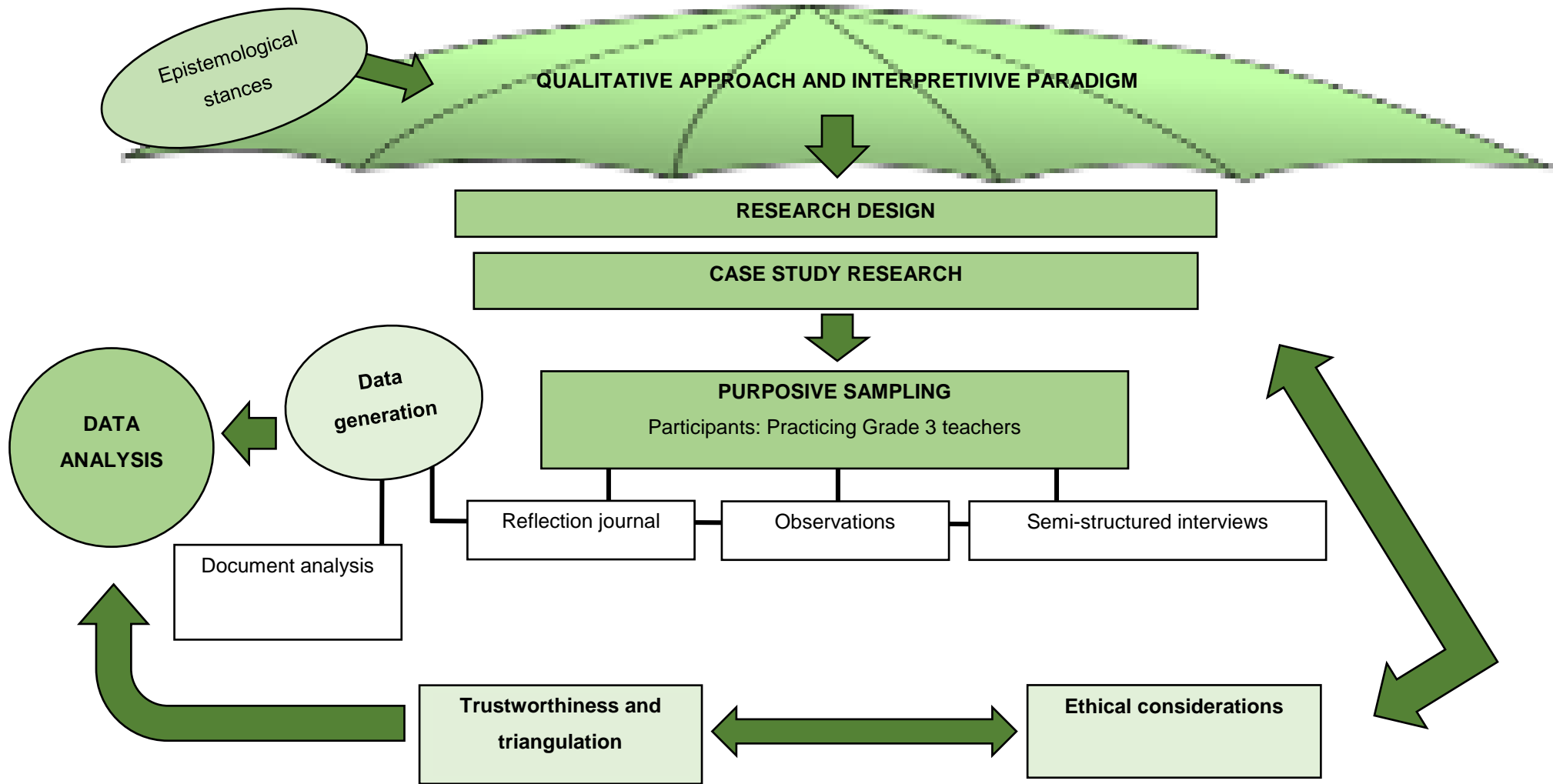


Figure 3.1: A diagrammatical presentation of the research design and methodology used to conduct the study

The diagrammatical presentation as seen in Figure 3.1, will be elaborated upon in the following section. A qualitative approach and an interpretivist paradigm were employed to conduct the study. To ensure successful comprehension, the words 'interpretivist' and 'paradigm' were separated to cultivate a rich and detailed understanding.

- a. Cooper and White (2012) define a **paradigm** as a group of expectations or philosophies that support our thought-processes and how we consider the world to function. The paradigm in this study was informed by interpretive views of the world.
- b. Staller (2010) and Cooper and White (2012:18) provide keywords in which **interpretive** views are explained as interpretations that derive *meaning* from *lived realities* and *shared experiences* that are *authentic* and ultimately wish to gain *understanding*.

To implement an interpretivist paradigm, a case study was used to provide empirical evidence (which refers to non-numerical data) of the indicated research topic. This study allowed the participants, who are Grade 3 teachers, to provide their understanding of mathematical learning difficulties (LD) and how these difficulties affect their teaching. The participants provided feedback on mathematical learning difficulties and how it influences teaching in their classrooms. From their teaching, the participants were able to identify factors that affect the quality of teaching mathematics in Grade 3 and if they make use of any strategies and/or resources to support learners experiencing dyscalculia. The selection of different schools ensured a diversity of school contexts and ensured that the researcher could generate rich data that varied in cultural, contextual and social factors.

3.4 QUALITATIVE RESEARCH APPROACH

Qualitative research is interested in social processes, individuals' meaning-making of the world and how they view the world (Staller, 2010). Hays and Singh (2012) further add that researchers employ qualitative modes of inquiry when they want to yield detailed contextual descriptions. The authors further suggest that this type of inquiry is employed in natural settings, focuses on depth and detail and yields views and experiences from the perspective of the participant. For this reason, the researcher

chose participants that could provide their detailed understanding of dyscalculia and how it affects their teaching.

3.5 RESEARCH DESIGN

A research design informs a study's research plan (Mouton, 2001). Furthermore, it is, defined by DeForge (2010:1253) as "the plan that provides the logical structure that guides the investigator to address research problems and answer research questions". The research problem statement (section 1.4 *Problem Statement*) necessitated the need to research the concerns that were identified. In this study, the severe need for the improvement of mathematical teaching not only in Grade 3 but in the FP, identified the research questions (section 1.6 *Research Questions*) of this study. These research questions influenced the chosen research design (DeForge, 2010).

A research design is further defined as the steps that a researcher takes to organise and plan the research process (Toledo-Pereyra, 2012). The research design of this study was case study research. A case study is a "detailed inquiry into a bounded entity or unit (or entities) in which the researcher examines a relevant issue" (Putney, 2010:116). Flyvbjerg (2004), furthermore, states that case studies are closely linked to real-life situations. Drawing from these views, the researcher chose a case study to investigate the real-world environment of Grade 3 teachers.

Rule and John (2011) and Creswell and Poth (2018) believe that case studies provide detailed insight into a situation that requires investigation. The detailed and systematic insight into the situation is used to generate knowledge from which an argument is built to defend particular views and insights (Rule & John, 2011). Case studies are used to explore issues within a "limited and focused setting" and can be used to relate to other similar cases (Rule & John, 2011:7).

This study followed a qualitative mode of inquiry. Qualitative modes of inquiry focus on the nature of reality that is socially constructed and how meaning can be obtained (Cooper & White, 2012). In the context of this study, the reality of teachers' views and understanding of dyscalculia and how to support learners with dyscalculia were examined to derive meaning. Dyscalculia is an umbrella term used throughout this study for all MLD that learners could experience.

3.6 THE ROLE OF THE RESEARCHER

Brinkmann and Kvale (2008) state that the researcher should uphold moral integrity when conducting research. The authors further state that it might be difficult for a qualitative researcher to maintain objectivity when research is conducted, and thus, moral integrity could be questioned. Simon (2011) further states that the researcher is an instrument in qualitative research since the data is generated by a human. Staller (2010) opines that qualitative inquiry requires the researcher to integrate their values and identities when interpreting data, which influences objectivity. Greenbank (2003) and Smith and Noble (2014) believe that the researcher should remain objective by stating and removing any possible prejudices, expectations or prior experiences that could influence the study by employing reflective methods such as member checking and triangulation. To become an effective qualitative researcher, one needs to construct a picture by considering practice, theory and research from various sources (Simon, 2011).

The researcher engaged with teachers to gain an in-depth understanding of the experiences that the participants are faced with daily. For this reason, the researcher was the primary research instrument and data was generated directly from the selected participants. The relationship between a participant and a researcher should be bound in trust and should ensure that the participants were eager to participate in other research studies, in the future (Ryen, 2004). Hays and Singh (2012) further add that qualitative modes of inquiry are based on the relationships built between the researcher and the participants. The authors continue to state that these relationships should be embedded in empathy and the participant should be seen as the expert. To obtain detailed and rich data, it was important for the researcher to ensure that the participants felt safe and comfortable.

Data were analysed to establish whether common themes could be identified from the findings, to establish a framework that could guide the recommendations and provide strategies to strengthen teacher support to learners experiencing dyscalculia.

The research methods used, informed the researcher on how the engagement with the participants should be sensitively implemented so that honest participation was

assured. The questions were structured to ensure open-ended responses were provided and left enough space that other prompts could support in-depth responses.

The researcher acknowledges that researchers could emphasise their own beliefs when they choose what to research, how to conduct research and how to analyse and interpret the data (Edge & Richards, 1998 cited in Scotland, 2012). Therefore, all interviews and observation notes were either audio-recorded or written out by hand and transcribed electronically so that it could be shared with the participants which are called member-checking, which also ensured that objectivity was maintained. The researcher also employed triangulation to uphold objectivity (See section 3.3.5.2 *Triangulation* for more information).

3.7 DATA GENERATION

Semi-structured interviews, classroom observations and document analysis were used to generate data. Open-ended questions, which were directed by the literature review, were used to guide the interviews with participants but allowed them to explore the questions in-depth (Bergin, 2018). The aim of using the interviews was to experience the world through the lived experiences of each participant (Rapley, 2004; Cooper & White, 2012). Observations were conducted during mathematical lessons and were used to link the interviews to the observations. Document analysis was used to identify gaps or strengthen the information gained from the interviews and observations. The participants all came from different backgrounds and held different predispositions of mathematics, which led to important and worthy views of the current way in which different teachers are supported to address dyscalculia in their classrooms. The researcher searched for specific key words by highlighting the relevant words with a highlighter in the documents that were analysed. The two documents that proved to be the most valuable to the study was the CAPS as well as the planning of the respective schools and or teachers.

The interviews brought diverse experiences and understandings from various classrooms that brought varied views on how to strengthen teacher support to learners experiencing dyscalculia. Before the data generation procedure commenced, the researcher ensured that the outcomes of the procedure were communicated to the participants.

3.7.1 Data Analysis

Qualitative modes of inquiry employ inductive data analysis strategies (Hays & Singh 2012). The purpose of inductive data analysis strategies is explained by Thomas (2006) as the process to condense verbatim data into a summarised version; to identify themes within the research aims and the summarised version; and then to develop an underlying framework that is evident within the verbatim data. The data generated from this study were transcribed and employed as textual data. This research study identified consistent and relevant themes through the interpretations made from the interviews, observations and document analysis (Bergin, 2018).

The reason for employing an inductive approach is because it is an easily applied and methodical set of procedures to ensure reliability and validity (Thomas, 2006). Furthermore, Putney (2010) claims that it may be useful for the researcher to outline the chronological steps taken in data generation and analysis.

Figure 3.3 presents how data was analysed:

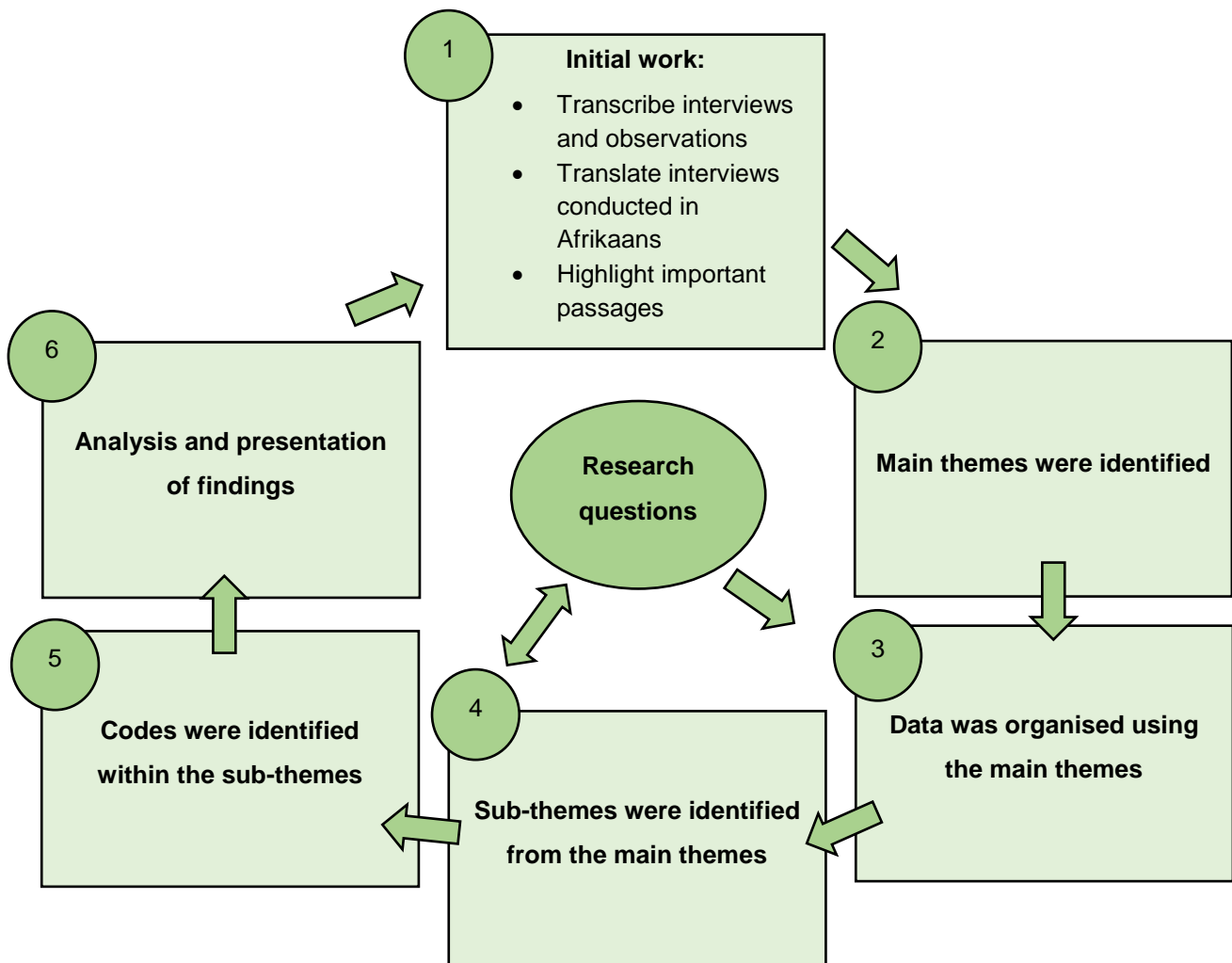


Figure 3.3: The data analysis process (Adapted from Kuckartz, 2013:7)

Kuckartz (2013) asserts that one should identify, schematise and analyse repetitive codes that could form the main themes or sub-themes. Even though this process was explicated in-depth in Chapter 4, it was worthy to mention the process now as it was a direct result of the research design that the researcher chose. The codes were manually colour coded, which developed the identification of the main themes. The main themes were also informed by the research questions. The main themes informed the sub-themes and all data were then grouped within the different sub-themes. From these themes and sub-themes, the researcher was then able to analyse and present the findings of the data generation process. This process was also employed when the researcher analysed the documents.

3.7.2 Validation of the Findings

Qualitative researchers should minimise and eradicate any possible biases that may occur in the design, implementation or analysis of a research study (Bloomberg & Volpe, 2015). Bias is minimised through implementing and promoting trustworthiness and triangulation (Thomas, 2006; Hays & Singh, 2012; Bloomberg & Volpe, 2015), which are discussed in the next two sections.

3.7.2.1 Trustworthiness

Bloomberg and Volpe (2015) assert that trustworthiness encapsulates the validity of a study, which is the degree to which a study measures what it wants to measure, in other words, it seeks to produce research that is credible, accurate and plausible. In this study, the aim is to measure the degree of teacher support to learners experiencing dyscalculia. Within trustworthiness, four important constructs need to be employed to ensure that trustworthiness was upheld (Hays & Singh, 2012; Anney, 2014). These constructs, namely: transferability, credibility, confirmability and dependability are discussed in the following section:

- a. **Transferability** is the degree to which the findings of a study can be applied in other research contexts (Bloomberg & Volpe, 2015). This study upheld transferability by obtaining rich and detailed information from the participants to ensure that the findings of the study could be generalised within other types of classroom environments.
- b. **Credibility** relates to the validation of the findings and the results of a research study by ensuring that the researcher's interpretation and analysis can be justified (Agar, Glaser, Straus, Hammersley, Kirk, Miller, Miles, Huberman, Seale & Silverman, 2004). This is usually informed by a process called member-checking (Thomas, 2006).
- c. The concept of **reliability** refers to the objective nature of research which implies that the subjective views of the researcher will not influence the study (Bloomberg & Volpe, 2015; Noble & Smith, 2015). Bloomberg and Volpe (2015) are cognisant that to improve reliability, the researcher should reflect continuously and have documented records of transcripts and field notes, which will provide an opportunity to assess the conclusions of a study. This is also called a "decision trail", which

shows a clear and unambiguous view of the decisions that the researcher took (Noble & Smith, 2015:35).

- d. **Dependability** is closely linked to reliability and aims to establish whether the data generation and analysis procedures can be tracked, and the findings can be employed in similar contexts (Bloomberg & Volpe, 2015; Moon, Brewer, Januchowski-Hartley, Adams & Blackman, 2016). The authors further maintain that this can be employed through an audit trail, which is an in-depth explanation of the generation and analysis procedures, which Anney (2014) concurs and adds that it can also be promoted through triangulation.

3.7.2.2 Triangulation

Triangulation is defined as a process of using several sources of data or approaches to analyse data, which increases the credibility of a study (Golafshani, 2003; Hastings, 2010; Hays & Singh, 2012; Anney, 2014). This process leads to a more detailed comprehension of the study, and in this study, it was applied by using interviews, observations and document analysis (Hastings 2010). Triangulation was upheld by not only interviewing the teachers but also observing a mathematical lesson to perceive and understand how teachers support learners with dyscalculia. This study also used member checking, which is a process used to enable participants to review transcripts and provide comments on the accuracy and the conclusions drawn from it (Greenbank, 2003; Hastings, 2010).

The reason for employing triangulation was to ensure that the findings of the study can be cross-examined by any other researcher to arrive at the same conclusions as to the researcher of this study (Anney, 2014). Moon *et al.* (2016) assert that triangulation can also be promoted by employing document analysis, which is one of the data generation procedures of this study. When researchers avail multiple perspectives in a study by implementing various methods and linking them to the conceptual background that informed the study, this is known as triangulation (Flick, 2008).

3.8 ETHICAL CONSIDERATIONS

Arifin (2018) postulates that appropriate ethical considerations are of extreme importance in any research study. In this study, ethical clearance; informed consent,

anonymity and confidentiality were upheld to ensure that the researcher maintained all ethical principles needed to identify and eliminate possible risks of the study.

3.8.1 Ethical Clearance

Persuad (2010:108) suggests that most research that uses humans as participants, requires the approval of some sort of “institutional review board”. For this reason, ethical clearance was obtained from the Gauteng Department of Education to conduct interviews and observations within selected Grade 3 classrooms with the respective teachers.

3.8.2 Informed Consent

Informed consent is a continuous communication procedure between participants and the researcher, to ensure that the participants’ welfare is accommodated and that they are comfortable with the process of the study (Ryen, 2004; Owens, 2010). It ensures that participation is voluntary without any coercion or threat (Ryen, 2004; Owens, 2010). Arifin (2018); Hays and Singh (2012); and, Brinkmann and Kvale (2008) continue to state that when obtaining consent from participants, three imperative conditions must be upheld, namely: the participants should understand the study’s intention; consent must be provided voluntarily; and the participant must be competent to provide consent. Hays and Singh (2012:81) provide another important concept called “process consent” where consent is not seen as a once-off agreement but rather as an ongoing process.

Informed consent was obtained from all participants and research sites involved in the study, as well as from the University of Pretoria’s Faculty of Education Ethics Committee. Participants, being Grade 3 teachers, were provided with consent forms that highlighted the research process, assured that anonymity would be upheld and that no harm would come to them. The consent was acquired through a written (signed) agreement as seen in Appendix D but also throughout the data generation process where the researcher ensured that the participants were comfortable with the proceedings.

3.8.3 Anonymity and Confidentiality

Anonymity and confidentiality aim to protect participants' identity and the specific research site where data generation took place (Ryen, 2004). This was implemented by not revealing any names or identities that could be associated with the participants and research sites (Arifin, 2018). Arifin (2018:31) adds that researchers could make use of "pseudonym names and verbatim quotes" to sustain this imperative ethical principle.

If participants wished to refrain from participating in the study, they could do so with ease and without feeling threatened. Participants and school names have remained anonymous throughout the study. Anonymity and confidentiality were upheld by using pseudonyms to indicate respective teachers, as an example, the teachers were referred to as "Teacher" and a specific number of the alphabet: *Teacher A*.

3.9 SUMMARY

This chapter provided an in-depth view of the research methodology that informed the study to strengthen teacher support to learners experiencing dyscalculia. The nature of a qualitative study provided the opportunity to use various data generation methods to guide the research. The case study focused on the factors that need to be considered if teacher support is to be strengthened to learners. The role of the researcher, as well as trustworthiness and ethical considerations, were discussed within the context of the study.

The subsequent chapter provides a detailed view of the data analysis process and the findings of the study.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In Chapter 3, the researcher discussed the methodological approach of the study. The research design, research type and methods of the study were discussed in-depth and were integrated into the context of the study. Chapter 4 focuses on the data generated from the participants. The results of the study are presented and discussed in detail. The primary research question formed the basis of how the data was analysed: *How can teacher's knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?* Both the primary research question as well as the sub-questions were addressed to identify emerging themes. The themes and sub-themes were identified through a detailed analysis of the relationship between the theoretical framework of the study and the data. The data analysis strategies that were explicated in Chapter 3 were implemented. As the data was processed and analysed, relating themes were identified from the data and supported by the literature.

4.2 RESEARCH SETTING AND PARTICIPANTS

As discussed in Chapter 3, the four schools that were selected were public primary schools in the Tshwane South district in Gauteng. Six out of the nine teachers who participated in the semi-structured interviews and observations were Caucasian females. One of the nine participants identified herself as a multi-cultural female and two females did not identify with any ethnic group. Teacher B (Pseudonym), who identified herself as a multi-cultural female, indicated that she works with different ethnic groups and that this has influenced her perception of her ethnicity. Two females did not want to answer the question when they were asked to indicate which ethnicity they identify themselves with. These two females did not provide the researcher with a reason as to why they wanted their ethnicity to remain anonymous. All the participants who were chosen were experienced teachers. They had been teaching for at least five years. Four of the participants also served as Heads of Department in the FP at a public school.

4.3 DESCRIPTION OF SEMI-STRUCTURED INTERVIEWS

For this study, semi-structured interview questions (Appendix F) and observation guidelines (Appendix G) were used to generate appropriate data from each of the teachers. Table 4.1 indicates the questions and guidelines that were used as seen in Appendices F and G.

Table 4.1: The semi-structured interview questions and observation guidelines

Background questions		
How old are you?		
Which ethnic group do you identify yourself with?		
What nationality are you?		
Are you currently involved in the teaching of Grade 3 learners this year?		
Do you have a teaching qualification? If yes, please indicate what type of qualification was obtained.		
Which quintile does your school represent?		
How many years have you been teaching Grade 3 learners?	5 years	
	7 years	
	9 years	
	10+ years	
How many learners have been experiencing dyscalculia in your class?		
How many learners in your class have mathematical learning difficulties?		
How many learners in your class experience a difficulty to comprehend mathematics?		
Interview questions		
1. What is your understanding of the term 'mathematical learning difficulties'?		
2. What is your understanding of the term 'dyscalculia'?		
3. What is your understanding of the term 'mathematical anxiety'?		
4. Are learners born with the ability to be competent in mathematics, or should this skill be taught to them? If the latter, which skills should be taught to learners?		
5. What are some of the challenges of teaching and assessing learners with mathematical learning difficulties?		
6. What do you think are possible reasons that learners experience mathematical learning difficulties?		
7. Do you have learners in your class who show signs of experiencing difficulties to obtain mathematical skills?		
8. Does the school have a process for referring learners for support and receiving support in mathematical learning difficulties?		
9. Do you like mathematics? How does this influence the way you teach mathematics?		
10. Do you make use of the CAPS or any other policies to support learners in mathematical learning difficulties?		
10.1 If yes, what do you use and how do you implement it in your classroom?		
10.2 If no, is there a specific reason?		

<p>11. Do you support learners that experience difficulties to obtain mathematical skills?</p> <p>11.1 If yes, how do you support these learners? Can you provide examples or show me the resources that you use?</p> <p>11.2 If no, is there a specific reason why you do not or cannot support these learners? Would you support learners if you had the opportunity?</p>	
<p>12. Does your school make use of specific planning for the teaching and learning of mathematics? How would you rate this planning according to the teaching and learning of mathematics?</p>	
<p>13. Do you use any of the following methods to support learners experiencing mathematical learning difficulties? Please elaborate on each of your answers, whether is it yes or no:</p> <p>13.1 Differentiated teaching (planning lessons according to learners' learning styles and competencies).</p> <p>13.2 Peer teaching and learning.</p> <p>13.3 Small group teaching.</p> <p>13.4 Individual teaching.</p> <p>13.5 Games.</p> <p>13.6 Media (technology, calculators, electronic appliances, online games, internet sources).</p> <p>13.7 Lesson study (a collaboration between teachers to plan for the learning and teaching of learners).</p>	
<p>14. What kind of resources would you want or what should be in place in your classroom to support learners with mathematical learning difficulties?</p>	
<p>15. Do you follow any steps or guides when teaching mathematics to Grade 3 learners?</p>	
<p>16. Do you think that teachers are trained sufficiently to teach Mathematics and to support learners with mathematical learning difficulties? Why or why not?</p>	
<p>17. What formal or informal training do you think teachers need to be able to effectively support learners with mathematical learning difficulties?</p>	
<p>18. What other types of training or workshops do you think are important to develop the skills of effectively supporting these learners?</p>	
<p>19. What are your perceived gaps (if any) in the current educational policies with regard to mathematical learning difficulties?</p>	
<p>20. What is your understanding of the word 'pedagogical content knowledge'?</p> <p>20.1 Do you think you have sufficient pedagogical content knowledge? Why/why not?</p>	
<p>21. What is your understanding of the word 'subject matter knowledge'?</p> <p>21.1 Do you think you have sufficient subject matter knowledge? Why/why not?</p>	
Observations	
Mathematical tasks	Comments
<ul style="list-style-type: none"> • What mathematical task or activity has the teacher presented? • Is it teacher – or learner-centred? • Are the learners engaged in the tasks or activity? • How are tasks presented? 	

<ul style="list-style-type: none"> How does the task or activity progress within the lesson? 	
Mathematical tools	Comments
<ul style="list-style-type: none"> Which mathematical tools or resources has the teacher provided the learners with? Does she provide any additional resources to learners experiencing mathematical learning difficulties? 	
Barriers to learning	Comments
<ul style="list-style-type: none"> Are there learners that experience barriers or difficulties? How does the teacher support these learners? 	
Perceived challenges	Comments
<ul style="list-style-type: none"> What are some of the challenges to teaching and assessing learners with mathematical learning difficulties? How does the teacher or the learner overcome these challenges? 	
Culture in the classroom	Comments
<ul style="list-style-type: none"> What is the culture in the classroom? How do the students behave? How does the teacher respond to misbehaviour? How does the teacher respond to learners that give wrong answers? 	
Open-ended (example: body language/ergonomics)	

As seen in Table 4.1 above, these were the questions and guidelines that were used to conduct the semi-structured interviews, as well as the observations. The questions for the semi-structured interviews were twofold and focused on the background of each teacher, as well as the questions related to the purpose of the study.

The background questions focused on the teachers' age, ethnicity, teaching experience and qualifications, as well as their exposure to mathematical learning difficulties. The questions about the study's purpose involved their understanding of MLD, especially dyscalculia, as well as how the teachers support learners experiencing MLD. Dyscalculia and MLD were used as interchangeable terms. The support varied from policies they implement, their school's planning and different strategies that were identified in Chapter 2. The last section focused on their perception of teacher training and development regarding MLD.

A question on the policy context required that teachers indicate which policies they implement in their classrooms to address dyscalculia. All nine teachers indicated that they implement the CAPS and it was established that all four schools' planning is based on the CAPS as well, which includes the daily; weekly and term planning. This

was used to establish whether the teachers could link the requirements and content of CAPS in the planning and whether it catered for dyscalculia.

The teachers were firstly asked if there are learners in their class that experience dyscalculia. If they did not know what the term meant, the researcher asked the teacher if there were any learners in their class that experience MLD. This question was asked before the formal data generation processes commenced as the study focuses on dyscalculia. All teachers indicated that there were learners in their class that experience dyscalculia. Questions were also asked to establish what challenges teachers experienced when teaching and assessing learners with dyscalculia. Teachers were also asked what they think possible reasons could be for learners experiencing these MLDs. They also had to say if they have learners in their class who experienced dyscalculia. Other questions included how they support learners with dyscalculia and whether they used specific methods to support these learners. The last section focused on the training of teachers and whether they think teachers are sufficiently trained and how they need to be trained.

The researcher's first point of contact was through sending emails to different schools in the chosen district and area. The study proposed that the Grade 3 teachers are observed whilst teaching a Mathematics lesson and interviewed at two different but suitable times within a week.

The researcher conducted the first interview and observation on the same day. The reason that the researcher initially started in this manner was to accommodate the teacher's schedule and to ensure the teacher was not inconvenienced. However, after careful reflection, the researcher concluded that the teacher did not provide any new insight that could prove valuable to the research. This was because all the answers were based on the lesson that was presented. This prompted the process of interviewing on a separate day as an observation to identify any possible discrepancies.

The first teacher was contacted again and asked to form part of another observation, but the teacher informed the researcher that she was busy administering and marking assessments and would not be able to meet again. This teacher formed part of the first school and at this specific school, the researcher was only allowed to conduct the

observation and interview with one allocated teacher. Therefore, the researcher contacted different schools and with their permission contacted the chosen Grade 3 teachers who indicated their willingness to participate in the research study. An appropriate time was scheduled with each teacher without affecting their working hours. In total, four schools were contacted and nine participants formed part of this research study.

The semi-structured interview, as well as the observation, were held on two different occasions with the participants in their respective classrooms since this was the most convenient and natural venue for them. Before the semi-structured interview commenced, the researcher assured each teacher of their anonymity and confidentiality and thanked them for participating in the study. The researcher also introduced herself and explained what the study entailed. The process of the interview (the questions and the recording of their answers) was addressed and the researcher ensured that the teachers were comfortable with the proceedings. This was done by obtaining the teachers' permission to audio record the interview and to take down notes during the observations. The researcher then switched on the audio recording device and started to ask the questions. The researcher made use of further prompting and allowed the teachers to elaborate on their answers. The researcher ensured that the participants were aware that the notes and recordings would form part of the data analysis. The researcher reiterated that confidentiality and anonymity would always be upheld. The teachers agreed to that.

Seven of the nine participants experienced the semi-structured interview as a positive communicative experience. The remaining two participants did not elaborate on most of their answers because they were anxious that their answers might get them into trouble with the school. The researcher assured these participants that all information shared would be kept confidential but they continued to provide brief and concise answers. All nine participants did not mind that the researcher acted as an observer. The participants were comfortable to share their experiences with the researcher, but some elaborated more than others. Some teachers were eager to share their experiences because they are aware of the importance of Mathematics in the FP.

The structured questions proved useful in guiding the participants to various issues related to the teaching and learning of Mathematics and supporting learners who

experience mathematical LD. The questions also gave insight into strategies that teachers could implement to support learners experiencing mathematical LD.

4.4 DESCRIPTION OF PARTICIPANTS

For this study, and to ensure the anonymity of the participants, they were referred to as 'Teacher'. For coding purposes, each teacher was coded as Teacher A to Teacher I. All participants agreed and had given their consent willingly to participate in the study. The researcher obtained informed consent from all of the participants as well as the respective principals and these were signed without any intimidation or constraints.

In total, nine participants agreed to take part in this study. Four schools were contacted and specific teachers teaching Grade 3 were identified. The following table provides an overview of the number of teachers at each school, their qualifications, and years of experience as well as the number of learners in their classroom:

Table 4.2: A summary of the teachers at each selected school

	Qualification	Age	Years of experience in teaching	Number of learners in classroom
School 1				
Teacher A	BEd Foundation Phase	29	7	35
School 2				
Teacher B	<ul style="list-style-type: none"> • BEd Foundation Phase • Diploma in remedial teaching 	64	More than 40	33
Teacher C	Higher Education Diploma	52	23	26 (1x learner with Down Syndrome)
Teacher D	Higher Education Diploma	47	25	34
School 3				
Teacher E	<ul style="list-style-type: none"> • BEd Foundation Phase • Postgraduate qualification 	38	16	26
Teacher F	Postgraduate Certificate in Education	38	7	25
School 4				
Teacher G	Junior primary diploma	51	More than 27	39
Teacher H	BEd Foundation Phase	27	5	38

Teacher I	<ul style="list-style-type: none"> • BA degree • Postgraduate Certificate in Education 	40	9	38
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The researcher assured all the relevant participants of the ethical principles of confidentiality and anonymity. They were also assured that the information provided could not be traced back to them in “reports, presentations or other forms of dissemination” (Crow & Wiles, 2008:2). A specific coding system and pseudonyms were used when generating the final report. The system consisted of the word “Teacher” and a letter of the alphabet (A to I) as presented in Table 4.2 above. In the next section, the profile of the teachers is discussed in detail. These profiles provide a brief overview of the teachers’ ages, their genders, their qualifications and experiences, as well as their training opportunities and their vision of teaching learners with mathematical learning difficulties.

4.4.1.1 Teacher A

Teacher A is a qualified FP teacher. She has a degree in FP education. She has been teaching for seven years. Teacher A has only taught Grade 3 learners. She has only taught at the school where the research was conducted. She has received training in CAPS from district officials. She enjoys teaching in the FP and advocates for further education and training by stating that “*people need to attend courses all the time, so you can only learn more and you can learn so much from others too on supporting learners*”.

4.4.1.2 Teacher B

Teacher B has more than 40 years of experience in teaching. She is a qualified FP teacher and holds a degree in FP teaching as well as a diploma in remedial teaching. Teacher B has taught most grades within the primary school setting as well as Grade R at different schools in the Gauteng area. She has received various training in curricula since she was exposed to various curricula in her years of teaching. Teacher B also indicated that in 2019, she had been teaching Grade 3 for two consecutive years. Teacher B is passionate about teaching and indicates that mathematical concepts can be taught and strengthened if “*you get a good teacher who explains the concepts and if they have laid the foundation well, then they should not really have problems*”.

4.4.1.3 Teacher C

Teacher C is a qualified FP teacher and also the HoD for Grade 3 and Grade R learners. She has a Higher Education Diploma (HED) and has been teaching for 23 years. Teacher C has taught all the grades in the FP. She moved to Grade 3 in 2019 after teaching Grade 2 because she has a learner in her class with Down Syndrome. The teacher and the learner had built a positive relationship, and thus, the learner had to be taught by her. Down Syndrome is a genetic condition that affects physical growth and is accompanied by intellectual disability and distinctive facial features (Deakin, Moore & Jahoda, 2018). Teacher C has received training in CAPS from the district officials. She has an immense passion for teaching, which was evident when the interview was conducted. During the interview, she indicated that *“these children with mathematical learning difficulties need my support because they are my babies, a lot of them do not have any support from home and that is why I am here”*.

4.4.1.4 Teacher D

Teacher D holds a HED in teaching. She has been teaching for 25 years but has taught Grade 3 learners for six consecutive years in total. Teacher D has taught all the grades in the FP and has received training in CAPS from the district officials. She believes that the way a teacher teaches and supports learners has an impact on their learning because *“how you teach to the children is definitely how it will affect your children’s marks because you are going to either teach it negatively or you will teach it positively”*.

4.4.1.5 Teacher E

Teacher E is a qualified FP teacher and has a postgraduate qualification in teaching. She also holds a degree in FP teaching. She has been teaching Grade 3 learners for 16 years and has been at the same school since she started teaching. She has been trained by district officials on CAPS and also attends courses offered by the South African Teachers’ Union (SAOU) and the Skole Ondersteuningsentrum (SOS). She has an immense passion for teaching and showed detailed knowledge of how to support learners with MLD during her interview. She believes in practical examples to consolidate the understanding of mathematical concepts since she stated that *“I am a big proponent of using as many senses as possible while counting, for example”*.

4.4.1.6 Teacher F

Teacher F has a Postgraduate Certificate in Education (PGCE) and has been teaching for 7 years. Teacher F has taught Grades 1 and 3 in the FP at schools in the Gauteng area. She has received training in CAPS from the district officials and attends mathematical workshops when they are available. Teacher F advocates for an innovative and multi-sensory teaching approach through asserting that *“I realised how much fun you can make Mathematics and I started to incorporate games and everyday objects for example their food in my class time so that the learners are able to learn in another way”*.

4.4.1.7 Teacher G

Teacher G holds a junior primary diploma in teaching and has been teaching Grade 3 learners for seven consecutive years. Prior to her seven years, she has more than 20 years of teaching experience. She has taught all the grades in the FP and has taught at six different schools in Gauteng. She has obtained training from district officials in CAPS. Teacher E also indicated that in 2019 she had one of the largest numbers of learners in her Grade 3 class which totalled to 39 learners.

4.4.1.8 Teacher H

Teacher H is a qualified teacher and has a degree in FP education. She has been teaching for five years at the specific school where she was interviewed. Teacher H has only taught Grade 3 and has received training in CAPS from the district officials. She does not enjoy teaching as she indicated that *“I am really looking for another job but I don't know what I want to do. You know neh, it is difficult to work with these children if they do not respect you”*.

4.4.1.9 Teacher I

Teacher I holds a BA degree and a PGCE. She has been teaching Grade 3's for nine consecutive years. She has taught at two different schools in the Gauteng area. She has received training in CAPS from district officials. Teacher, I indicated that she is experiencing difficulties in disciplining her class by stating that *“I am so tired of these children's manners. They swear, shout, kick and scream whenever I want to say something. They have extreme discipline problems and there are two learners in my*

class that have severe emotional problems. I am so sorry that you have to see this. This lesson is going to take very long”.

4.5 DATA ANALYSIS PROCESS

As mentioned previously, the process of data generation included the semi-structured interview, observation, reflection journal notes, as well as document analysis. Teachers were asked to provide a brief background, which included their age, the ethnic group they identify with, their teaching qualifications and the number of learners that experience mathematical learning difficulties in their classroom. It was important to establish the participants’ understanding of dyscalculia and how they support learners who experience mathematical learning difficulties. The researcher conducted each interview individually and probed for further information if the participant’s answer lacked depth. As the data analysis process progressed, three main themes were identified with several sub-themes.



Figure 4.1: The data analysis process

The diagram above in Figure 4.1 visually represents the data analysis process. The first step involved transcribing and highlighting important passages. After each

interview, the interview was transcribed directly from the audio recording, and eight of the nine recordings were translated to English by the researcher. The transcribing process was completed immediately after the interview, to ensure that all the data was generated and captured accurately. The observations and reflection journals were left as “raw data” and were not transcribed electronically. The researcher compiled all of the data in a research book, which included all the relevant documents and notes necessary to complete the data generation process.

The researcher thoroughly read each interview and observation several times, immersing herself fully in the data generated from the respondents. The researcher filtered through each interview, observation, reflection and document to identify generic and unique contributions by highlighting important passages (Kuckartz, 2013). Even though the observations were conducted, the data was not substantial enough for inclusion in the study due to the limited time in each class. This supported the researcher to identify the main themes applicable to the study. This guaranteed that a holistic approach was taken to ensure that all relevant information regarding the strengthening of teacher support to learners experiencing dyscalculia in Grade 3 was included and identified. Similar responses and emerging issues were grouped to form themes and to organise the teachers’ responses. These themes were then separated and within each theme, the researcher filtered through the documents and highlighted the distinctive contributions. These processes were all done on hard copy. Each theme was analysed and coded to structure sub-themes, and these sub-themes informed how the data would be grouped and to conduct thematic analysis (Kuckartz, 2013). The findings were then analysed and presented ethically and accurately. The researcher furthermore searched for specific key words by highlighting the relevant words with a highlighter in the documents that were analysed. The two documents that proved to be the most valuable to the study was the CAPS as well as the planning of the respective schools and or teachers. These themes were joined with the themes found from the interviews and other data sources to indicate any possible emerging key words.

4.6 RESEARCH RESULTS

The findings of the data that were analysed, led to the results to emerge from the data inductively. These results are explained in detail in the next section by supporting the

statements with verbatim quotes and observations, the analysis thereof, as well as corroborating literature.

An overview of these results was grouped into themes and sub-themes. These are presented in Figure 4.2 below. An in-depth and detailed discussion of each theme and sub-theme is presented.

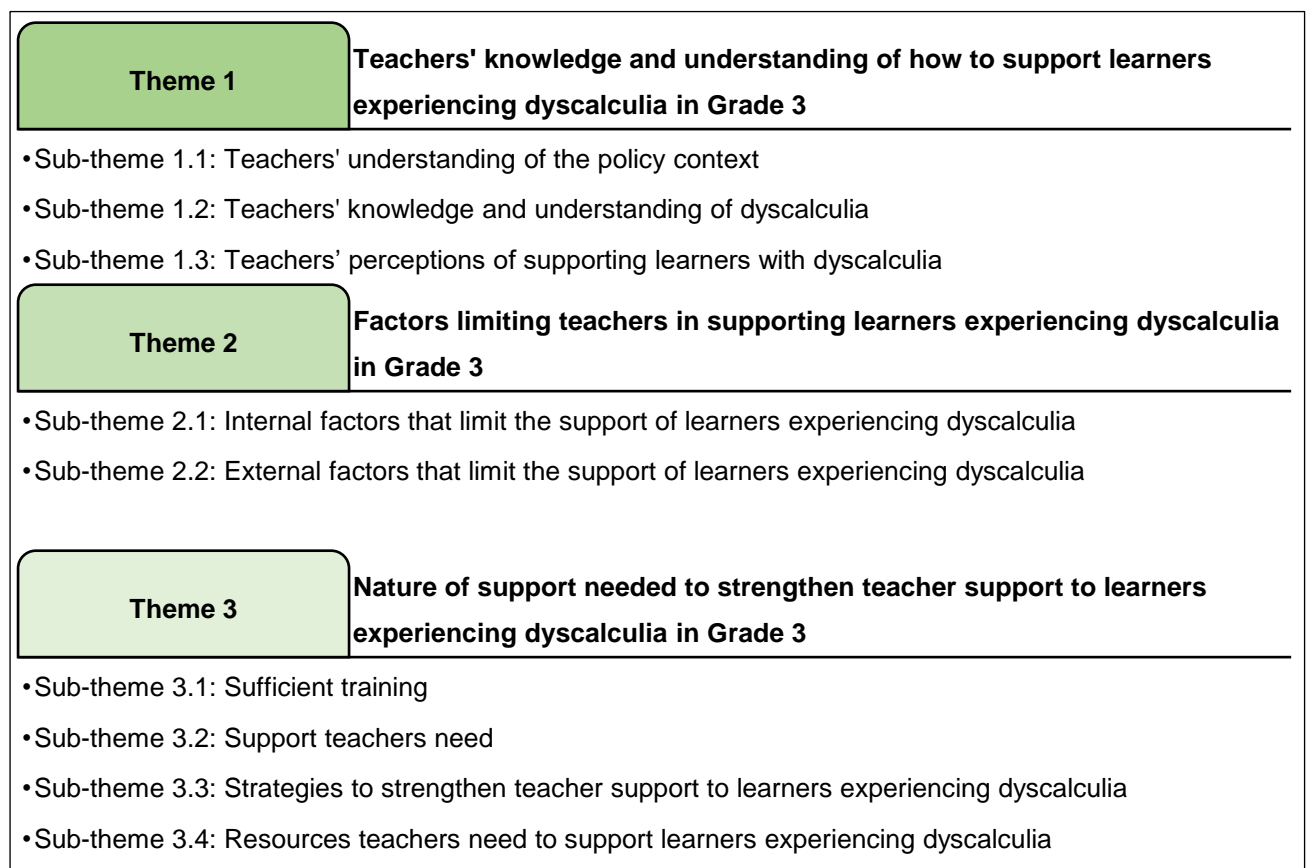
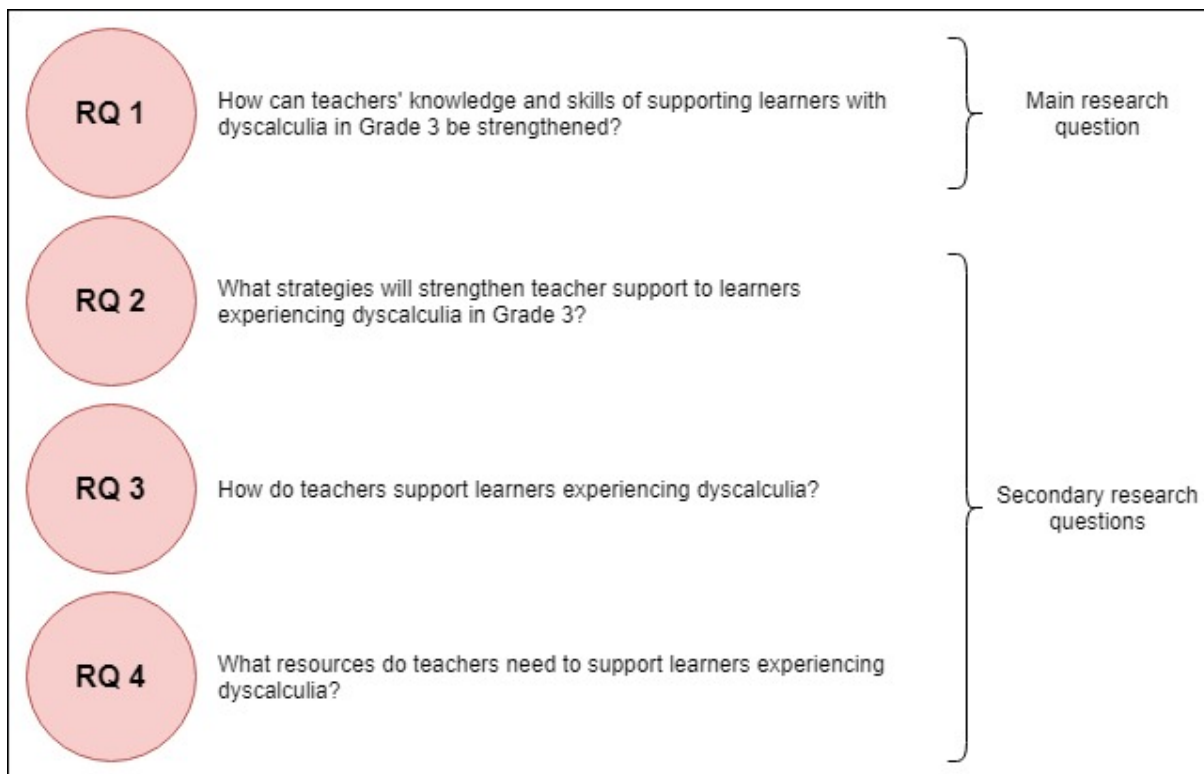


Figure 4.2: Overview of the main themes and sub-themes

Another important aspect to take into consideration is that each theme and sub-theme aimed to answer the research questions as set out in Chapter 1. For this study to ensure easy reference and understanding I use the codes RQ 1 for the primary research question and RQ 2, RQ 3 and RQ 4 for the three secondary questions.

To facilitate the process of understanding how each theme and sub-theme links to the research questions. Figure 4.3 indicates the research question and its acronym represented as an icon. These icons are placed in the left-hand margin of the sections that follow:



As previously mentioned, the researcher made use of raw data, analysis and literature in this chapter to support the findings. The diagram in Figure 4.4 visually represents the icons used in this section to indicate what was used to support the analysis in the written section that follows. Four icons were used and indicated whether the section referred to the interviews (I), the reflection journal (RJ), the documents that were analysed (D) or literature (L). Observations did not form part of the data of this study since it was not of substantial worth and was caused by a limited time in each class. These icons are placed in the left-hand margin of the sections which follow:

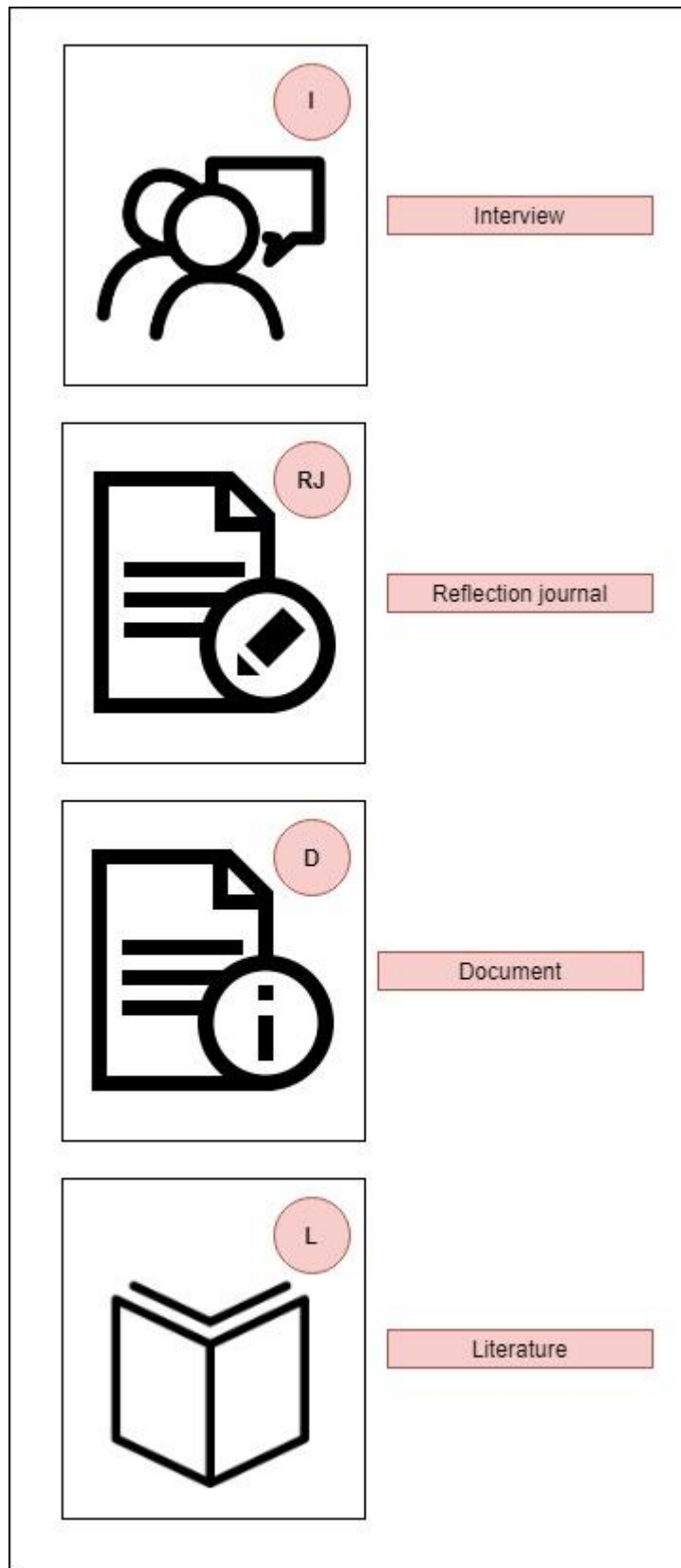
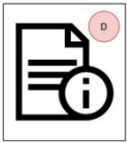


Figure 4.4: Icons used in this chapter

Theme 1: Teachers' Knowledge and Understanding of How to Support Learners Experiencing Dyscalculia in Grade 3

Theme 1 aimed to generate data on teachers' knowledge and understanding of learners experiencing dyscalculia. The DBE policies relevant to this study are the CAPS for the FP, the "National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom", the "Guidelines for Inclusive Teaching and Learning" and the WP6, as explicated in section 2.3 *Contextual Background*, which focuses on how learners experiencing learning difficulties should be supported and how the mathematical curriculum should be planned and executed in Grade 3. These policies have made provision to support learners experiencing dyscalculia, however, it is important to indicate what teachers know and understand about dyscalculia and how they think these learners should be supported. According to the DBE (2011b), Section 2.7.2 of the Mathematics CAPS document clearly articulates that teachers must adapt the curriculum to meet the needs of learners in their classrooms. The WP6 (DoE, 2001) also supports this notion by advocating the implementation of inclusion within the educational system that focuses on the adaptation of the curriculum.



4.6.1.1 Sub-theme 1.1: Teachers' Understanding of the Policy Context

Teachers were asked whether they make use of the CAPS or any other relevant policies or guidelines to support learners with dyscalculia and how they implement this in their classroom. The teachers were also asked whether their school makes use of specific planning for the teaching and learning of mathematics and whether they think it addresses MLD effectively. Lastly, they were asked whether they follow any specific steps or guides when teaching mathematics to Grade 3 learners.

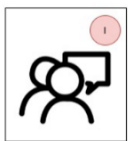


All nine participants indicated that they use the CAPS to plan for their teaching, learning and assessment. They also indicated that CAPS is the policy document of the Department of Education and, therefore, "*we have to use the CAPS daily because everything we do has to be aligned with the outcomes set from the Department of Education*". When Teacher A was asked whether she has any knowledge of the WP6 she responded "*No, I don't know. I have never heard of the White Paper 6 before. What is it about?*" After explaining it to the teacher, she stated that "*No, I have not heard of it but I will definitely go look at it*". None of the other teachers made mention



of the WP6 and when they were asked about it they all indicated that they had no knowledge of it. Teacher C added that she uses *“a lot of the stuff that we developed in the previous curriculum [known as the Revised National Curriculum Statement as indicated by Msila, 2007] because there were very good ideas and they are teaching the same content and concepts as the current curriculum”*. Even though the DBE develops policies, the training thereof is not sufficient as found in the data of the study as well as in the literature (Badugela, 2012; Maharajh et al. 2016).

This teacher further added that even though her school implements CAPS *“so that everybody gets the same foundation and it is required by the department”*, she uses *“mostly instinct to teach mathematics because I have a lot of experience in teaching”*. In this instance, instinct is referred to as the teacher using previous experience and knowledge to teach mathematical concepts to learners experiencing learning difficulties. It is through the teachers’ experience in trial and error that they have gained knowledge of different strategies to teach and support these learners.



The teachers’ attitudes towards their schools’ planning were positive with comments such as *“our planning is pretty successful, we’ve got quite a success rate in learners’ scores within the school context but also on a broader scale”* (Teacher C); *“if you do not have the school’s planning integrated with CAPS, then you cannot teach the work to the learners...”* (Teacher D); *“...I do think that the school’s planning is very well and well set out”* (Teacher F); *“well, I think our school’s planning is good”* (Teacher H); *“...our planning gives you a very good guideline on what you should and should not do...”* (Teacher I). All nine participants indicated that their school’s planning is guided by the CAPS. Only a few negative comments were made regarding the school’s planning such as *“I think the planning needs more work to be quite honest with you, it does not address all necessary aspects required by teaching especially on how to address learners with learning difficulties”* (Teacher F). Schools, as well as teachers must plan for their teaching. This statement is resonated by Pang (2016) who stated that not only does it constitute the essence of quality teaching and professional development, but that it also provides teachers with new insight into the teaching of learners through careful reflection. The schools that were contacted were asked to provide their planning, which was carefully reviewed, and the following conclusions could be made:



School A's planning does not form part of this observation list since the researcher did not have access to it.

Table 4.3: The different schools' planning compared to CAPS

	School B (weekly planning)	School C (daily planning)	School D	CAPS
Time allocated	<p>Time indicated for different topics at the top of the page.</p> <ul style="list-style-type: none"> Counting: 5x10 minutes Mental maths: 5x10 minutes Concept development: 4x60 minutes Problem-solving: 5x10 minutes Number of the day and consolidation: 1x30 minutes. 	<p>Time indicated for different content areas at the top of the page.</p> <ul style="list-style-type: none"> Numbers, operations and relationships: 120 minutes a week Patterns, functions and algebra: 80 minutes a week Space and shape: 80 minutes a week Measurement: 80 minutes a week Data handling: 60 minutes a week 	<p>Time has been indicated next to each topic.</p> <ul style="list-style-type: none"> Whole class: Mental math: 5x10 minutes Problem-solving: 5x10 minutes Whole class: Number concept development: 5x10 minutes Whole class: New concepts and revisions: 5x15 minutes Group work: Review concepts: 5x10 minutes Independent: 5x30 minutes 	<p>According to CAPS (DBE, 2011), the time allocation per content area per week should be as follows: 120 minutes need to be spent on numbers, operations and relationships; 80 minutes should be allocated to patterns, functions and algebra; 80 minutes for space and shape; 80 minutes scheduled for measurement; and 60 minutes planned for data handling. This totals 420 minutes a week that need to be spent on mathematics.</p>
Topics	<p>The planning is completely typed out and consists out of these four topics for each week. The mental maths has been indicated as being group work activity.</p>	<p>Planning has four topics, namely subject; activity; resources and time. The subject column has already been completed and consists of counting skills; mental maths; problem-solving; concepts and skills and the activity.</p>	<p>None indicated.</p>	<p>CAPS (DBE, 2011:12) indicates that during a Mathematics lesson the following should take place:</p> <ul style="list-style-type: none"> Whole class activity (mental mathematics and consolidation of concepts) Small group teaching (counting, concept development, problem-solving, patterns, space and shape, measurement and data handling)

				<ul style="list-style-type: none"> • Independent work (consolidation of concepts)
Resources	No specific resources have been indicated that the teacher can use.	Resources used in this specific lesson are 100 charts as well as flashcards.	No specific resources have been indicated that the teacher can use.	A wide variety of resources has been provided by the CAPS (DBE, 2011:17). Resources include counters, large dice, counting frames, height charts, number grid posters, number lines, flashcards, play money and a calendar.
Support	None indicated.	The very last section of the page has a space for small group activities or differentiated instruction, however, nothing has been documented in this section.	None indicated.	<p>CAPS (DBE, 2011:13) indicates that learners that experience difficulties should be supported through:</p> <ul style="list-style-type: none"> • Activity-based learning • Practical examples with concrete objects • Practical examples should be used for a longer period • More time granted for the completion of assessments • Adaptation of activities
Additional	There are 'notes' provided to the teacher on how to instruct learners to complete the activity.	Assessment is also indicated in this planning, whether it is informal, formal and which instrument was used to assess. On this specific day the assessment was formal and would be assessed through oral assessment, demonstration as well as a written assessment. The teacher will use observation and a worksheet as an assessment.	The planning is completely typed out but has a column where the teacher can make notes.	

From Table 4.3 above, it is evident that even though the selected schools' planning has certain aspects that correlate with the stipulations in CAPS, there are still areas that do not show a relationship. School C's time allocated is the same as what is specified in CAPS. The biggest area of inconsistency is regarding the support of learners experiencing learning difficulties as well as the resources that can be used to promote the development of mathematical skills and concepts.

4.6.1.2 Sub-theme 1.2: Teachers' Knowledge and Understanding of Dyscalculia

The teachers were asked what their understanding is of MLD and dyscalculia. The reason for asking the teachers what their definition is of both these terms was to find out whether they use the terms interchangeably or if they see them as separate terms. The teachers did not see the terms as describing one difficulty and rather saw dyscalculia as a problem on its own, or rather something they could not explain at all.

In the left column of Table 4.4, the definition of dyscalculia as is provided, as defined in Chapters 1 and 2, while the teachers' knowledge and understanding of dyscalculia can be seen in the right column.

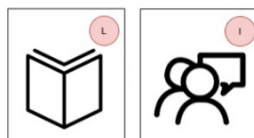


Table 4.4: Teachers' understandings of dyscalculia

Definition of dyscalculia includes:	Teachers understanding of dyscalculia included the following:
Dyscalculia can be explained as a barrier for learners to obtain mathematical skills (Hannell, 2013; Emerson & Babbie, 2015; Hornigold, 2015; Hudson, 2016).	<p><u>Teacher A:</u> "If I can explain it so quickly, it also comes down to children with mathematical problems or who are experiencing math problems".</p> <p><u>Teacher B:</u> "Probably the same because these are mathematical problems, learning problems".</p>
These skills include, for example, learners' counting skills which are impaired; they experience difficulty with arithmetic; abstract concepts of time-telling (Vaidya, 2004); basic calculations; studying multiplications; using a calculator; estimating answers; working memory; working with money and when the learner shows a constant and paramount barrier in mathematics (Hornigold, 2015; Bornman & Rose, 2017).	<p><u>Teacher D:</u> "Uhm, I almost want to say it is, it's a kid who doesn't know his numbers well and how to add them up correctly".</p> <p><u>Teacher E:</u> "Uhm, I'm not 100% sure now how to express myself around it but I think it also has a lot to do with poor understanding".</p>

	<u>Teacher I:</u> <i>"They probably can't count?"</i>
Dyscalculia is a neurological impairment and indicates that the main deficit is the ability to process numbers (Emerson & Babbie, 2015).	None.
This learning difficulty might be caused by developmental, visual perceptual, social, economic or emotional factors (Emerson & Babbie, 2015).	None.
	<u>Teacher C:</u> <i>"Dyscalculia is the mathematical term for dyslexia".</i> <u>Teacher D:</u> <i>"His numbers are turned around".</i> <u>Teacher E:</u> <i>"the swopping of numbers".</i> <u>Teacher F:</u> <i>"if I remember correctly I've heard about it before is when learners, no, I'm actually going to lie if I say something now, I don't know if it has something to do with how they understand mathematics or if they swop things around like we do in language. I thought about it before, but I can't tell you what it is".</i> <u>Teacher G:</u> <i>"it's basically the same as Dyslexia with reading; it means that you are Ddyslexic in mathematics".</i> <u>Teacher H:</u> <i>"that's a good question. I really do not know if I will not be able to answer that question".</i>

From Table 4.4, it is evident that teachers do not have a comprehensive understanding of what dyscalculia entails. Six of the nine participants either provided an unclear definition or stated that they do not know what it is. It is of vital importance that teachers have a sound understanding of concepts so that they can plan their lessons accordingly. When Teacher H was asked what her understanding of dyscalculia is, she answered that *"That's a good question. I really do not know if I will be able to answer that question"*. Teacher F added that *"If I remember correctly I've heard about it before is when learners, no, I'm actually going to lie if I say something now, I don't know if it has something to do with how they understand mathematics or if they swop things around like we do in language. I thought about it before, but I can't tell you what it is"*.

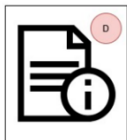
Teacher C stated that “*Dyscalculia is the mathematical term for dyslexia like when learners turn their numbers around*”. When these two teachers were asked to elaborate on their answers, they indicated that they did not possess any other understanding of dyscalculia. Teachers E echoed this view by adding that “*Dyscalculia is the swopping of numbers*”. Nevertheless, dyscalculia cannot necessarily be defined as the mathematical equivalent of dyslexia because there are differences between these two types of LD (Peters, Bulthé, Daniels, Op de Beeck & De Smedt, 2018).

For this reason, there is evidence that teachers do not understand the concept of ‘dyscalculia’, therefore, it will be a challenge for them to accommodate those learners who experience dyscalculia.



4.6.1.3 Sub-theme 1.3: Teachers’ Perceptions of Supporting Learners with Dyscalculia

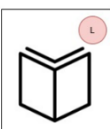
The different strategies that the teachers use to support these learners are discussed in section 2.5.2 *Strategies to Support Teachers to Help Learners Experiencing Dyscalculia*.



CAPS (DBE, 2011b:12) mentions that learners that experience dyscalculia should be exposed to “activity-based learning”. Furthermore, these learners should be given concrete objects, practical activities and more time to complete assessments and activities as well as to acquire thinking skills (DBE, 2010; DBE, 2011b;). Lastly, as mentioned previously, CAPS (DBE, 2011b) states that the number of activities should be adapted without compromising the learning content and the skills that are required for successful comprehension.

4.6.2 Theme 2: Factors that Limit Teacher Support to Learners Experiencing Dyscalculia

In section 3.3 *Research Methods*, the barriers that learners experience in mathematics were explained. These barriers form the basis of this section and are analysed to see whether these intrinsic and extrinsic barriers limit teacher support to learners experiencing dyscalculia in Grade 3. It is important to note that intrinsic and internal, and extrinsic and external were used as interchangeable terms. The internal factors



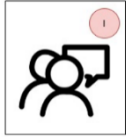
that limit teacher support are intrinsic barriers that the learners experience, such as dyscalculia, whereas the external factors that limit teacher support are extrinsic barriers that are experienced such as inappropriate teaching strategies (Engelbrecht, 2016).

The question that guided this section was “What are some of the challenges to teaching and assessing learners with mathematical learning difficulties?” This open-ended question left room for elaboration on either intrinsic or extrinsic difficulties. The teachers were also asked to elaborate on reasons why they think these learners experience these difficulties, and this enabled the researcher to see whether the teachers viewed it as situations they had control over or not.

4.6.2.1 Sub-theme 2.1: Internal Factors that Limit the Support of Learners Experiencing Dyscalculia in Grade 3

The teachers only identified one internal factor that limits the support of learners experiencing dyscalculia in Grade 3. The teachers believed some learners are more gifted in mathematics than their counterparts that display “right-brain hemisphere dominance” (Ali & Kor, 2007; Engelbrecht, 2016:291). The teachers were asked whether they think learners are born with the ability to be competent in mathematics, or whether this skill should be taught to them. Although the answers varied, it was evident that most teachers felt that learners had to be born with it or that it was both a talent and a skill that needs to be developed.

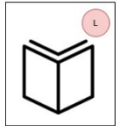
Teacher B stated that: “...*they are born with a talent, because, you can clearly see in a child's performance that he or she is language-oriented or he is mathematically oriented*”. Teacher C concurred this statement by adding that “...*it depends on your intellectual ability...*”, which can also be viewed as an intrinsic barrier that the learners experience that might have LD. Teacher C specifically mentioned that some learners have specific brain hemisphere dominance, by adding that “...*we all know that left-brain right-brain is a fact...*”. Teacher G felt that “...*some of them have a natural inclination towards mathematics...*” and Teacher I supported this statement by adding “...*some people are more mathematically oriented than other people...*”



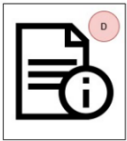
Another internal factor that limits the support of learners experiencing dyscalculia is mathematical anxiety. Teacher E stated that some learners do not “*even want to write the date*” and Teacher F is of the opinion that as soon as they “*...are writing a test...*” they start “*...experiencing anxiety*”. Teacher H concurred the difficulties learners experience when writing tests by stating that “*I have a lot of children that start to stress when they have to write a test, they are extremely scared that they will fail the test or that they will not be able to understand what is in the test or understand the questions that are in the test. They hit a blank*”.

RQ 3

4.6.2.2 Sub-theme 2.2: External Factors that Limit the Support of Learners Experiencing Dyscalculia



The teachers identified various external factors that limit the support of learners experiencing dyscalculia in Grade 3. The teachers’ factors differed according to information analysed from the interviews, observations and journal entries. The teachers identified that they do not have enough time to successfully support learners and that it is influenced by having too many evaluations. However, in CAPS (DBE, 2011b) the use of various assessments is promoted to provide each learner with the opportunity to demonstrate their true potential. Time was identified as being a cultural resource in Chapter 2 by the Organisation for Economic Co-operation and Development (OECD, 2010) as the time learners can spend on learning activities. Resources are discussed in detail in theme 3, and is, therefore, not discussed in this section, it is, however, important to take note that the concept of time is seen as an external factor that limits the support of learners experiencing dyscalculia in Grade 3. The previous statement is supported by Izci (2016) who explains external factors as being factors that the teacher has control over and includes time allocated to teaching and learning.



Teacher F mentioned that “*I must teach the concept today and tomorrow, I must assess it, and then the concept isn't captured yet, but they are assessed in it. So, for me that is the problem. That is why we experience learning difficulties because the children don't understand the concepts...*” One of the other biggest challenges that teachers experience is language barriers, where the learners do not have access to the language of learning and teaching (LoLT). This is also identified as a cultural

resource and is, therefore, not discussed in this section. Another barrier that Teacher C experienced is that many of the learners in her classroom started school in rural areas. She added that “...a child that comes out of a rural school... is lost and that is where the language comes in, and to catch up it takes a huge amount of extra work, extra lessons”. Even though the main theme of this quote encapsulates language barriers, it can also be seen that learners who experience dyscalculia and who change schools are in situations that limit the support they need.

Another aspect identified that could influence teacher support is teachers’ lack to show sensitivity to learners’ barriers. Teacher sensitivity is imperative to learners experiencing difficulties (Verschueren & Koomen, 2012). Nevertheless, the findings highlighted that some teachers could not show sensitivity to barriers the learners face. These teachers treated the learners with disrespect and mocked their difficulties. Engelbrecht (2016) alluded that this contributes to barriers that learners can experience in obtaining mathematical skills and understanding and that teachers do have control over how they address learners’ difficulties.

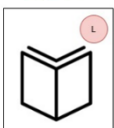


The following two journal entries also indicate a lack of sensitivity and a lack of how to support learners experiencing dyscalculia:

Entry 7 – Teacher I	Entry 9 – Teacher F
<p>“The teacher sent individual learners to another teacher to support these learners”.</p>	<p>“The teacher seems very knowledgeable on how to support learners experiencing MLD (dyscalculia) but in practice there is no evidence of these strategies and methods”.</p>



4.6.3 Theme 3: Nature of Support Needed to Strengthen Teacher Support to Learners Experiencing Dyscalculia in Grade 3



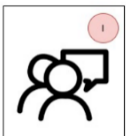
As the interviews and observations were conducted, it was evident that the Grade 3 teachers admitted to not having received sufficient training on how to support learners experiencing dyscalculia. It was also evident that the teachers felt that the lack of parental involvement and support also played a vital role in how they support these learners. This theme consists of information gathered from the participants and the literature on support and training needed by teachers to effectively support learners

with dyscalculia. South African research has provided valuable information regarding the implementation of support structures to learners experiencing LD, which proved that teachers experience it as a stressful activity and that the teachers do not receive sufficient support to successfully implement it (Nel, Tlale, Engelbrecht & Nel, 2016). This necessitates the importance of continuous teacher training within the school environment and the district level (DBE, 2011a). Nel *et al.* (2016) stress the value of parental involvement to support learners experiencing difficulties but explain that non-involvement can sometimes be ascribed to illiteracy within the South African educational environment. In South Africa, continuous professional development of teachers is managed through the implementation of the Continuing Professional Teacher Development (CPTD) system (Bernadine, 2019).

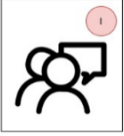
4.6.3.1 Sub-theme 3.1 Sufficient Training

When the participating teachers were asked whether they felt that they were sufficiently trained to implement successful teacher support to learners experiencing dyscalculia in Grade 3, all participants indicated two positions:

- Firstly, that they were inappropriately trained during formal training (degrees and certificates), where supporting learners with dyscalculia was not dealt with or lacked detailed training; and;
- Secondly, that informal training (workshops and courses) were not implemented regularly and failed to address all the different content areas of Mathematics.

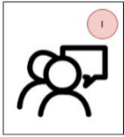


Teacher A concurred the above stance of formal training by indicating that “*I think the big thing is, uhm, one's studies, inclusive education is in our studies, but it does not, I almost want to say, is not one of the main aspects in your studies. So, for you to really get into support you have to go on to study in inclusive education for example, uhm, and not everyone, I think most of the staff completed a regular degree*”. According to Boudersa (2016); and Navsaria, Pascoe and Kathard (2011), teachers do not receive sufficient and effective formal training to support learners experiencing difficulties. If teachers receive a good quality education and professional development opportunities, the teaching and learning environment will be positively impacted (Bernadine, 2019; Boudersa, 2016).



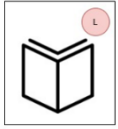
Teacher D asserted that even though the subject heads are sent for informal training, the other teachers are not trained and she feels that *“the further I progress through the years it feels to me like it is getting worse as the curriculum is expanded but we are not informed. Usually one teacher is sent per phase. So that teacher is usually very up to date but the rest of us who also offer Maths are not up to date. Feedback is given from that person but it's so fast you can't, you can't keep up”*.

Teacher E agreed with the notion that training is not implemented regularly by stating that *“The department will also offer training opportunities. Not always as much though”*. Teacher F further added that training is *“too far and few between. It was two years ago, and I would really like to do a follow-up course. I would like to go for training every year because mathematics isn't a thing that stands still. Because me and you [sic] do not think about a sum in the same way and use the same method to get to the answer, I think it is very important to address that... I would really like the training for teachers to take place more frequently and for it to be instructive and meaningful”*. Teacher H, furthermore, concurred that *“I do not think that there are enough workshops for it, you can never learn enough, I do not think that there is anything that is currently enriching us in a quarter or taught to us what exactly we must do with serious learning problems... I would just say that there needs to be more workshops that specifically focus on mathematical learning difficulties and not only how to teach mathematics but specifically how to support the learner that struggles with it”*.

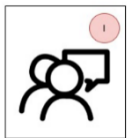


Even though the teachers mainly took this stance, they also advocated for practical experience to be incorporated in current educational training. Teacher B opined that *“I think the content is good, but when it comes to the practical then I think the students need to get more practical teaching that they can be in touch with what happens in a classroom because what you learn in books and what really happens here in a class is two different worlds”*. Teacher C declared that *“practical experience is our biggest problem, I mean with all due respect, some of the teachers that come in here they don't even know how to handle classroom, they don't know how to fill in a register, I mean we had to do that in our fourth year, we were told all those things. So, it's not hands-on”*. Teacher I indicated that *“the reality of what you experience in class and what you are taught are worlds apart. To have a degree or a diploma or whatever*

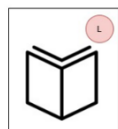
would not make a difference because you must come sit with these children that are problem cases and see where the problem lies”.



Bernadine (2019:2) recognises the imperativeness of teacher training and professional development by stating that “Teacher professional development should therefore, be looked at as a continuous process. This is true because learning is a lifelong process. If teachers do not keep up with the global changes, especially those that come with technology, then they will not fit in this era. It is on this basis that continuing professional development (CPD) is prioritised”. Powell, Terrell, Furey and Scott-Evans (2003) add that professional development has a significance for learners’ achievements.



Nevertheless, many of the teachers had a positive attitude to the possibility of further education and training in dyscalculia. Teacher A felt that “*attending courses all the time so you can only learn more*” and further said that “*when there are new trends or so in education, then one must also keep up with it*”. Teacher B stated that “*there is always room for improvement in the sense that you can always learn something new*” which is concurred by Teacher E’s statement that as a teacher you need “*to enrich yourself all the time and make sure you stay up to date*”. Teacher G stated that “*you can always learn, you can never stop learning, you can always receive more advice and more ideas*”. Only one teacher had a negative comment and opined that “*I have to be careful now because teachers don't like holiday workshops because their time is precious to rest. So, I don't really want to say workshops*”.

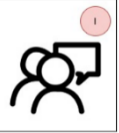


Chen (2017) believes that principals play a critical role in promoting a positive attitude in teachers to attend professional development opportunities and further adds that the principals should create teaching groups so that teachers can learn together. Professional development opportunities are critical to ensure that South African teachers can produce quality education (Mogashoa, 2017). Furthermore, in a study conducted by Bernadine (2019), the findings conclude that teachers do not want to attend these opportunities due to them being technologically illiterate and many of the professional development opportunities are electronic. The OECD (2009) added that other factors that negatively affect teachers’ attitudes toward these opportunities are that it conflicts with their work responsibilities, it does not meet their needs for professional development, they have responsibilities at home, and it is too expensive,

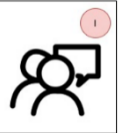
they do not receive the necessary support within the school environment or that they do not meet the pre-requisites.

RQ 1

4.6.3.2 Sub-theme 3.2: Support Teachers Need

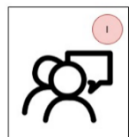


The teachers mentioned that further education and training were provided by the department, the SAOU (Teachers' union) and the Afrikaans School Support Centre regarding the support of learners experiencing LD. All nine participants indicated that there are different support structures in place to support learners experiencing dyscalculia such as the “*school-based support team*” (Teacher A, E, F & I); the “*deputy head*” (Teacher A); a “*Head of Department*” (Teacher E & F) “*an occupational therapist*” (Teacher C, D & E); “*an educational psychologist*” (Teacher E, F & H); “*a speech therapist*” (Teacher C & E); a “*play therapist*” (Teacher E) and the “*department*” (Teacher I). However, the teachers felt that the structure that lacked the most support is that of parental involvement. The WP6 (DoE, 2001) affirms that a lack of parental involvement contributes to LD. Nevertheless, the “Guidelines for Inclusive Teaching and Learning” (DBE, 2010) provide guidelines to foster and promote parental involvement.



Teacher A stated that “*parents' involvement is no longer what it was*” and further opined that parents do not want their children to be assessed for LD because “*they will refuse it because they know that many times other things also come out in such [an] evaluation. Not only is there a mathematical or academic problem, but there are sometimes domestic circumstances that parents try to hide*”. According to teacher B, the lack of parental involvement negatively influences learners' ability to understand mathematical knowledge and acquire mathematical skills because “*the parents are not really focused on raising awareness of numbers, concepts like multiplication and division for the child from their childhood*”. Teacher E mentions that cultural resources such as time also plays a role, but that time is not only restricted to the classroom or school context, but also has to do with the time that parents spend with their children at home because “*...many times, both parents come home late. So, they [learners] come home, [go] to bed or eat, then [go] to bed, sleep. There is hardly time to look at their homework*”. Teacher F thinks that parents are not informed or made aware of what the curriculum content entails because “*the parents aren't necessarily aware and then they teach them [the learners] the wrong things at home, such as vertical addition*”.

and subtraction, which is something we do not teach to them in Grade 3. That is not part of our curriculum. So, now the child is confused because they are taught something different at home than what they are taught at school” but that “parents also play a very important role in the support of their child”.



The WP6 (DoE, 2001:20) raises the following statement regarding how teachers should be assisted to support learners with LD: “One of the tasks of the district support team was to assist educators in institutions in creating greater flexibility in their teaching methods and the assessment of learning. They will also provide illustrative learning programmes, learning support materials and assessment instruments”. Furthermore, the DBE (2010b) states that a policy should be developed to support teachers to be able to straddle the grade of a learner that experiences dyscalculia.

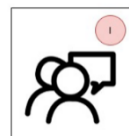
4.6.3.3 Sub-theme 3.3: Strategies to Strengthen Teacher Support to Learners Experiencing Dyscalculia

RQ 1

The researcher asked the participants whether they make use of any of the strategies mentioned in section 2.5.2 *Strategies to Support Teachers to Help Learners Experiencing Dyscalculia* to help those learners experiencing dyscalculia. They were

RQ 2

also asked to elaborate on their answer. The researcher asked this question to gain a better understanding of what teachers implement in the classroom and their reasons for doing so. Some of the reasons for not implementing certain strategies were due to the classroom size, limited time or ignorance of how to implement them. Most of the teachers indicated that they support learners with dyscalculia by implementing individualised teaching and using remedial teaching after school. Teacher B indicated that she not only uses peer teaching but also uses language-specific peer teaching by “*find[ing] someone who explains it in their own language because these learners have English as a third (3rd) language*”. Teachers C and E indicated that “*We also work concretely*” (Teacher E) which is something that is promoted by the DBE (2010:17) to support learners with dyscalculia. Teachers B and C also mentioned that they use “*peer teaching*” (Teacher C) to support these learners. Teacher F added that she promotes parental involvement “*I also sent some of the things home because I feel that the parents also play a very important role in the support of their child because sometimes the parents understand their child better than what I do. So, I also like to involve the parents in the support process so that it's not only the teacher's*



responsibility”. Teachers B and I indicated that they also use “reteaching” (Teacher I) which is influenced by repetition (Teacher B).

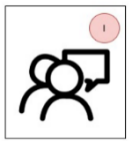
The Guidelines for Inclusive Teaching and Learning (DBE, 2010) also proposed strategies that teachers can implement to support learners that experience LD. These strategies, combined with the strategies identified in section 2.4.2 *Strategies to Support Teachers to Help Learners Experiencing Dyscalculia*, were used to compile Table 4.5 that indicates teachers’ identified strategies that they use in the class to support learners experiencing dyscalculia in Grade 3:

Table 4.5: Teachers' identified strategies of supporting learners experiencing dyscalculia in Grade 3

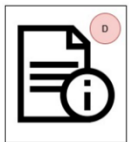
Educational strategy	Teachers' identified strategies in the class								
	A	B	C	D	E	F	G	H	I
The Guidelines for Inclusive Teaching and Learning (DBE, 2010:95)									
“Using concrete materials”			x		x				
“Dividing learning tasks”									
“Using redundancy”			x		x			x	
“Emphasise active involvement”									
“Immediate positive feedback”									
	A	B	C	D	E	F	G	H	I
Section 2.5.2 Strategies to Support Teachers to Help Learners Experiencing Dyscalculia									
Differentiated instruction		x	x		x	X			
Peer teaching and learning	x	x	x	x	x	X		x	X
Small group teaching	x				x	X	x	x	X
Individual teaching	x		x	x	x	X		x	X
Games			x		x	X			X
Media			x		x	X			X
Lesson study		X	x	x	x	X	x	x	X

As seen in Table 4.5 above, it can be said that teachers implement some strategies more frequently than others. It would have been insightful to analyse learners’ performance against teachers’ identified strategies to support learners experiencing dyscalculia but unfortunately, the researcher does not have access to the learners’ marks and scores. This can be seen as a limitation to the study. Two participants indicated that they make use of concrete materials to support the teaching and learning of mathematics and three teachers implement the use of “repetition” to facilitate this process. Five participants do not make use of differentiated teaching. Teacher D stated that “it is very difficult in a class of 34... you work with everyone at the same pace”. Whereas Teacher G did not even know what the term meant and asserted that “no, I have never heard of using that”. Furthermore, Teachers H and I think that “the classes are too big” and Teacher I also added that “the time is too little”.

Watts-Taffe, Laster, Broach, Marinak, Connor and Walker-Dalhouse (2012) promote the use of differentiated instruction but the Guidelines for Inclusive Teaching and Learning (DBE, 2010) state that it should in no way negatively affect the standard of the curriculum, moreover, the implementation of differentiation should not be based on how much time a teacher has but should rather be implemented as a teaching philosophy. Furthermore, the implementation of differentiated teaching was discussed in section 2.3.2 *National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom* (DBE, 2011b).



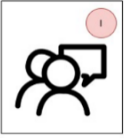
Teacher G was the only teacher that does not use peer teaching and learning because *“that is impossible with a big group like this”*. Three participants advocated against the use of small group teaching, with comments being made such as *“there’s not really time to do group work. We struggle, we struggle as it is, to get through our programme”* (Teacher B); *“I do not use small group teaching because of discipline”* (Teacher C); and *“it doesn’t work for me”* (Teacher D). Two teachers do not use individual teaching because *“there isn’t really a place for that except if you make time for it after school”* (Teacher G). More than half of the participants do not make use of mathematical games to support the teaching and learning of mathematics. Teacher B mentioned that *“there is not really time for playing games. Then we will never get through our syllabus”*. Teacher D concurs this statement by adding that *“Our time is limited. We don’t really have time to play games”*. Teacher G took a disciplinary stance on the implementation of games and opined that it *“causes big problems”*. Lastly, even though Teacher H mentioned that she uses games *“if the children behave or they finished their work quickly”* there is no implementation of using games to facilitate the learning and teaching process.



One strategy that was not anticipated by the researcher is called straddling. Teacher E mentioned the use of this type of teaching and learning strategy to support learners experiencing dyscalculia. She stated that *“Usually you work back, for example, when a Grade 3 is struggling you will work back to Grade 2 math and Grade 1 math depending on where the child is struggling”*.

4.6.3.4 Sub-theme 3.4: Resources Teachers Need to Support Learners Experiencing Dyscalculia

RQ 4



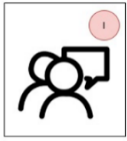
As mentioned in section 2.4.1.4 *Lack of Resources*, resources can be divided into three distinct categories that influence successful curriculum implementation (Adler, 2000). Although these three categories guide the following section and identify resources that lack implementation and resources that are already in place, one category that was not investigated by literature, is worthy of mention. This category includes physical resources and equipment, the teachers mentioned the following resources but stated that they use few of these due to a lack of time or classroom management: “*measuring tapes*” (Teacher A), “*technology such as YouTube videos*” (Teacher A), “*100-charts*” (Teacher A), “*3D shapes*” (Teacher A), “*clocks*” (Teacher A), “*games*” (Teacher B), “*number charts*” (Teacher C & F), “*blocks*” (Teacher C, D & I), “*posters*” (Teacher D), “*scales*” (Teacher D), “*fraction wall*” (Teacher E), “*counters*” (Teacher E & I), “*play money*” (Teacher F), and “*pins*” (Teacher F). Contrary to research conducted by Kiggundu and Nayimuli (2009), the study found that teachers have sufficient physical resources and equipment to facilitate the teaching and learning process.

The first resource identified in the literature to be discussed are human resources. As mentioned earlier, the teachers identified different individuals in the school structure that they believe support them in the identification and support of learners with dyscalculia. The only human resource that is currently lacking is the involvement of parents of learners with or without dyscalculia. Human resources also include pre-service training and other professional development initiatives, this has also been discussed in Section 2.4.1.4. Furthermore, the WP6 (DoE, 2001:18) adds that classroom teachers are the primary resources used to implement and promote support to learners experiencing LD, and, therefore, the focus was on “multi-level instruction, co-operative learning and curriculum enrichment”.

Cultural resources include the number of time learners have for learning and the time teachers have for teaching activities, class size and the LoLT. Nel *et al.* (2016) affirm, from a literature point of view, that teachers are not provided with sufficient resources such as time for teaching and learning activities. According to Merritt (2017), this has

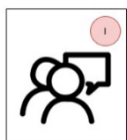


a negative influence not only on teachers' teaching but has an immense impact on learners' learning.



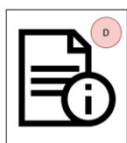
Teachers' experiences regarding cultural resources were negative. Teacher A stated that *"...the great thing, is but one's time. To find the time to, so, so far as resources are concerned at this stage, we now have enough to help them adequately"*. The teacher clearly articulated the concern for the amount of time they have for learning and teaching activities but included that physical resources and equipment are sufficient. Teacher B also expressed her concern for time by adding that *"...Some of the challenges [of] assessing learners with mathematical learning difficulties? I think the time factor. We don't really have enough time to teach because it's just assessment, assessment, and assessment. That's it. Everything is bound for assessment. It's no longer that the kids can just enjoy it. I would say if one could have had more time. Time is crucial to me here because if you have more time, you can do more with a child. Then you can, for example, capture a concept through games because we have games. It's all in the closet, in the storeroom. We have the most beautiful games but there is no time to do it"*. Teacher B reiterated Teacher A's view by confirming the availability of physical resources and resources but the lack of the other categories within resources.

Four other teachers also echoed the lack of time they have for teaching and learning activities. Teacher D mentioned that *"I think I have to say I think the child who is struggling mathematically is the one who suffers because you don't have the time to support that individual child"*. Teacher E added *"...Some challenges in teaching and assessing learners with mathematical learning difficulties [is] definitely time. Time around remediation, around assistance, around extra practice"*, which provides insight into the notion that teachers do not have sufficient time to support learners experiencing difficulties. In Teacher F's interview, it became apparent that the teacher felt as if there is not enough time provided to teach the whole mathematics curriculum, she stated that *"...you only have so much time in one day and there's a lot of things that are left out because you are pressured for time, you only have a certain time to complete [a] specific section..."*. Teacher G expressed her concern by adding that *"Time and its just repetition and repetition..."* is the resource that lacks the most in her classroom.

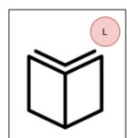


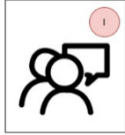
A few teachers also mentioned that the large number of learners they have in one class adds to challenges when it comes to learning, teaching and assessing learners with dyscalculia. Teacher G, H and I were most concerned with how the classroom size affects the learners' learning and their teaching since all three of these teachers had classroom sizes of almost 40 learners each. Walton (2011) and Walton (2016) also alluded to the fact that teachers struggle to support learners with LD due to overcrowded classrooms.

Another factor that was mentioned by the teachers was language barriers due to learners' home language being different from the LoLT. Six of the teachers mentioned that some learners in their class do not speak English as a home language and, therefore, they are taught in a language that might only be their second or third language. Teacher B stated that *"these learners [the learners in the teacher's class] have English as a third language, not their first language"*. In Teacher C's class *"...they [the learners] are not proficient in English; they do not understand the mathematical language. They just don't understand it. That's the challenge, to teach them the language before you can teach them mathematics"*. Teacher D specified that *"In our school, language, it boils down to language. The language that they have not been exposed to"*. Teacher E provided more background on learners' home language by stating that *"...here are children in my class who do not necessarily have Afrikaans as their first language at home."* and Teacher F added that when this takes place *"Language, if they are not taught in their home language, certain principles are left out..."* Teacher H concluded *"...language is a problem when it comes to any work that needs to be explained to them"* which provides valuable insight that not only the teaching and learning of mathematics is affected but also other subjects.



The WP6 (DoE, 2001) affirms that inappropriate LoLT contributes to LD. Kioko (2015) stated that when learners are not taught in their home language, various difficulties arise, which include learners not engaging in the learning process, it negatively affects their confidence, enthusiasm and creativity and their cultural identity. Furthermore, it has a direct impact on the learners' diversity and individuality and facilitates the purpose of unlocking their full potential to participate as members of society (Stein, 2017).





CAPS (DBE, 2011:486) supports the notion that mathematical assessment tasks should not be “language-based” or be dependent on reading, to demonstrate the true ability of each learner. Furthermore, material resources needed to successfully strengthen teacher support to learners experiencing dyscalculia were identified by the researcher as being the Mathematics CAPS, the “Guidelines for Inclusive Teaching and Learning”, the “National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom” and the WP6. These policies and documents have been discussed throughout this chapter.

4.7 CONCLUSION

In this chapter, the aim was to present the research findings on the scope within the documents and policies needed to successfully implement support to learners with dyscalculia as well as the experiences, attitudes and readiness of teachers to include this in the curriculum. The findings were validated by the responses of the participating teachers in semi-structured interviews, observations and a reflection journal.

The data gathered was organised to identify key themes and sub-themes, which provided room to expand on the relevance of the study against literature. In Chapter 5, the data is measured against the theoretical framework and recommendations are provided for the strengthening of teacher support to learners experiencing dyscalculia in Grade 3.

CHAPTER 5: INTERPRETATION OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In Chapter 4, the researcher presented the findings that emerged from the data analysis. The research findings were presented according to the themes and sub-themes. The views, quotes and responses of the teachers' semi-structured interviews were provided, as well as the researcher's observation notes and reflection entries. This was, furthermore, supported by the analysis of the documents and policies identified. This study focused on Grade 3 teachers' views of what dyscalculia entails; what their perceptions regarding the support of learners experiencing dyscalculia are; what the existing gaps are in the implementation of this support; while the kind of support that needs to be provided to these Grade 3 learners was researched and investigated.

Data analysis enabled the researcher to acquire an analytic understanding of the research that was investigated (Nieuwenhuis, 2007) and to interpret and make sense of the findings that emerged. Chapter 5 interprets the research findings to discuss the findings regarding the aim of the study (see section 1.5.1 *Aims of the Study*), the relevant literature regarding strengthening teacher support to learners experiencing dyscalculia (Chapter 2), and the conceptual framework chosen (Chapter 2). Furthermore, Chapter 5 aimed to answer the research questions that guided the study (see Chapter 1).

As mentioned previously, the research questions was coded, therefore, RQ 1 was used for the primary research question and RQ 2, RQ 3 and RQ 4 for the three secondary questions.

5.1.1 Primary Research Question

How can teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened? (RQ 1)

5.1.2 Secondary Research Questions

- What strategies will strengthen teacher support to learners experiencing dyscalculia? (RQ 2)
- How do teachers support learners experiencing dyscalculia? (RQ 3)
- What resources do teachers need to support learners experiencing dyscalculia? (RQ 4)

The research questions are numbered from RQ 1 – RQ 4, so that it would be easy to establish which question related to which sub-theme. This easy referencing will help to align the findings, themes and the questions that guided this study. The researcher made use of three themes and nine sub-themes to establish a comprehensive understanding of the findings (Chapter 4). These themes, as well as the literature and conceptual framework (Chapter 2), were used to provide a comprehensive summary. Furthermore, this summary guided the conclusions and recommendations. The literature provided perspectives from a global and a local viewpoint regarding different aspects of strengthening teacher support to learners experiencing dyscalculia. Through reflecting on both the findings and the literature, it is evident that in South Africa, strengthening teacher support to learners experiencing dyscalculia is not implemented as successfully as it could be. However, many of the correct support structures are in place such as adequate physical equipment and resources, as well as teaching strategies.

5.2 THEMES AND SUB-THEMES

In the process of interpreting the research findings, it is relevant that the themes and sub-themes that emerged from the data analysis, be referred to once more. The themes allowed the research findings to be organised in a way that makes recommendations specific to those themes. Furthermore, within these themes, the various research questions were identified, reported and answered.

In Table 5.1 below, the themes and sub-themes were presented, and the different research questions that guided the study were grouped accordingly and aligned to the related sub-themes. This enabled the researcher to strengthen the answer to the

research questions by providing evidence of findings and literature. Furthermore, the researcher indicated which findings supported the literature, which findings contradicted the literature and which findings provided new insight into the literature.

Table 5.1: Themes, sub-themes and research questions

Themes	Sub-themes	Research questions
Teachers' knowledge and understanding of how to support learners experiencing dyscalculia in Grade 3	Teachers' understanding of the policy context	RQ 1 & 3
	Teachers' knowledge and understanding of dyscalculia	RQ 3
	Teachers' perceptions of supporting learners with dyscalculia	RQ 3
Factors limiting teachers in supporting learners experiencing dyscalculia in Grade 3	Internal factors that limit the support of learners experiencing dyscalculia	RQ 3
	External factors that limit the support of learners experiencing dyscalculia	RQ 3
Nature of support needed to strengthen teacher support to learners experiencing dyscalculia in Grade 3	Sufficient training	RQ 1
	Support teachers need	RQ 1
	Strategies to strengthen teacher support to learners experiencing dyscalculia	RQ 1 & 2
	Resources teachers need to support learners experiencing dyscalculia	RQ 4

5.3 INTERPRETATION OF RESEARCH FINDINGS

The following sections aimed to interpret the findings that stemmed from the research study.

5.3.1 Teachers' Knowledge of Supporting Learners Experiencing Dyscalculia in Grade 3

5.3.1.1 Teachers' Understanding of the Policy Context

The findings of the research study confirmed that the participants show low levels of understanding of what policies are relevant to support learners with dyscalculia. Maharajh *et al.* (2016) postulate that teachers do not have sufficient knowledge of policies due to a lack of training. All teachers were aware of the FP CAPS and how it guides the assessment. Teachers were familiar with policy content in CAPS for Grade 3 and had varying levels of confidence regarding the grade-specific content.

Regarding the policy requirements for assessing and supporting learners in mathematics, teachers' planning provided various insights. The CAPS (DBE, 2011a) stipulates that 420 minutes per week should be spent on the teaching and learning of mathematics. Even though school B's (Teacher B, C & D) planning indicated that they spend 420 minutes per week on mathematics, the planning only focused on numbers, operations and relationships for the whole week and did not account for the other four content areas. School C (Teacher E & F) provided opportunities to explore all five content areas and had the same time allocation as stipulated by CAPS (DBE, 2011a). School D's (Teacher G, H & I) planning indicated how they plan their daily activities, and only encapsulated one content area where 85 minutes were given for mathematics on that specific day. CAPS (DBE, 2011a) indicated that 420 minutes a week needs to be spent on mathematics, which totals to 84 minutes a day. This indicated that all nine teachers' planning was guided and influenced by CAPS (DBE, 2011a).

Apart from the CAPS, teachers do not have adequate knowledge of policies that are meant to provide information on how to support learners with LD. The previous statement is echoed in research conducted by Ferreira and Schulze (2014) who state that teachers lack knowledge of how these policies can be utilised to support

learners with dyscalculia. Even teachers who had studied remedial or inclusive education in their initial or in-service training did not mention any other policies that could be used to support their knowledge, skills or teaching methods. Teachers were not aware of the WP6, the “Guidelines for Inclusive Teaching and Learning” or the “National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom”. They could not make any reference to the importance of these policies to their teaching or the supporting of learners.

The teachers, furthermore, voiced their concerns on the negative impact that the constant changes in the curriculum have on their teaching and learners’ mathematical skills and understanding. Teacher D believed that the constant changes in the curriculum were far too many for the teachers to keep track of how exactly they should be implemented. Literature provided by King-McKenzie *et al.* (2013) reiterates that these constant changes overwhelm teachers.

Research questions one and three (RQ 1 and 3) can be answered in this section. Firstly, *how can teachers’ knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?* Teachers’ knowledge and skills of supporting learners with dyscalculia in Grade 3 can be strengthened by improving their knowledge of different policies, documents and textbooks through teacher training and development. Secondly, *how do teachers support learners experiencing dyscalculia?* Teachers support learners experiencing dyscalculia by implementing the CAPS in their planning and execution of lessons, however, this is not sufficient as the CAPS did not provide specific guidelines on how to support learners with dyscalculia.

5.3.1.2 Teachers' Knowledge and Understanding of Dyscalculia

Sousa, Dias and Cadime (2017) postulate that teachers need sufficient knowledge of dyscalculia to adapt their teaching methods and implement support strategies for these learners. Furthermore, Shalev and Gross-Tsur (2001) and Williams (2013) affirm that teachers neither have sufficient knowledge of dyscalculia nor know how to support these learners. This is reflected in the data findings, where it is evident

that none of the teachers had a comprehensive understanding of what dyscalculia entails and how to support learners experiencing dyscalculia.

Even though five teachers had heard of dyscalculia before, they still provided an ambiguous understanding of what dyscalculia entails. Dias, Pereira and Van Borsel (2013) reported in their study that teachers with more experience had more knowledge of dyscalculia and how to support learners experiencing dyscalculia. Contradictory to this were the findings of this study's data which indicated that the most experienced teacher (Teacher A) still did not understand what dyscalculia entails. Research question three (RQ 3) can be answered in this section: *How do teachers support learners experiencing dyscalculia?* The teachers use various strategies to support learners experiencing dyscalculia, which include peer teaching and learning, as well as lesson study. Few teachers opted for the use of other strategies such as media, games and individual teaching but explained that the time allocated to the teaching and learning of mathematics negatively influences the implementation of these strategies.

Butterworth, Varma and Laurillard (2011) emphasise the importance of training teachers on how to support students experiencing dyscalculia, as well as how accurate support structures can be designed for these learners.

5.3.1.3 Teachers' Perceptions of Supporting Learners with Dyscalculia

Teachers displayed positive and negative perceptions and attitudes when discussing the support of learners with dyscalculia. There was, however, a big discrepancy between what some of the teachers said in the interview and the practical application that was observed. During the observation, the researcher noted that some teachers talked to the learners with respect and treated their mathematical difficulties with patience and understanding, however, three teachers showed signs of irritation, scolded learners and showed discouragement and ignorance towards their learning difficulty. Themane and Osher (2014) affirm the importance for teachers to create supportive environments for learners experiencing LD. These environments will prevent learners from suffering from mathematical anxiety and disliking the subject. *How do teachers support learners experiencing dyscalculia?* The findings provide evidence that some teachers created a safe and

conducive environment for these learners, whereas other teachers felt overwhelmed and treated the learners with disrespect.

5.3.2 Factors that Limit Teacher Support to Learners Experiencing Dyscalculia in Grade 3

5.3.2.1 Internal Factors that Limit the Support of Learners Experiencing Dyscalculia

The internal factors identified in the study that limited teachers' support to learners experiencing dyscalculia were dyscalculia, mathematical anxiety and the teachers' beliefs about learners' abilities in mathematics. Four teachers believed that learners are born with the ability to be competent in mathematics. Engelbrecht (2016) ascribe teachers' beliefs about learners' competencies as a barrier that limits the support of learners experiencing dyscalculia. Three teachers mentioned the negative effect learners' mathematical anxiety has on their support to these learners which is reiterated by literature provided by Suárez-Pellicioni *et al.* (2013); Emerson and Babbie (2015); and, Cropp (2017) and. Unfortunately, many teachers lacked detailed knowledge of how to support learners with dyscalculia in an inclusive environment and how to design support structures that would be beneficial to their learning.

5.3.2.2 External Factors that Limit the Support of Learners Experiencing Dyscalculia

The teachers concurred that the curriculum requires too many formal evaluations and that this affects learners' acquisition of mathematical skills and understanding. Teacher B added that the number of formal evaluations also affects their time to support learners with dyscalculia since they are not provided with an adequate time that is provided to capture certain skills and concepts. The issue of too many formal evaluations was not anticipated by the researcher even though it was briefly mentioned as a barrier that learners can experience in obtaining mathematical skills and comprehension, as discussed in section 2.5.1.2 *External and Internal Barriers That Influence Mathematical Development* (Engelbrecht, 2013). Further investigation is needed to develop a comprehensive understanding of how this influences the support needed by learners experiencing dyscalculia.

Eight of the nine teachers voiced their concerns regarding the time that is provided by the curriculum for assessment, skills and concept development and time for teaching. Although this was not thoroughly reviewed in this study, significant emphasis has been put on this issue. As mentioned previously, the time learners have for learning activities influences their achievement in mathematics (Usman, 2016; OECD, 2010). The influence time has on mathematical skills and comprehension was elaborated on in section 5.3.3.4 *Resources Teachers Need to Support Learners Experiencing Dyscalculia*. Furthermore, the teachers explained that no access to the LoLT has a noteworthy influence on the support of learners experiencing dyscalculia. It is important to note that this is a situation the teacher has no control over (Engelbrecht, 2016). This was also elaborated on in section 5.3.3.4 *Resources Teachers Need to Support Learners Experiencing Dyscalculia*.

The researcher identified other factors through a critical evaluation of the observations and the reflective journal. The researcher found that some teachers displayed inadequate knowledge and skills related to SMK. One teacher (Teacher I), explained one of the topics (time) in the content area of measurement incorrectly. Ball *et al.* (2008), Hannula (2017) and Lee *et al.* (2018) emphasise the importance teachers' SMK has on learners' competence in mathematical understanding. One of the aspects of SMK, namely CCK, is teachers' competence in executing basic numeracy skills without errors. Teacher I did not display competence in executing basic skills of time-telling. Subject matter knowledge has an influence on learners' academic achievement (Kiamba, Mutua & Mulwa, 2018) and since learners have a spontaneous tendency of imitating teachers' actions (Matti, 2017), the wrong skill and concept will also be imitated if the learners have not developed the skill of time-telling.

Teacher sensitivity is imperative to learners experiencing difficulties (Verschueren & Koomen, 2012). Nevertheless, the findings highlighted that some teachers could not show sensitivity to barriers learners' faced. These teachers treated the learners with disrespect and mocked their difficulties. Engelbrecht (2016) alluded that this contributes to barriers that learners can experience in obtaining mathematical skills and understanding and that teachers have control over how they address learners' difficulties.

Teachers are sometimes reluctant towards the teaching and learning of mathematics (Crawford, 2018). According to Savina (2019), teachers' resistance can be ascribed to various reasons, which include a lack of theoretical knowledge, lack of support and advice, lack of self-confidence, as well as not being provided with enough time. In the findings of this study, teachers did not necessarily display a resistance towards the teaching and learning of mathematics but rather indicated a lack of training on how to support learners with dyscalculia. As indicated by Teacher H, the teacher felt that she had not received any information or support on how teachers are supposed to support learners with LD and that this has made her reluctant to teach mathematics to learners experiencing dyscalculia. These factors need to be addressed for the strengthening of teacher support to be successfully implemented. Furthermore, this will also build teachers' knowledge and skills of how to support these learners.

5.3.3 Nature of Support Needed to Strengthen Teacher Support to Learners Experiencing Dyscalculia in Grade 3

5.3.3.1 Sufficient Training

As mentioned in Chapter 4, the teachers felt that they were not appropriately trained during formal training to know how to support learners with dyscalculia. They also opined that the informal training they attend is not conducted regularly and that it does not address the necessary knowledge and understanding needed to support learners with dyscalculia. Jameel and Ali (2016) support this evidence, as they indicated that teachers are not properly trained in mathematics. Other researchers indicated the same statement, which is that teachers are not properly trained in mathematics and that this influences learners' achievement (CDE, 2011; Harris & Sass, 2011; Lai *et al.*, 2011; Fuje & Tandon, 2018).

Engelbrecht *et al.* (2007) and Lumadi (2013) are among the few that echo the differences in attitudes of teachers. In the findings of the research data, it became evident that teachers displayed a positive disposition towards teacher training and development, specifically towards how to support learners with dyscalculia, which is concurred by a study conducted by Lumadi (2013). All the teachers that were

interviewed had at least five years of experience, it would, therefore, be valuable to research how different years of teaching experience influence teachers' views on supporting learners with dyscalculia, as seen in research carried out by Mavuso (2014). Teacher training and development will have a positive impact on teachers' knowledge and skills of supporting learners with dyscalculia. It is, therefore, imperative that training opportunities are provided to teachers to provide them with the necessary support needed to teach learners experiencing dyscalculia.

5.3.3.2 Support Teachers Need

From the teachers' viewpoint, it is evident that teachers feel that they receive support from all role players in the educational environment to address the difficulties that learners experience. However, the findings indicate that the only support structure that is not successful in place yet, is the involvement of parents and that the teachers feel that this influences the ability of learners to grasp mathematical skills and knowledge.

The teachers believed that parents play a significant role in their children's acquisition of mathematical knowledge and skills and without their contribution, the learners will experience difficulties. Firstly, the term 'parental involvement' is explained as a situation in which parents are involved in the education of their children (Ntekane, 2018). This situation aims to build the relationship between parents and their children to cultivate a love for learning and aspiration for success (Clinton & Hattie, 2013). Ntekane (2018) adds that parental involvement improves learners' willingness to learn and their persistence to grasp new knowledge and skills. According to Jafarov (2015), poor parental involvement is due to low educational levels, lack of time or no interest. Teachers' views in the findings echo the previous statement. Their views indicated that the lack of parental involvement is influenced by parents' working hours (lack of time) and their lack of knowledge of the curriculum (low educational levels).

If parental involvement can be improved, it will have a positive impact on how teachers support learners with dyscalculia (DBE, 2010). The parents can support the teacher to identify relevant resources and strategies that can be used to support

their child. Research has indicated that parents know their children better than teachers (Allen & Cowdery, 2015; Ashbridge & Josephidou, 2018), therefore, parents could provide teachers with immense support. Moreover, teachers' knowledge and skills will also improve because the parent could inform the teacher of alternative support structures.

5.3.3.3 Strategies to Strengthen Teacher Support to Learners Experiencing Dyscalculia

The teachers had different opinions on the implementation of the strategies identified by the literature in Chapter 2. Some of the teachers used most of the strategies, whereas other teachers did not use more than two of the mentioned strategies. The reasons for not implementing the strategies ranged from difficulties associated with big classes and the time provided for mathematics in the curriculum. From Table 4.2, it is evident that the most popular strategies that teachers implement are peer teaching and learning as well as lesson study (total of nine participants). This is followed by small group teaching and individual teaching (total of six participants). Nevertheless, the researcher thinks that all these strategies should be implemented to ensure learners with dyscalculia are successfully supported, which also answers the first and second RQ.

Firstly, *how can teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 be strengthened?* The teachers need to receive training and development opportunities regarding different strategies that they can implement when teaching and supporting learners with dyscalculia. *What strategies will strengthen teacher support to learners experiencing dyscalculia in Grade 3?* All the strategies mentioned in section 2.5.2 *Strategies to Support Teachers to Help Learners Experiencing Dyscalculia*, namely: differentiated instruction; peer teaching and learning; small group teaching; individual teaching; games; media; and lesson study.

One strategy that was not investigated in the literature is called "straddling", which Teacher E has identified as a strategy to strengthen teacher support to learners experiencing dyscalculia. On the SAOU webpage, straddling is explained as part of curriculum differentiation, where the learners' activities are adapted, for them to

access it on a lower level. For this reason, straddling will form part of differentiated instruction.

5.3.3.4 Resources Teachers Need to Support Learners Experiencing Dyscalculia

The following section answers RQ 4 and, therefore, addresses the resources that teachers need to support learners experiencing dyscalculia. As mentioned in the literature (Chapter 2), resources do not necessarily refer to physical objects such as counters and blocks that learners need to support their understanding of mathematics. Nevertheless, the teachers declared that these types of resources are provided to them. Resources they have include blocks, counters, 100-charts and games. However, they stated that they do not have the time to use all of them.

In section 2.4.1.4 *Lack of Resources*, the different resources that influence successful curriculum implementation were discussed. The first resource, namely human resources, which includes teachers, their PCK and all other role players, were more or less adequately implemented. The teachers found all the role players in the educational environment to provide excellent support and cater for their needs. Teachers' PCK was, however, not as successful since the researcher found during the observations, that some of the teachers lacked adequate knowledge and skills of mathematics. This statement is supported by findings from Zuber-Skerritt (1992); Kaino and Moalosi (2013); and, Venkat and Spaul (2015) that found that teachers lack sufficient PCK.

The teachers lacked adequate knowledge of which material resources they can use to strengthen their support to learners experiencing dyscalculia. CAPS was the only policy mentioned, with no reference to other documents, policies or textbooks. Maharajh (2016) found that South African policies are not implemented due to there being a lack of training, resources and support. The findings indicated that the teachers do implement the CAPS, but that they do not know other policies that will support learners with dyscalculia due to them lacking sufficient training.

Lastly, the resource found to lack the most successful implementation were cultural resources. Firstly, the teachers indicated that the time needed for them to

successfully teach, assess and support learners with dyscalculia is limited. The Star's Bongani Nkosi (2018) wrote that the CAPS is known for demanding too many assessments with little time left for teaching. Furthermore, Nkosi (2018) quotes Basil Manuel, the executive director of the National Professional Teachers Organisation, who stated that teachers are completely overwhelmed by the implementation of CAPS.

Secondly, the teachers found that the LoLT influenced learners' mathematical acquisition since there were learners who do not speak English as a Home Language. The Language in Education Policy of 1997 states that learners should be taught in their Home Language in the FP (DBE, 1997). For this reason, English should be taught as an additional language if learners do not speak it as a Home Language. Nevertheless, Setati and Barwell (2008) found that many learners who learn mathematics are taught in a language that is not their Home Language. Countless research (Kieffer, Lesaux, Rivera, & Francis, 2009; Beal, Adams & Cohen, 2010; Sibanda & Graven, 2018) have been conducted on the relationship between language proficiency and achievement in mathematics, which indicates that a low comprehension of the LoLT has a negative influence on learners' achievement in mathematics.

Lastly, the teachers felt that the number of learners in their class affected their ability to support all learners with dyscalculia. Marais (2016) believes that overcrowded classrooms are part of the South African educational system and could remain this way for a long time, which creates an immense challenge for teachers to create an environment conducive to learning. Chingos (2013) and Zenda (2019) support the notion that overcrowded classrooms negatively influence learners' performance.

5.4 THE EFFICACY OF THE CONCEPTUAL FRAMEWORK TO THE RESEARCH FINDINGS

The study was conceptually framed against Vygotsky's Zone of Proximal Development (ZPD) and Fuller's Concerns-Based Model of Teacher Development (CBMoTD). The research data of this study and the conceptual framework are chosen indicated a definite link. Firstly, various aspects of the challenges that

teachers experience to successfully support learners with dyscalculia became evident in the data analysis. These challenges can also be referred to as concerns since these are areas of concern that the teachers must face. The major concerns identified, can be divided into Fuller’s three areas of concern as indicated in the CBMoTD. Table 5.2 provides a brief overview of the concern topics of the CBMoTD and the associated concerns obtained from data analysis:

Table 5.2: New insights gained from the CBMoTD

Self-concerns	Task or situation concerns	Concerns of impact on learners’ learning
How teachers view themselves and their teaching.	Daily responsibilities of a teacher.	Teachers’ abilities to support learners in reaching their full potential.
Teachers’ sufficiency in showing sensitivity .	Teachers’ understanding of policies to support learners experiencing dyscalculia.	Time allocated to the teaching and learning of mathematics.
	Teacher training and development in mathematics.	Formal evaluations required by the DBE.
	Teachers’ PCK and SMK of mathematics.	Parental involvement in learners’ achievement in mathematics.
	Resources (physical) teachers need to address learners’ difficulties to obtain mathematical skills and understanding.	

The three concerns from the CBMoTD identify three major concerns that teachers face, and within these three concerns, the concerns and challenges identified from the data were grouped. As seen in Table 5.2 above, various challenges were identified in the research data. The CBMoTD, therefore, provided valuable insight into the context of teachers’ experiences. It supported the identification of areas of concern that need to be addressed if the support provided by teachers to learners experiencing dyscalculia is successfully strengthened.

The other framework that guided this study, namely, the ZPD, supported the identification of how teachers can be supported to teach learners with dyscalculia. The ZPD guided the research study by identifying how these learners need to be supported to work independently. This supported the identification of different strategies that teachers can use to support learners with dyscalculia. Referring to Figure 5.1, the strategies identified to form part of assisted learning where the

learner is supported to achieve a goal or understanding. Without these strategies, the learner will not be supported and will, thus, experience difficulty to make progress. The ZPD provided valuable insight into the identification of these strategies that teachers can use, modify and adapt to support learners with dyscalculia to reach the ZPD where the learners do not require any assistance.

5.5 RESEARCH LIMITATIONS AND RECOMMENDATIONS

5.5.1 Limitations of the Study

Although the research study reached its aims as indicated in Chapter 1, limitations were unavoidable. Queirós, Faria and Almeida (2017) posit that qualitative research has both strengths and weaknesses, which supported the notion to identify some challenges that limited this study. These challenges and limitations were dealt with as best as possible.

The first aspect that needs to be mentioned, is the fact that the study was conducted in four schools in one district in the Gauteng province. Considering the number of schools in South Africa, this is a small number. Although nine different cases were examined, all the participants taught in more or less the same teaching circumstances. To cater to teachers from various contexts, further studies with larger sample sizes across different provinces and or districts need to be undertaken to understand how the context influences strengthening teacher support to learners experiencing dyscalculia since the dynamics of each province and district differ vastly from one another. These reasons are indicators that the findings cannot be generalised to a wider population but instead can be inferred as part of this context. Atieno (2009) explains that the main weakness of qualitative research is that the outcomes cannot be extended to a wider population. Further study would, therefore, be required from a broader population group.

The timeframe proposed for data generation was the third school term. However, delays in obtaining participants and permission delayed this process until the fourth term. The researcher struggled immensely to obtain access to different schools and Grade 3 teachers. Many of the schools immediately expressed their views regarding their fixed timelines and other schools never replied to the invitations sent out by the

researcher. This influenced the mathematical activities and lessons presented by the teachers because a number of them had finished with the mathematical curriculum for the year. The teachers were also reluctant to share their experiences due to a fear of getting into trouble with the school. The researcher had to constantly remind the teachers that all information shared would be kept confidential, as indicated in both the invitation letter and consent letter.

5.5.2 Recommendations

The research findings guided the following recommendations on how to strengthen teacher support to learners experiencing dyscalculia in Grade 3.

5.5.2.1 Recommendations for Teacher Development and Training

Teacher development and training on the identification and support of learners experiencing dyscalculia is a high priority. Many teachers do not have the knowledge and understanding of how to support learners with dyscalculia. Capacity building and ongoing workshops will benefit teachers to support and minimise mathematical anxiety and phobias among learners and teachers. Teachers need to be trained on different policies and how to implement them; they need to be trained in the understanding of MLD and how to support learners experiencing it; concerns teachers face need to be addressed through training and workshops; and teachers also need training (pre-service and in-service) on mathematical PCK and SMK. Teacher support needs to be strengthened by analysing and addressing the resources that lack successful implementation.

The conceptual framework identified possible aspects that could be addressed in teacher development and training. The CBMoTD identified possible concerns teachers could have when it comes to teaching learners experiencing dyscalculia, which can be addressed by further education and training, and in pre-service training. Furthermore, the ZPD identifies different strategies teachers could implement to support these learners, and although some teachers already make use of some of the strategies, training could still be beneficial as curricula change and the world becomes more technologically advanced. Moreover, workshops and other training and development opportunities in mathematical learning difficulties need to be made available to teachers.

5.5.2.2 Recommendations for Resources Teachers Need

For the study, resources did not refer to concrete or semi-concrete physical resources or equipment. Resources included the teachers themselves, the LoLT, time allocated to learning and teaching activities, teacher planning and policies. However, according to the DBE (2011:16) the physical resources and equipment that should be included in a Grade 3 Mathematics classroom are counters, large dice, a big counting frame, 100-chart, different number lines, play money and mathematical games, as examples, which the teachers indicated that they do have sufficient physical resources.

The first type of resource that needs to be addressed and analysed through further teacher development and training are the teachers' level of PCK and SMK. The OECD (2010) echoes the previous statement and adds that this also needs to be addressed in pre-service training. Secondly, more time needs to be provided for teaching and learning activities to provide learners with enough time to grasp mathematical content and skills. Furthermore, learners should be placed in schools where the LoLT is their Home Language, and where this is not possible, supportive measures should be put in place to ensure that learners are provided with an environment that supports their optimal development.

The CBMoTD also provides imperative information regarding the resources that teachers need to effectively teach mathematics. As previously mentioned, the three stages within the CBMoTD progress from the one stage of concern that the teachers experience to the next stage (Fuller, 1969; Conway & Clark, 2003). This is a valuable insight into the findings because when the concerns within each topic of concern are analysed, it could provide an understanding of which of the concerns these teachers face should be addressed first. For this reason, a checklist was developed by the researcher by scrutinizing the insights gained from the CBMoTD and the data analysis (see Table 5.3). The purpose of this checklist is to enable teachers to identify which concerns they have regarding the successful implementation of support to learners experiencing dyscalculia and to address these concerns. The checklist should be followed chronologically, commencing from self-concerns to task

or situation concerns and then to the concerns teachers have on their impact on learners' learning.

Table 5.3: Checklist to identify which concerns teachers have regarding the support of learners experiencing dyscalculia

Checklist to identify which concerns I have regarding the support of learners experiencing dyscalculia. <i>* Discussion with colleague, HoD, principal etc.</i>	√	X
Self-concerns		
Sensitivity towards learners' barriers		
Do I show sensitivity to learners experiencing dyscalculia? <i>* Why or why not? How can this be addressed?</i>		
Task or situation concerns		
Understanding of policies		
Do I have sufficient knowledge of the policies that I can use to support learners with dyscalculia? <i>* Why or why not? How can this be addressed?</i>		
Teacher training and development in mathematics		
Have I been sufficiently trained in the teaching of mathematics? Do I know how to support learners with dyscalculia? <i>* Why or why not? How can this be addressed?</i>		
Adequate pedagogical content knowledge and subject matter knowledge		
Do I have sufficient PCK and SMK? <i>* Why or why not? How can this be addressed?</i>		
Physical resources needed		
Do I have enough resources to support learners with dyscalculia? <i>* Why or why not? How can this be addressed?</i> <i>* How can I incorporate the use of different resources into my lesson?</i>		
Concerns of impact on learners' learning		
Time allocated to the teaching of mathematics		
Is there enough time for the teaching and learning of mathematics? <i>* Why or why not? How can this be addressed?</i> <i>* Will it be possible to adapt my teaching to fit with the allocated time?</i>		
Formal evaluations required		
How can I incorporate the different formal evaluations into the programme so that learners are not overwhelmed?		
Parental involvement		
<i>* How can I involve parents in the teaching and learning of their child?</i>		

5.5.2.3 Recommendation for Teaching Strategies

The study's data indicated that teachers use various strategies to support learners experiencing dyscalculia. Even though many of these strategies were implemented, the study emphasises the use of all the strategies to support learners with dyscalculia. These include but are not limited to, differentiated instruction or straddling; peer teaching and learning; small group teaching; individual teaching; games; media and lesson study.

5.6 SUMMARY

In Chapter 5, the research findings were presented regarding the ZPD and the CBMoTD as the conceptual framework utilised in the study. The emerging themes and sub-themes organised the interpretation which was discussed in detail. The recommendations of the research findings for the strengthening of teacher support to learners experiencing dyscalculia were formulated by data analysis.

5.7 CONCLUDING REMARKS

The purpose of the study was to investigate how teacher support could be strengthened to learners experiencing dyscalculia in Grade 3. The detailed and in-depth literature review provided the researcher with insight into possible linkages and gaps in the current educational system regarding mathematics and dyscalculia. Findings from the data were gathered, analysed and generated from the semi-structured individual interviews, classroom observations, reflection journal entries and document analysis were compared to literature as reviewed and discussed in Chapter 2. The literature review/discussion/synthesis provided insight into areas where the published research contradicts or supports the findings, and also whether new findings were made. The published research, as well as the findings, support the notion that learners with dyscalculia are not yet supported as they should be. It also provided valuable insight into how these learners can be supported.

The literature (published research) and findings have contradictory voices regarding how teachers can support learners experiencing dyscalculia. The literature (published research) focused on different strategies to support teachers to help these learners, whereas the findings found that these strategies cannot play a role yet due to external factors that limit the teachers. The external factors found to play the most significant role was insufficient time dedicated to the teaching and learning of mathematics, the LoLT as well as lack of parental involvement. From the teachers' experience in their practice, they implement various strategies mentioned in the literature review, with the most popular being peer teaching and learning as well as lesson study. The only new finding that commenced from the study is the use of straddling as a strategy to support teachers to help learners with dyscalculia. However, even though this term was not elaborately mentioned or discussed in the literature review, differentiated teaching is defined in the same manner as straddling.

Another new insight was the importance of parental involvement to facilitate learners' learning in mathematics. The literature (published research) did not necessarily emphasise the importance of sufficient time as a resource in mathematics classrooms which contrasted to the great need reflected in the findings, that teachers have to be provided with ample time for the teaching and learning of mathematics.

This chapter also aimed to answer the research questions that guided this study. The primary research question is answered by exploring how teachers' knowledge and skills of supporting learners with dyscalculia in Grade 3 can be strengthened. In an attempt to answer the three secondary research questions, the emphasis is laid on strategies teachers can implement to support these learners, how teachers are currently supporting these learners, as well as the resources teachers require to support these learners. A discussion on the various strategies that teachers can use to support these learners was provided. It also became evident that teachers have a poor understanding of what dyscalculia entails and how to support learners experiencing it, and, therefore, it is imperative to strengthen teachers' knowledge and skills of supporting these learners. Moreover, a large number of resources were identified that teachers need to successfully support these learners, which also needs to be addressed and improved.

Although the research findings of this study cannot be generalised, the study supports the strategies presented to strengthen teacher support. In conclusion, the study recommends that schools that need to strengthen teacher support to learners experiencing dyscalculia, should provide ample training opportunities for teachers, address time allocated to the teaching and learning of mathematics to learners with dyscalculia and promote the involvement of parents.

LIST OF REFERENCES

- Adebisi, R.O., Liman, N.A. & Longpoe, P.K. 2015. Using Assistive Technology in Teaching Children with Learning Disabilities in the 21st Century. *Journal of Education and Practice*, 6(24):14-20.
- Adler, J. 2000. Conceptualising Resources as a Theme for Teacher Education. *Journal of Mathematics Teacher Education*, 3(3):205–224:10.1023/A:1009903206236.
- Agar, M.H., Glaser, B.G., Straus, A.L., Hammersley, M., Kirk, J., Miller, M., Miles, M.B., Huberman, A.M., Seale, C., & Silverman D. 2004. Quality and Credibility. In: Seale, C. (2004) *Qualitative research practice*. London: SAGE, 378.
- Ali, R.M. & Kor, L.K. 2007. Association between Brain Hemisphericity, Learning Styles and Confidence in Using Graphics Calculator for Mathematics. 3(2):127–131.
- Allen, K.E. & Cowdery, G.E. 2015. *The exceptional child: inclusion in early childhood education*. 7th ed. Clifton Park, NY: Thomson Delmar Learning.
- Almerino, P.M., Etcuban, J.O., De Jose, C.G. & Almerino, J.G.F. 2019. Students' Affective Belief as the Component in Mathematical Disposition. *International Electronic Journal of Mathematics Education*, 14(3):475-487:<https://doi.org/10.29333/iejme/5750>.
- Andersson, U. & Lyxell, B. 2007. Working Memory Deficit in Children with Mathematical Difficulties: A General or Specific Deficit? *Journal of Experimental Child Psychology*, 96(3):197–228:10.1016/j.jecp.2006.10.001.
- Anney, V. 2014. Ensuring the Quality of the Findings of Qualitative Research: Looking at Trustworthiness Criteria. *Journal of Emerging Trends in Educational Research and Policy Studies*, 5(2):272-281.
- Arifin, S.R. 2018. Ethical Considerations in Qualitative Study. *International Islamic University Malaysia*, 1(2):30-33.
- Arriaga-Sanz, C., Riaño-Galán María-Elena, Cabedo-Mas, A. & Berbel-Gómez N. 2017. Songs Are Taught, Songs Are Learnt: Musical Preferences in Early Childhood. *Music Education Research*, 19(3):309–326:10.1080/14613808.2016.1214694.
- Ashbridge, J. & Josephidou, J. 2018. Part 1: Introduction to Professional Studies. Chapter 6: The Role of The Teacher and Other Adults. In: Cooper, H. & Elton-Chalcraft, S. *Professional Studies in Primary Education*. London, SAGE:142 – 160.
- Ashcraft, M. H. 2002. Math Anxiety: Personal, Educational, and Cognitive Consequences. *Current Directions in Psychological Science*, 11(5):181–185.
- Ashraf, I., Ashraf, F., Saeed, I., Gulzar, H., Shah, K., Azhar, N., Bukhari, S.R., Ilyas, T. & Anam, W. 2015. Reasons for Low Performance of Teachers: A Study of

Atieno, O. P. 2009. An Analysis of the Strengths and Limitation of Qualitative and Quantitative Research Paradigms. *Problems of Education in the 21st Century*, 13:13-18.

Attarzadeh, M. 2011. The Effect of Scaffolding on Reading Comprehension of Various Text Modes on Iranian EFL Learners with Different Proficiency Levels. *Social Sciences & Humanities*, 4(2):1-28.

Badugela, T.M. 2012. Problems Facing Educators in Implementing the National Curriculum Statement: The Case of Tshifhena Secondary School, Vhembe District, Limpopo Province, South Africa. MEd Dissertation. Pretoria: University of South Africa.

Ball, D.L., Thames, M.H. & Phelps, G. 2008. Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education*, 59(5):389–407.

Bausmith, J.M. & Barry, C. 2011. Revisiting Professional Learning Communities to Increase College Readiness: The Importance of Pedagogical Content Knowledge. *Educational Researcher*, 40(4):175–178.

Beal, C., Adams, N.M. & Cohen, P.R. 2010. Reading proficiency and mathematics problem solving by high school English language Learners. *Urban Education*, 45(1):58–74.

Bergin, T. 2018. An Introduction to Data Analysis: Quantitative, Qualitative and Mixed Methods. SAGE.

Bernadine, G.G.K. 2019. Challenges Faced by Educators in the Implementation of Continuing Professional Teacher Development (CPTD): Gauteng Province. *IntechOpen*, 1-12:10.5772/intechopen.84836.

Beteille, T., 2019. *Supporting Teachers To Educate Successful Students*. [online] World Bank Blogs. Available at: <https://blogs.worldbank.org/education/> [Accessed 26 June 2020].

Bird, R. 2009. *Overcoming Difficulties with Number: Supporting Dyscalculia and Students who Struggle with Maths*. 1st ed. London: SAGE.

Bloomberg, L.D. & Volpe, M. 2015. *Completing your qualitative dissertation: a road map from beginning to end*. 4th ed. Thousand Oaks, California: SAGE Publications.

Bogdanova, O., Ginku, E., Bogdanova, E., Zueva, D., Malanchini, M. & Kovas, Y. 2014. Mathematical Anxiety and Mathematical Learning: Multidimensional Approach. *Personality and Individual Differences*, 60:9:10.1016/j.paid.2013.07.178.

Booth, D. & Coles, R. 2017. *What is a “Good” Teacher?* Pembroke Publishers Limited.

- Bornman, J. & Rose, J. 2017. Chapter 9: Understanding children with learning disabilities. In: *Believe that all can achieve: Increasing classroom participation in learners with special support needs*. Pretoria, South Africa: Van Schaick Publishers, 170-172.
- Boudersa, N. 2016. The Importance of Teachers' Training and Professional Development Programs in the Algerian Educational Context: Toward Informed and Effective Teaching Practices. *Revue en ligne éditée par l'École Normale Supérieure d'Oran-Algérie*, 1.
- Brady, K. & Woolfson, L. 2008. What Teacher Factors Influence Their Attributions for Children's Difficulties in Learning? *The British journal of educational psychology*, 78:527–44:10.1348/000709907X268570.
- Brinkmann, S. & Kvale, S. 2008. Ethics in Qualitative Psychological Research. In: Willig, C. & Stainton Rogers, W. (2008) *the sage handbook of qualitative research in psychology*. Los Angeles: SAGE, 259-273.
- Brundrett, M. & Rhodes, C. 2013. *Researching educational leadership and management: methods and approaches*. London: SAGE.
- Bryman, A. 2016. *Social Research Methods*. United Kingdom: Oxford University Press [Online] Available from: <https://www.managementboek.nl/code/inkijkexemplaar/9780199689453/social-research-methods-engels-alan-bryman.pdf> [Accessed: 2019-11-03].
- Burton, D. & Bartlett, S. 2009. *Key issues for education researchers*. London: SAGE (Education studies, key issues).
- Butterworth, B. 2005. Developmental Dyscalculia. In: Reed, J. & Rogers, J.W., (eds.) *Child Neuropsychology: Concepts, Theory, and Practice*. Wiley & Sons, Chichester, UK, 357-347.
- Butterworth, B., Varma, S. & Laurillard, D. 2011. Dyscalculia: From Brain to Education. *Science*, 332(6033):1049–1053.
- Byers-Heinlein, K. & Lew-Williams, C. 2013. Bilingualism in the Early Years: What the Science Says. *Learn Landsc.* 7(1):95-112.
- Centre for Development and Enterprise. 2011. Value in the classroom: The quantity and quality of South Africa's teachers. *CDE in Depth*, (11).
- Charlesworth, R. & Lind, K. 2013. *Math and Science for Young Children*. 7th ed. Wadsworth: Cengage Learning.
- Chen, C. 2017. Facilitation of Teachers' Professional Development through Principals' Instructional Supervision and Teachers' Knowledge-Management Behaviors. *Intechopen*:10.5772/intechopen.77978.

- Chilisa, B. & Kawulich, B. 2012. Selecting a research: paradigm, methodology and methods. In: Wagner, C, Kawulich, B. & Garner, M. (eds.) *Doing Social Research: A global context*. s.l.:McGraw Hill, 51-61.
- Chingos, M.M. 2013. Class size and student outcomes: Research and policy implications. *Journal of Policy Analysis and Management*, 32(2):411-438:10.1002/pam.21677.
- Christmas, D., Kudzai, C. & Josiah, M. 2012. Vygotsky's zone of proximal development theory: What are its implications for mathematical teaching? *Greener Journal of Social Sciences*, 3(7):371–376.
- Claessens, A. & Engel, M. 2013. How Important Is Where You Start? Early Mathematics Knowledge and Later School Success. *Teachers College Record*, 115(6).
- Clements, D.H. & Sarama, J. 2014. The importance of the early years. In: Slavin, R.E. (ed.) *Science, technology & mathematics (STEM)*, 5-9, Thousand Oaks, CA: Corwin.
- Clinton, J. & Hattie, J. (2013) New Zealand Students' Perceptions of Parental Involvement in Learning and Schooling. *Asia Pacific Journal of Education*, 33(3):324–337:10.1080/02188791.2013.786679.
- Cohen, L., Manion, L., & Morrison, K. 2007. *Research Methods in Education*. Routledge [Online] Available from: <https://isimblogblog.files.wordpress.com/2016/05/rme-edu-helpline-blogspot-com.pdf>. [Accessed: 2019-11-02].
- Common Core State Standards Initiative. 2010. *Standards for Mathematical Practice | Common Core State Standards Initiative*. [Online] Corestandards.org. Available from: <http://www.corestandards.org/Math/Practice/> [Accessed: 2019-06-14].
- Constitution of the Republic of South Africa. 1996. *National Education Policy Act (Act No 27 of 1996)*. South African Government: Pretoria. Constitution of the Republic of South Africa (1998) *Notice No. 2432 of 1998*. Pretoria: South African Government.
- Conway, P.F. & Clark, C.M. 2003. The Journey Inward and Outward: A Re-Examination of Fuller's Concerns-Based Model of Teacher Development. *Teaching and Teacher Education*, 19(5):465–482:10.1016/S0742-051X(03)00046-5.
- Cooper, K. & White, R.E. (2012) *Qualitative research in the post-modern era: contexts of qualitative research*. Dordrecht: Springer: 10.1007/978-94-007-2339-9.
- Craig, J. 2018. The Promises of Numeracy. *Educational Studies in Mathematics: An International Journal*, 99(1):57–71:10.1007/s10649-018-9824-5.

Crawford, K. 2018. When teachers think differently about themselves as math learners, students benefit. *Stanford Graduate School of Education*. [Online] Available from: <https://ed.stanford.edu/news/study-when-teachers-think-differently-about-themselves-math-learners-students-benefit> [Accessed: 2019-12-19].

Creswell, J.W. 2014. *Educational research: planning, conducting and evaluating quantitative and qualitative research*. 4th ed. Pearson new international edn. Harlow, Essex: Pearson (Pearson custom library).

Creswell, J.W. & Poth, C.N. 2018. *Qualitative inquiry & research design: choosing among five approaches*. 4th ed. Thousand Oaks, California: SAGE.

Cropp, I. 2017. Using Peer Mentoring to Reduce Mathematical Anxiety. *Research Papers in Education*, 32(4):481–500.

Cross, C., Woods, T. & Schweingruber, H. 2009. *Mathematics Learning in Early Childhood: Paths toward Excellence and Equity*. [ebook] Washington: The National Academies Press. Available from: <http://math4all.onmason.com/wp-content/blogs.dir/1543/files/2014/09/Math-learning-in-Early-Childhood.pdf> [Accessed: 2019-06-08].

Crow, G. & Wiles, R. 2008. Managing anonymity and confidentiality in social research: the case of visual data in Community research. NCRM Working Paper. ESRC National Centre for Research Methods.

Daniel, J. 2012. *Sampling essentials: practical guidelines for making sampling choices*. Los Angeles: Sage Publications.

Deakin, K., Moore, D.G. & Jahoda, A. 2018. Children and Young People with Down Syndrome: Their Awareness of Down Syndrome and Developing Self-Perceptions. 31(6), 1197–1208:10.1111/jar.12494.

DeAngelis, T., 2012. *Support For Teachers*. [online] American Psychological Association. Available at: <https://www.apa.org/monitor/2012/02/teachers> [Accessed 26 June 2020].

De Castro, M.V., Bissaco, M.A., Panccioni, B.M., Rodrigues, S.C. & Domingues, A.M. 2014. Effect of a Virtual Environment on the Development of Mathematical Skills in Children with Dyscalculia. *PloS one*, 9(7):103354:10.1371/journal.pone.0103354.

De Clercq, F. & Phiri, R. 2013. The Challenges of School-Based Teacher Development Initiatives in South Africa and the Potential of Cluster Teaching. *Perspectives in Education*, 31(1):77–86.

Dednam, A. 2011. Learning impairment. In: *Addressing Barriers to Learning: A South African Perspective*. Pretoria, South Africa: Van Schaik Publishers, 399-417.

DeForge, B. R. 2010. Research Design Principles. In: Salkind, N.J. (2010) *Encyclopaedia of research design*. Thousand Oaks, Calif.: Sage, 1253-1259.

De Oliveira, L.C. 2011. In Their Shoes: Teachers Experience the Needs of English Language Learners through a Math Simulation. *Multicultural Education*, 19(1):59–62.

Department of Basic Education. 1997. *Language in Education Policy*, Government Printer, Pretoria.

Department of Basic Education. 2010a. *Education Information Standards: Dictionary of Education Concepts and Terms*, Pretoria: The Department of Basic Education.

Department of Basic Education. 2010b. *Guidelines for Inclusive Teaching and Learning*. Pretoria: Department of Basic Education.

Department of Basic Education. 2011a. *National Curriculum Statement Grades 1 – 3 (English) Mathematics*. Pretoria: Government Printer.

Department of Basic Education. 2011b. *National Curriculum Statement – Curriculum and Assessment Policy Statement: Guidelines for Responding to Learner Diversity in the Classroom (English)*. Pretoria: Government Printer.

Department of Basic Education. 2012. *Report on the Annual National Assessments 2012: Grades 1 to 6 & 9*. Pretoria: The Department of Basic Education.

Department of Basic Education. 2014. Report on the Annual National Assessment of 2014 Grades 1 to 6 & 9. Government Printer.

Department of Basic Education. 2019. *Mathematics in English Grade 3 – Book 2*. Pretoria: South African Government.

Department of Education. 2001. *Education White Paper 6 – Special Needs Education: Building an Inclusive Education and Training System (English)*. Pretoria: Government Printer.

Dias, M., Pereira, M.M. & Van Borsel, J. 2013. Assessment of the awareness of dyscalculia among educators. *ACR*, 18(2):93-100.

Dowker, A. 2009. *What Works for Children with Mathematical Difficulties?* Nottingham: University of Oxford.

Dunphy, E. 2009. Early Childhood Mathematics teaching: challenges, difficulties and priorities of teachers of young children in primary schools in Ireland. *International Journal of Early Years Education*, 17(1):3-16.

Edgington, M. 2004. *The foundation stage teacher in action: Teaching 3, 4 and 5 year olds*. 3rd edn. London: Paul Chapman Publisher.

Elliott, R., Kazemi, E., Lesseig, K., Mumme, J., Carroll, C. & Kelley-Petersen, M. 2009. "Conceptualizing the Work of Leading Mathematical Tasks in Professional Development," *Journal of Teacher Education*, 60(4):364–379.

Emerson, J. 2015. *Understanding dyscalculia and numeracy difficulties*. London, United Kingdom: Jessica Kingsley.

Emerson, J. & Babbie, P. 2013. *The Dyscalculia Assessment*. 2nd ed. London: Bloomsbury Education.

Emerson, J. & Babbie, P. 2015. Part 1: Overview of Numeracy Learning and Assessment. In: *Understanding Dyscalculia and Numeracy Difficulties*. London: Jessica Kingsley Publishers, 7-85.

Engelbrecht, A. 2016. Supporting learners in acquiring the skill of mathematisation. In: Nel, N., Nel, M. & Hugo, A. *Learner support in a diverse classroom: a guide for foundation, intermediate and senior phase teachers of language and mathematics*. 2nd ed. Pretoria: Van Schaik, 275.

Engelbrecht, P., Green, L, Naicker, S. & Engelbrecht, L. 2007. *Inclusive Education in Action in South Africa*, 1st edition. Pretoria: Van Schaik.

Farrell, P., Sherratt, F. & Richardson, A. 2016. *Writing built environment dissertations and projects: practical guidance and examples*. 2nd ed. Chichester, West Sussex, United Kingdom: John Wiley & Sons.

Feeney, S. 2016. *Who am I in the lives of children? : An introduction to early childhood education*. 10th ed. Boston: Pearson.

Ferreira, C. & Schulze, S. 2014. Teachers' Experience of the Implementation of Values in Education in Schools: 'Mind the Gap'. *South African Journal of Education*, 34(1):1–13.

Flick, U. 2008. Concepts of Triangulation. In: Flick, U. (2008) *Managing quality in qualitative research*. London: SAGE, 38-54.

Flick, U. 2009. *An introduction to qualitative research*. 4th ed. Los Angeles: SAGE publications.

Flyvberg, B. 2004. Five Misunderstandings about Case-Study Research. In: Seale, C. (2004) *Qualitative research practice*. London: SAGE, 390-404.

Franey, J.J. 2016. *Understanding Teacher development theories*. [Online] Available from <http://www.developingdifferencemakers.com/education-blogs/april-12th-201611> [Accessed: 2019-09-10].

Freeman, M. 2010. Vygotsky and the virtual classroom: sociocultural theory comes to the communications classroom. *Christian Perspectives in Education*, 4(1):1–17.

- Fuchs, L.S., Fuchs, D., Powell, S.R., Seethaler, P.M., Cirino, P.T. & Fletcher, J.M. 2008. Intensive Intervention for Students with Mathematics Disabilities: Seven Principles of Effective Practice. *Learning Disability Quarterly*, 31, 79-92.
- Fuje, H. & Tandon, P. 2018. When Do In-Service Teacher Training and Books Improve Student Achievement? Experimental Evidence from Mongolia. *Review of Development Economics*, 22(3):1360–1383:10.1111/rode.12387.
- Fuller, F.F. 1969. Concerns of Teachers: A Developmental Conceptualization. *American Educational Research Journal*, 6(2), 207–226.
- Garcia, E. & Weiss, E. 2019. *The Teacher Shortage Is Real, Large And Growing, And Worse Than We Thought*. [online] Economic Policy Institute. Available at: <https://www.epi.org/publication/> [Accessed 26 June 2020].
- Gathercole, S.E. & Alloway, T.P. 2004. Working Memory and Classroom Learning. *Dyslexia review*, 15(3):4–9.
- Geary, D.C. 2011. Consequences, Characteristics, and Causes of Mathematical Learning Disabilities and Persistent Low Achievement in Mathematics. 32(3):250–63:10.1097/DBP.0b013e318209edef.
- Geary, D.C. 2010. Mathematical Disabilities: Reflections on Cognitive, Neuropsychological, and Genetic Components. *Learning and Individual Differences*, 20(2), 130–133:10.1016/j.lindif.2009.10.008.
- Ghazvini, S.D. 2011. Relationships between Academic Self-Concept and Academic Performance in High School Students. *Procedia - Social and Behavioral Sciences*, 15:1034–1039:10.1016/j.sbspro.2011.03.235.
- Gobo, G. 2004. Sampling, Representativeness and Generalizability. In: Seale, C. (2004) *Qualitative research practice*. London: SAGE, 405-426.
- Golafshani, N. 2003. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, 8(4), 597-606.
- Gold, M.E. & Richards, H. 2012. To Label or Not to Label: The Special Education Question for African Americans. *Educational Foundations*, 26(1-2):143–156.
- Government Communication Information System. 2017/8. *Yearbook*. Pretoria: Department of Education.
- Government Communication Information System. 2018/9. *Yearbook*. Pretoria: Department of Education.
- Goldkuhl, G. 2019. The Generation of Qualitative Data in Information Systems Research: The Diversity of Empirical Research Methods. *Communication of the Association for Information Systems*, 44:572 – 599:<https://doi.org/10.17705/1CAIS.04428>.

Greenbank, P. 2003. The Role of Values in Educational Research: The Case for Reflexivity. *British Educational Research Journal*, 29(6), 791–801.

Hannell, G. 2013. *Dyscalculia: Action Plans for Successful Learning in Mathematics*. 2nd ed. Oxon: Routledge.

Hannula, J. 2017. Subject matter knowledge and pedagogical content knowledge in the learning diaries of prospective mathematics teachers. *CERME*, 3312-3319.

Harden, R. M. & Crosby, J. 2000. Amee Guide No. 20: The Good Teacher Is More Than a Lecturer--The Twelve Roles of the Teacher. *Medical Teacher*, 22(4):334–47.

Harris, B. & Petersen, D. 2019. Developing Math Skills in Early Childhood. *Mathematica*, [Online]. Available from: <https://www.mathematica.org/our-publications-and-findings/publications/developing-math-skills-in-early-childhood> [Accessed: 2019-12-15].

Harris, D.N. & Sass, T.R. 2011. Teacher Training, Teacher Quality and Student Achievement. *Journal of Public Economics*, 95(7-8), 798–812:10.1016/j.jpubeco.2010.11.009.

Hastings, S.L. 2010. Triangulation. In: Salkind, N.J. (2010) *Encyclopedia of research design*. Thousand Oaks, Calif.: Sage, 1538-1540.

Hays, D.G. & Singh, A.A. 2012. *Qualitative inquiry in clinical and educational settings*. New York: Guilford Press.

Henderson, A. 2012. Chapter 1: Dyslexia and dyscalculia. In: 2nd ed. *Dyslexia, Dyscalculia and Mathematics: A practical guide*. Oxon: Routledge, 1-7.

Herbel-Eisenmann, B., Johnson, K.R., Otten, S., Cirillo, M. & Steele, M.D. 2015. Mapping Talk about the Mathematics Register in a Secondary Mathematics Teacher Study Group. *Journal of Mathematical Behavior*, 40:29–42:10.1016/j.jmathb.2014.09.003.

Hope, W.C. 2002. Implementing Educational Policy: Some Considerations for Principals. *Clearing House*, 76(1):40–43.

Hornigold, J. 2015. *Dyscalculia Pocketbook*. 1st ed. Hampshire: Teachers' Pocketbook.

Hudson, D. 2016. Brain That Work a Little Differently: Introducing Specific Learning Difficulties. In: *Specific Learning Difficulties - What Teachers Need to Know*. Philadelphia: Jessica Kingsley Publishers, 11-26.

Human Science Research Council. 2016. *Media statement by the Human Sciences Research Council (HSRC) on the release of the TIMSS 2015 grade 5 study*, Pretoria: Human Sciences Research Council.

Ignacio, N.G., Nieto, L.J.B. & Barona, E.G. 2006. The Affective Domain in Mathematics Learning, *International Electronic Journal of Mathematics Education (IEJME)*, 1(1):16-32.

Izci, K. 2016. Internal and External Factors Affecting Teachers' Adoption of Formative Assessment to Support Learning. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 10(8):2541-2548. [Online] Available from: <https://files.eric.ed.gov/fulltext/ED567798.pdf> [Accessed: 2019-08-24].

Jafarov, J. 2015. Factors Affecting Parental Involvement in Education: The Analysis of Literature. *Khazar Journal of Humanities and Social Sciences*, 18(4), 35-44.

Jalongo, M.R. & Isenberg, J.P. 2012. *Exploring your role in early childhood education*. 4th ed. Upper Saddle River, N.J.: Pearson.

Jameel, H.T. & Ali, H.H. 2016. Causes of Poor Performance in Mathematics from the Perspective of Students, Teachers and Parents. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 15(1):122 – 136.

Jansen, J.D. 1998. Curriculum Reform in South Africa: A Critical Analysis of Outcomes-Based Education. *Cambridge Journal of Education*, 28(3):321–31.

Jaya, N. & Geetha, T. 2009. *Primary School Teachers Skills To Help Dyscalculic Children*. 1st ed. India: Kalpaz Publishers. Karande, S. (2008) Current Challenges in Managing Specific Learning Disability in Indian Children. *Journal of Postgraduate Medicine*, 54(2):75-77.

Johnson, P., Shúilleabháin A.N., Ríordáin M.N. & Prendergast, M. 2019. The Evolution of Student Teachers' Concerns Regarding Mathematics Curricular Reform," *International Journal of Science and Mathematics Education*, (20191026):10.1007/s10763-019-10023-2.

Jojo, Z., 2019. Mathematics Education System in South Africa [Online First]. *IntechOpen*:10.5772/INTECHOPEN.85325. Available from: <https://www.intechopen.com/online-first/mathematics-education-system-in-south-africa>.

Jupp, V. 2006. *The SAGE Dictionary of Social Research Methods*. SAGE Publishing.

Kaino, L.M. & Moalosi, S. 2013. Teachers' Mathematical Pedagogical Content Knowledge: Some Trends in Search of Adequate Knowledge for Effective Teaching. *Journal of Social Sciences*, 37(2):189-196.

Karande, S. 2008. Current Challenges in Managing Specific Learning Disability in Indian Children. *Journal of Postgraduate Medicine*, 54(2), 75–77. Available from: <http://web.a.ebscohost.com/uplib.idm.oclc.org/ehost/pdfviewer/pdfviewer?vid=1&si>

[d=62ef330c-1986-49ce-a387-ef27b7e12afd%40sessionmgr4008](#) [Accessed: 2019-10-13].

Kiamba, E.W., Mutua, F. & Mulwa, D. 2018. Influence of Teacher's Subject Matter Knowledge on Students' Academic Achievement of Kiswahili Language in Public Secondary Schools in Kathonzweni Sub-County, Kenya. *Scholarly Research Journal of Humanity Science and English Language*, 6(29):8052-8059.

Kieffer, M.J., Lesaux, N.K., Rivera, M. & Francis, D.J. 2009. Accommodations for English language learners taking large scale assessments: A meta-analysis on effectiveness and validity. *Review of Educational Research* 79, 1168–1202.

Kiggundu, E. & Nayimuli, S. 2009. Teaching Practice: A Make or Break Phase for Student Teachers. 29(3):345–358.

King-McKenzie, E., Delacruz, S., Bantwini, B. & Bogan, B. 2013. Pre-Service Teachers' Perceptions of Co-Teaching of Professional Development School Teachers and University Faculty. *School-University Partnerships*, 6(2).

Kioko, A. 2015. *Why Schools Should Teach Young Learners In Home Language* | *British Council*. [online] Britishcouncil.org. Available at: <<https://www.britishcouncil.org/voices-magazine/why-schools-should-teach-young-learners-home-language#:~:text=In%20summary%2C%20the%20use%20of,and%20creativity%20in%20teacher%20preparation.>> [Accessed 23 June 2019].

Klein, E., Bahnmüller, J., Mann, A., Pixner, S., Kaufmann, L., Nuerk, H.-C., Moeller, K., Wilcox, T. & Heine, A. 2013. Language Influences on Numerical Development - Inversion Effects on Multi-Digit Number Processing. *Frontiers in Psychology*, 4.

Kothari, C. 2020. *Research Methodology: Methods And Techniques*. 2nd ed. [ebook] New Delhi: New Age International (P) Limited. Available at: <<http://dl.saintgits.org/xmlui/bitstream/handle/123456789/1133/Research%20Methodology%20C%20R%20Kothari%20%28Eng%29%201.81%20MB.pdf?sequence=1&isAllowed=y>> [Accessed 23 June 2020].

Kruger, C. 2011. Net 9% van gr.6-kindern is vaardig genoeg. *Rapport*, 2 June.

Kuckartz, U. 2013. *Qualitative text analysis: A guide to methods, practice & using software*. Translated by A. McWhertor. Los Angeles: SAGE.

Kunter, M., Klusmann, U., Baumert J., Richter, D., Voss, T. & Hachfeld, A. 2013. Professional Competence of Teachers: Effects on Instructional Quality and Student Development. *Journal of Educational Psychology*, 105(3):805–820.

Lai, F., Sadoulet, E. & De Janvry, A. 2011. The Contributions of School Quality and Teacher Qualifications to Student Performance: Evidence from a Natural Experiment in Beijing Middle Schools. *The Journal of Human Resources*, 46(1):123–153.

- Lazarides, R., Gaspard, H. & Dicke, A.-L. 2019. Dynamics of Classroom Motivation: Teacher Enthusiasm and the Development of Math Interest and Teacher Support. *Learning and Instruction*, 60:126–137:10.1016/j.learninstruc.2018.01.012.
- Lee, J. 2010. Exploring Kindergarten Teachers' Pedagogical Content Knowledge of Mathematics. *International Journal of Early Childhood: Journal of OMEP: l'Organisation Mondiale pour l'Education Prescolaire*, 42(1):27–41:10.1007/s13158-010-0003-9.
- Lee, Y., Capraro, M.M. & Capraro, R.M. 2018. Mathematics Teachers' Subject Matter Knowledge and Pedagogical Content Knowledge in Problem Posing. *International Electronic Journal of Mathematics Education*, 13(2):75-90.
- Liamputtong, L. 2010. Cross-Cultural Research and Qualitative Inquiry. *Turkish Online Journal of Qualitative Inquiry*, 1(1):16-29.
- Lovitt, C., & Clarke, D. 2011. A designer speaks. *Journal of the International Society for Design and Development in Education*, 1(4):1-25.
- Lumadi, M.W. 2013. Implementing a Responsive Curriculum to Diverse Learners. *Journal of Social Sciences*, 35(2):111-123.
- Lunenberg, M., Dengerink J. & Korthagen, F.A. 2014. *The professional teacher educator: roles, behaviour, and professional development of teacher educators*. Rotterdam, Netherlands: Sense (Professional learning, volume 13).
- Machaba, M.M. 2013. *Teacher Challenges in the Teaching of Mathematics at Foundation Phase*. Pretoria: The University of Pretoria.
- Mack, L. 2010. The philosophical underpinnings of educational research. Available from: <https://secure.apu.ac.jp/> [Accessed: 2019-01-15].
- Mackay, B.D. 2014. Learning Support to Grade 4 Learners who Experience Barriers to English as Language of Learning and Teaching. MEd Dissertation. Pretoria: University of South Africa.
- Mader, J., 2017. *Teacher Training Is Failing Students With Disabilities*. [online] The Atlantic. Available at: <https://www.theatlantic.com/education/archive/> [Accessed 26 June 2020].
- Maehler, C. & Schuchardt, K. 2009. Working Memory Functioning in Children with Learning Disabilities: Does Intelligence Make a Difference? *Journal of intellectual disability research: JIDR*, 53(1):3–10:10.1111/j.1365-2788.2008.01105.x.
- Maggie, M.H. 2015. Curriculum Policy Implementation in the South African Education Context: Reference to environmental education in the Natural Sciences. *ISTE*, 355-370.
- Maharajh, L.R., Nkosi, T. & Mkhize, M.C. 2016. Teachers' Experiences of the Implementation of the Curriculum and Assessment Policy Statement (CAPS) in

Three Primary Schools in Kwazulu Natal. *Africa's Public Service Delivery & Performance Review*, 4(3):371–388:10.4102/apsdpr.v4i3.120.

Mahlo, F.D. 2011. Experiences of Learning Support Teachers in the Foundation Phase, with reference to the implementation of Inclusive Education in Gauteng. Doctoral Thesis. Pretoria: University of South Africa.

Marais, P. 2016. We Can't Believe What We See': Overcrowded Classrooms through the Eyes of Student Teachers. *South African Journal of Education*, 36(2):10.15700/saje.v36n2a1201.

Maree, K. 2016. Chapter 3: Planning a research proposal. In: Maree, K. (ed.) *First Steps in Research*. Pretoria: Van Schaik, 25-47.

Maree, K. & Pietersen, J. 2016. Chapter 10: Sampling. In: Maree, K. (ed.) *First Steps in Research*. Pretoria: Van Schaik, 192-202.

Martinson, B. & Chu, S. 2008. Impact of learning style on achievement when using course content delivered via a game-based learning object. In R. E. Ferdig (eds.) *Handbook of Research on Effective Electronic Gaming in Education*, 478-488. Pennsylvania: IGI Global.

Mashau, S., Steyn, E., Walt, J. van der & Wolhuter, C. 2008. Support Services Perceived Necessary for Learner Relationships by Limpopo Educators. *South African Journal of Education*, 28(3):415–430.

Matti, S. 2017. Imitation as a Learning Strategy and Associations with Teachers' Social Cognitive Skills during Sibling Teaching. MA Dissertation.

Mavuso, M.F. 2014. Strategies for Facilitating Learning Support Processes. What can Teachers do Support Learners with Specific Learning Difficulties? *Mediterranean Journal of Social Sciences*, 5(2):455-461:10.5901/mjss.2014.v5n2p455.

Mbatha, M.G. 2016. Teachers' Experiences of Implementing the Curriculum and Assessment Policy Statement (CAPS) in Grade 10 in Selected Schools at Ndwedwe in Durban. MEd Dissertation. Pretoria: University of South Africa.

McCray, J.S. & Chen, J.-Q. 2012. Pedagogical Content Knowledge for Preschool Mathematics: Construct Validity of a New Teacher Interview. *Journal of Research in Childhood Education*, 26(3):291–307.

McGee, L.M. & Ukrainetz, T.A. 2009. Using Scaffolding to Teach Phonemic Awareness in Preschool and Kindergarten. *The Reading Teacher*, 62(7):599–603:10.1598/RT.62.7.6.

McLaren, D. 2017. Chapter 2: Funding Basic Education. In: *Basic Education Rights Handbook - Education Rights in South Africa*. Johannesburg: SECTION 27, 65.

Meiers, M. & Trevitt, J. 2010. Language in the mathematics classroom. *Australian Council for Educational Research*. [Online] Available from: <https://research.acer.edu.au/cgi/viewcontent.cgi?article=1006&context=digest> [Accessed: 2019-12-19].

Merritt, E.G. 2017. Time for Teacher Learning, Planning Critical for School Reform. *Phi Delta Kappan*, 98(4):31–36.

Mills, D. & Alexander, P. 2013. *Small group teaching: a toolkit for learning*. York: The Higher Education Academy. Available from: https://www.heacademy.ac.uk/sites/default/files/resources/Small_group_teaching_1.pdf. [Accessed: 2019-07-29].

Miundy, K., Zaman, H.B. & Nordin, A. 2017. Advances in Visual Informatics: 5th International Visual Informatics Conference, Ivic 2017, Bangi, Malaysia, November 28-30, 2017, Proceedings. *Review on Data Driven Preliminary Study Pertaining to Assistive Digital Learning Technologies to Support Dyscalculia Learners*. Cham: Springer International Publishing: Springer, 233–246:10.1007/978-3-319-70010-6_22.

Mogashoa, T. 2017. A Critical Review of the Kind of Training or Professional Development Typically Offered to the Teachers. *IntechOpen:10.5772/intechopen.78741*.

Moon, K., Brewer, T.D., Januchowski-Hartley, S.R., Adams, V.M. & Blackman, D.A. 2016. A Guideline to Improve Qualitative Social Science Publishing in Ecology and Conservation Journals. *Ecology and Society*, 21(3).

Mooney, C. G. 2013. *Theories of Childhood: An Introduction to Dewey, Montessori, Erikson, Piaget, and Vygotsky*. 2nd ed. St. Paul, MN: Redleaf Press.

Motshekga, A. 2016. *Trends in International Mathematics and Science Study 2015 results*. Pretoria: South African Government.

Mouton, J. 2001. *How to succeed in your master's and doctoral studies: A South African guide and resource book*. Pretoria: Van Schaik.

Mruk, C.J. 2013. Defining self-esteem as a relationship between competence and worthiness: How a two-factor approach integrates the cognitive and affective dimensions of self-esteem. *Polish Psychological Bulletin*, 44(2):157–164. <https://doi.org/10.2478/ppb-2013-0018>.

Msila, V. 2007. From Apartheid Education to the Revised National Curriculum Statement: Pedagogy for the Identify Formation and Nation Building in South Africa. *Nordic Journal of African Studies*, 16(2):146-160.

Muhonen, H., Rasku-Puttonen, H., Pakarinen, E., Poikkeus, A.-M. & Lerkkanen, M.-K. 2016. Scaffolding through Dialogic Teaching in Early School Classrooms. *Teaching and Teacher Education*, 55:143–154:10.1016/j.tate.2016.01.007.

Mullis, I.V.S., Martin, M. O., Foy, P. & Hooper, M. 2015. *TIMSS 2015: International Results in Mathematics*, Boston: Boston College.

Namkung, J.M. & Fuchs, L.S. 2012. Early Numerical Competencies of Students with Different Forms of Mathematics Difficulty. 27(1):2–11:10.1111/j.1540-5826.2011.00345.x.

National Association of Special Education Teachers. 2017. *National Association of Special Education Teachers: Introduction to Learning Disabilities*. [Online] Naset.org. Available from: <https://www.naset.org/index.php?id=2522> [Accessed: 2019-02-05].

National Education Evaluation & Development Unit. 2013. *National report 2012: The state of literacy teaching and teaching in the Foundation Phase*. Pretoria, South Africa: Author. Available from http://uscdn.creamermedia.co.za/assets/articles/attachments/44530_needu_full_report_2012.pdf. [Accessed: 2019-08-06].

Naudé, M. 2014. Chapter 1: How Foundation Phase learners learn mathematics. In: Naudé, M. & Meier, C. (eds.) *Teaching Foundation Phase Mathematics*. Pretoria: Van Schaik Publishers, 2-25.

Naudé, M. & Meier, C. 2015. *Teaching Foundation Phase Mathematics: A guide for South African students and teachers*. Hatfield, Pretoria: Van Schaik Publishers.

Navsaria, I., Pascoe, M., & Kathard, H. 2011. It's Not Just the Learner, It's the System! Teachers' Perspectives on Written Language Difficulties: Implications for Speech-Language Therapy. 58:10.4102/sajcd.v58i2.31.

Ndlovu, M.C. 2011. University-school partnerships for social justice in mathematics and science education: the case of the SMILES project at IMSTUS. *South African Journal of Education*, 31:419-433.

Nel, M., Engelbrecht, A., Swanepoel, H. & Hugo, A. 2013. *Embracing diversity through multi-level teaching: for foundation, intermediate and senior phase*. Cape Town, South Africa: Juta.

New, R.S. & Cochran, M. 2007. Transformation. *Early Childhood Education: An International Encyclopaedia*, 4, Westport.

Nieuwenhuis, J. 2016a. Chapter 4: Introducing qualitative research. In: Maree, K. (ed.) *First Steps in Research*. Pretoria: Van Schaik Publishers, 50-70.

Nieuwenhuis, J. 2016b. Qualitative research designs and data-gathering techniques. In: Maree, K. (ed.) *First Steps in Research*. Pretoria: Van Schaik Publishers, 72-102.

Nkambule, G. & Amsterdam, C. 2018. The Realities of Educator Support in a South African School District. *South African Journal of Education*, 38(1).

- Nkosi, B. 2018. School curriculum under review. *The Star*, 7 September.
- Noble, H. & Smith, J. 2015. Issues of validity and reliability in qualitative research. *Evidence Based Nursing*, 18(2):34-35.
- Nowell, L.S., Norris, J.M., White, D.E. & Moules, N.J. 2017. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16(1).
- Ntekane, A. 2018. Parental Involvement in Education. *ResearchGate*, 1-5:10.13140/RG.2.2.36330.21440.
- Ntshaba, L.P. 2012. A study of Technology Education Instructional Practices in Grade nine classrooms: A case study of three Senior Secondary schools in the King William's Town district. MEd Dissertation. Fort Hare University.
- Okendu, J.N. 2012. The impact of school administrative structure and adequate supervision on the improvement of instructional processes. *Academic Research International Journal*, 2(3):497-500.
- Ono, Y. & Ferreira, J. 2010. A case study of continuing teacher professional development through lesson study in South Africa. *South African Journal of Education*, (30):59-74.
- Ono, Y., Stols, G. & Rogan, J. 2015. What Constitutes Effective Mathematics Teaching? Perceptions of Teachers. *African Journal of Research in Mathematics, Science and Technology Education*, 19(3):225–236:10.1080/10288457.2015.1080934.
- Opheim, L.G. 2013. Man-made difficulties in mathematics. In: Fuglestad, A.B., Lindenskov, L., Nordic Research Network on Special Needs Education in Mathematics and Nordic Research Conference on Special Needs Education in Mathematics (2013) *Special Needs Education in Mathematics: new trends, problems and possibilities*. Kristiansand: Portal forlag.
- Organisation for Economic Co-operation and Development. 2010. *Programme for International Student Assessment, & Organisation for Economic Co-operation and Development 2009 results: Chapter 3. Resources, policies and practices* (Vol. Vol. 4, what makes a school successful?). Paris: OECD Publishing.
- Owens, R.L. 2010. Informed Consent. In: Salkind, N. J. (2010) *Encyclopedia of research design*. Thousand Oaks, Calif.: Sage, 603-607.
- Pandor, N. 2008. *Partners in performance*. Braamfontein, s.n.
- Pang, M. 2016. Pedagogical Reasoning in Efl/esl Teaching: Revisiting the Importance of Teaching Lesson Planning in Second Language Teacher Education. 50(1):246–263.

Persuad, N. 2010. Participants. In: Salkind, N.J. (2010) *Encyclopedia of research design*. Thousand Oaks, Calif.: Sage, 1017-1018.

Petchimuthu, P., Sharma, N., Gaur, A. & Kumar, R. 2018. Pattern of Specific Learning Disability and Awareness among Care Providers in Children between 8-12 Years. *International Journal of Contemporary Pediatrics*, 5(3):809–809:10.18203/2349-3291.ijcp20181445.

Peters, L., Bulthé, J., Daniels, N., Op de Beeck, H. & De Smedt, B. 2018. Dyscalculia and Dyslexia: Different Behavioral, yet Similar Brain Activity Profiles during Arithmetic. *Elsevier*, 18:663–674:10.1016/j.nicl.2018.03.003.

Pieters, S., Desoete, A., Van Waelvelde, H., Vanderswalmen, R. & Roeyers, H. 2012. Mathematical Problems in Children with Developmental Coordination Disorder. *Research in Developmental Disabilities*, 33(4):1128–1135:10.1016/j.ridd.2012.02.007.

Powell, E., Terrell, I., Furey, S. & Scott-Evans, A. 2003. Teachers' Perceptions of the Impact of Cpd: An Institutional Case Study. 29(3).

Protheroe, N. 2007. What Does Good Math Instruction Look Like? *Principal*, 87(1):51–54.

Putney, L.G. 2010. Case Study. In: Salkind, N.J. (2010) *Encyclopaedia of research design*. Thousand Oaks, Calif.: Sage, 116-119.

Queirós, A., Faria, D. & Almeida, F. 2017. Strengths and Limitations of Qualitative and Quantitative Research Methods. *European Journal of Education Studies*, 3(9), 369-387:10.5281/zenodo.887089.

Rademeyer, A. 2014. Hoeveel wile het sewe fietse? Die vraag is te taai vir Gr. 1's - toetse. *Beeld*, 13 February.

Ramaa, S. & Gowramma, I. 2002. A systematic procedure for identifying and classifying children with Dyscalculia among primary school children in India. *Dyslexia*, 8(2):67-85.

Ramirez, G., Hooper, S.Y., Kersting, N.B., Ferguson, R. & Yeager, D. 2018. Teacher Math Anxiety Relates to Adolescent Students' Math Achievement. *AERA Open*, (2018):10.1177/2332858418756052.

Rapley, T. 2004. Interviews. In: Seale, C. (2004) *Qualitative research practice*. London: SAGE, 16-34.

Rhodes, C. & Beneicke, S. 2003. Professional Development Support for Poorly Performing Teachers: Challenges and Opportunities for School Managers in Addressing Teacher Learning Needs. *Journal of In-Service Education*, 29(1):123-140.

- Riccomini, P.J. Smith, G.W., Hughes, E.M. & Fries, K.M. 2015. "The Language of Mathematics: The Importance of Teaching and Learning Mathematical Vocabulary," 31(3):235–252.
- Rock, T.C. & Wilson, C. 2005. Improving Teaching through Lesson Study. *Teacher Education Quarterly*, 77-92.
- Rollnick, M. & Mavhunga, E. 2016. The Place of Subject Matter Knowledge in Teacher Education. In: Loughran, J. & Hamilton, M. (eds.) *The International Handbook on Teacher Education*. Dordrecht: Springer, 423-452.
- Rule, P. & John, V. 2011. *Your guide to case study research*. Pretoria: Van Schaik.
- Runhaar, P.R. 2017. How Can Schools and Teachers Benefit from Human Resources Management? Conceptualising Hrm from Content and Process Perspectives. *Educational Management Administration & Leadership*, 45(4):639–656.
- Ryen, A. 2004. Ethical Issues. In: Seale, C. (2004) *Qualitative research practice*. London: SAGE, 218-235.
- Sa'ad, T.U., Adamu, A. & Sadiq, M.A. 2014. The Causes of Poor Performance in Mathematics among Public Senior Secondary School Students in Azare Metropolis of Bauchi State, Nigeria, *IOSR Journal of Research & Method in Education (IOSRJRME)*, 4(6):32–40:10.9790/7388-04633240.
- Sadler, I. 2012. The Challenges for New Academics in Adopting Student-Centred Approaches to Teaching. *Studies in Higher Education*, 37(6):731–745:10.1080/03075079.2010.543968.
- Samkange, W. 2015. The Role of Labelling in Education: A Focus on Exceptional Learners. *Global Journal of Advanced Research*, 2(9):1419-1424.
- Savina, N.N. 2019. Major Factors of Teachers' Resistance to Innovations. 27(104), 589–609:10.1590/s0104-40362019002701807.
- Schleppegrell, M.J. 2007. The Linguistic Challenges of Mathematics Teaching and Learning: A Research Review. *Reading & Writing Quarterly*, 23(2):139–159.
- Schwieter, J.W. 2010. Developing Second Language Writing through Scaffolding in the ZPD: A Magazine Project for an Authentic Audience. *Journal of College Teaching & Learning*, 7(10):31–45.
- Scotland, J. 2012. Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching*, 5(9):9-16.
- Secomb, J. 2006. Review: A Systematic Review of Peer Teaching and Learning in Clinical Education. *Journal of Clinical Nursing*, 17(6):703–716.

- Setati, M. & Barwell, R. 2008. Making mathematics accessible for multilingual learners. *Pythagoras*, 67:2–4.
- Shalev, R.S. & Gross-Tsur, V. 2001. Developmental Dyscalculia. *Paediatric neurology*, 24(5):337– 342.
- Shalev, R.S., Auerbach, J., Manor, O. & Gross-Tsur, V. 2000. Developmental dyscalculia: prevalence and prognosis. *European Child & Adolescent Psychiatry*, 9(2):58-64.
- Shih, J.-L. & Su, H.-Y. 2008. Analyzing Children’s Cognitive Activities in Digital Problem-solving Learning Games “William Adventure”: An In-depth Case Study. Proceedings - ICCE 2008. *16th International Conference on Computers in Education*, 651-658.
- Sibanda, L. & Graven, M. 2018. Can Mathematics Assessments Be Considered Valid If Learners Fail to Access What Is Asked of Them? *South African Journal of Childhood Education*, 8(1).
- Simon, M. 2011. The role of the researcher. [Online] Retrieved from <http://dissertationrecipes.com/wp-content/uploads> [Accessed: 2019-09-12].
- Siyepu, S. (2013) The Zone of Proximal Development in the Learning of Mathematics. *South African Journal of Education*, 33(2):1-13.
- Skaalvik, E.M. & Skaalvik, S. 2018. Job Demands and Job Resources As Predictors of Teacher Motivation and Well-Being. *Social Psychology of Education: An International Journal*, 21(5):1251–1275.
- Smith, J. & Noble, H. 2014. Bias in Research. *Evidence Based Nursing*, 17(4).
- Sousa, P., Dias, P. C. & Cadime, I. 2017. Predictors of Primary School Teachers’ Knowledge about Developmental Dyscalculia. *European Journal of Special Needs Education*, 32(2):204–220:10.1080/08856257.2016.1216635.
- South African Government. 2016. *Minister Angie Motshekga: Trends in International Mathematics and Science Study 2015 results*. Pretoria: South African Government.
- Staller, K.M. 2010. Qualitative research. In: Salkind, N.J. (2010) *Encyclopaedia of research design*. Thousand Oaks, Calif.: Sage, 1159-1163.
- Steele, M.M. 2004. Making the Case for Early Identification and Intervention for Young Children at Risk for Learning Disabilities. *Early Childhood Education Journal*, 32(2):75–79:10.1007/s10643-004-1072-x.
- Stein, S.G. 2017. Turning Points: Recent Trends in Adult Basic Literacy, Numeracy, and Language Education. *New Directions For Adult And Continuing Education*, 2017(155):29–40.

Steyn, M.G. 2014. *Teaching the mathematical concept of time in Grade 2. Doctoral Thesis*. Pretoria: University of Pretoria.

Stronge, J. 2018. *Qualities of Effective Teachers*. 3rd ed. [ebook] ASCD. Available from: <https://books.google.co.za/>. [Accessed: 2018-12-30].

Suárez-Pellicioni, M., Núñez-Peña M.I. & Colomé, A. 2013. Mathematical Anxiety Effects on Simple Arithmetic Processing Efficiency: An Event-Related Potential Study. *Biological Psychology*, 94(3):517–526:10.1016/j.biopsycho.2013.09.012.

Superfine, A.C. 2008. Planning for Mathematics Instruction: A Model of Experienced Teachers' Planning Processes in the Context of a Reform Mathematics Curriculum. *Mathematics Educator*, 18(2):11–22.

Swanepoel, N. 2016. *Teaching English Reading Comprehension to Grade 2 First Additional Language Learners*. Published MEd Dissertation.

Talak-Kiryk, A. 2010. Chapter 2: Games as a Foundation for Learning. In: *Using Games in a Foreign Language Classroom*. Brattleboro, Vermont: SIT Graduate Institute, 4-17.

Taylor, H.G., Anselmo, M., Foreman, A.L., Schatschneider, C. & Angelopoulos, J. 2000. Utility of Kindergarten Teacher Judgments in Identifying Early Learning Problems. *Journal of Learning Disabilities*, 33(2):200–210.

Tennant J.E., Demaray M.K., Malecki C.K., Terry M.N., Clary, M. & Elzinga, N. 2015. Students' Ratings of Teacher Support and Academic and Social-Emotional Well-Being. *School psychology quarterly: the official journal of the Division of School Psychology, American Psychological Association*, 30(4):494–512:10.1037/spq0000106.

Thanh, N.C. & Thanh, T.T.L. 2015. The Interconnection Between Interpretivist Paradigm and Qualitative Methods in Education. *American Journal of Educational Science*, 1(2):24-27.

The Dictionary Unit for South African English. 2010a. 'Learner', *Oxford South African Concise Dictionary*, Cape Town.

The Dictionary Unit for South African English. 2010b. 'Strengthen', *Oxford South African Concise Dictionary*, Cape Town.

Themane, M. & Osher, D. 2014. Schools as Enabling Environments. *South African Journal of Education*, 34(4):1–6. [Online] Available from: <http://www.scielo.org.za/pdf/saje/v34n4/01.pdf> [Accessed: 2019-10-25].

Thomas, D.R. 2006. General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, 27(2):237–246.

Toledo-Pereyra, L.H. 2012. Research Design. *Journal of investigative surgery: the official journal of the Academy of Surgical Research*, 25(5):279–80.

Träff, U., Olsson, L., Östergren, R. & Skägerlund, K. 2016. Heterogeneity of Developmental Dyscalculia: Cases with Different Deficit Profiles. *Frontiers in psychology*, 7, 2000–2000:10.3389/fpsyg.2016.02000.

Trusz, S. 2018. Four Mediation Models of Teacher Expectancy Effects on Students' Outcomes in Mathematics and Literacy. 21(2):257–287:10.1007/s11218-017-9418-6.

Truxaw, M.P. & Rojas, E. 2014. A mathematics educator's journey to understanding challenges and affordances of learning mathematics in a second language. *Journal of Urban Mathematics Education*, 7(2):21-30.

UNESCO. 2001. *The Open File on Inclusive Education*. Paris: UNESCO.

Usman, Y.D. 2016. Educational Resources: An Integral Component for Effective School Administration in Nigeria. *Research on Humanities Education and Social Sciences*, 6(13):27-37.

Vaidya, S.R. 2004. Understanding Dyscalculia for Teaching. *Education*, 124(4):717-720.

Van de Walle, J.A., Karp, K.S. & Bay-Williams, J.M. 2016. *Elementary and middle school mathematics: teaching developmentally*. 9th ed. Upper Saddle River: Pearson.

Van der Berg, S., Spaull, N., Wills, G., Gustafsson, M. & Kotze, J. 2016. *Identifying Binding Constraints in Education*. [Online] Research on Socio-Economic Policy. Available from: <https://purpletod.co.za/docs/Report%20SA%20Education.pdf> [Accessed: 2018-08-13].

Van der Merwe, J. 2014. Leerlinge sukkel nog kwaai met wiskunde in SA skole. *Rapport*, 6 July.

Van der Nest, A. 2012. Teacher mentorship as professional development: Experiences of Mpumalanga primary school. MEd dissertation. Durban: University of South Africa.

Van der Walt, M., Maree, K. & Ellis, S. 2008. A mathematics vocabulary questionnaire for use in the intermediate phase. *South African Journal of Education*, 28, 489-504.

Van Heerden, J.C. 2012. *Understanding beneficiaries' experiences of quality in early learning centres*. Doctoral thesis. Pretoria: University of Pretoria.

Veldsman, G.C. 2018. *'n Spelgebaseerde Geletterdheidsvoorbereidingsprogram Vir Die Professionele Ontwikkeling Van Graad R-Opvoeders*. Published Doctoral Thesis.

- Venkat, H. & Spaul, N. 2015. What Do We Know About Primary Teachers' Mathematical Content Knowledge in South Africa? An Analysis of SACMEQ 2007. *International Journal of Educational Development*, 41:121–130:10.1016/j.ijedudev.2015.02.002.
- Vermunt, J.D. 2009. Professionalisering in het onderwijs: leren en laten leren. *Lecture in the context of the chair regarding educational innovation and collaboration at the University of Antwerp*. February 19, 2009.
- Verschueren, K. & Koomen, H.M.Y. 2012. Teacher-child relationships from an attachment perspective. *Attachment and Human Development*, 14(3):205-211.
- Vygotsky, L.S. 1978. Mind in society: The development of higher psychological processes. In: *M. Cole, V. John-Steiner, S. Scriber & E. Souberman*. Cambridge: Harvard University Press.
- Waite, M. 2007a. 'Learner', *Oxford Dictionary & Thesaurus*, Oxford.
- Waite, M. 2007b. 'Strengthen', *Oxford Dictionary & Thesaurus*, Oxford.
- Walton, E. 2016. *The language of inclusive education: exploring speaking, listening, reading, and writing*. London: Routledge. Available from: <https://books.google.co.za/books?id=e21ACwAAQBAJ&pg=PA77&lpg=PA77&dq=%E2%80%99How+does+the+department+expect+that+we+have+inclusive+education+when+we+have+such+large+class+sizes?> (Accessed: 2020-03-12).
- Walton, E. 2011. Getting Inclusion Right in South Africa. 46(4):240–245.
- Wang, L. 2016. Employing Wikibook Project in a Linguistics Course to Promote Peer Teaching and Learning. *Education and Information Technologies: The Official Journal of the IFIP Technical Committee on Education*, 21(2):453–470:10.1007/s10639-014-9332-x.
- Watts-Taffe, S., Laster, B.P., Broach, L., Marinak, B., Connor, C.M. & Walker-Dalhouse, D. 2012. Differentiated Instruction: Making Informed Teacher Decisions. *Reading Teacher*, 66(4):303–314.
- Wentzel, K. R., Battle, A., Russell, S. L. & Looney, L. B. 2010. Social Supports from Teachers and Peers as Predictors of Academic and Social Motivation. *Contemporary Educational Psychology*, 35(3):193–202:10.1016/j.cedpsych.2010.03.002.
- Westwood, P.S. 2004. Chapter 4: Learning difficulties: prevalence and causes. In: P. S. Westwood. *Learning and Learning Difficulties: A Handbook for Teachers*. Aust Council for Ed Research, 53-70.
- Williams, A. 2013. A Teacher's Perspective of Dyscalculia: Who Counts? An Interdisciplinary Overview. *Australian Journal of Learning Difficulties*, 18(1):1–16:10.1080/19404158.2012.727840.

- Willis, J.W. 2007. *Foundations of qualitative research: interpretive and critical approaches*. London: SAGE publications.
- Wium, A.-M. & Louw, B. 2012. Continued Professional Development of Teachers to Facilitate Language Used in Numeracy and Mathematics, *South African Journal of Communication Disorders*, 59(1):8-15.
- Wolcott, H.F. 2009. *Writing Up Qualitative Research*. California: SAGE publications.
- World Health Organization. 2013. 16 ideas for addressing violence against women in the context of HIV epidemic: a programming tool. Geneva: World Health Organization.
- Wriston, J.M. 2015. *The Importance of a Strong Mathematical Foundation*. Ohio: University of Akron.
- Yilmaz, Ç., Altun, S.A. & Olkun, S. 2010. Factors Affecting Students' Attitude towards Math: ABC Theory and Its Reflection on Practice. *Procedia - Social and Behavioral Sciences*, 2(2):4502–4506:10.1016/j.sbspro.2010.03.720.
- Yin, R.K. 2014. *Case study research: design and methods*. 5th ed. Los Angeles: SAGE (Applied social research methods series).
- Yule, G. 2006. *The Study of Language*. 3rd edn. Cambridge, UK: Cambridge University Press.
- Zenda, R. 2019. Impact of the Learner-Educator Ratio Policy on Learner Academic Achievement in Rural Secondary Schools: A South African Case Study. *Africa Education Review*, (2019):10.1080/18146627.2019.1588748.
- Zuber-Skerritt, O. 1992. *Professional development in higher education: a theoretical framework for action research*. London: Kogan Page.

APPENDIX A



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Education

Ethics Committee

10 June 2019

Ms Kayla Haarhoff

Dear Ms Haarhoff

REFERENCE: EC 19/05/01

This letter serves to confirm that your application was carefully considered by the Faculty of Education Ethics Committee. The final decision of the Ethics Committee is that your application has been **approved** and you may now start with your data collection. The decision covers the entire research process and not only the days that data will be collected. The approval is valid for two years for a Masters and three for Doctorate.

The approval by the Ethics Committee is subject to the following conditions being met:

1. The research will be conducted as stipulated on the application form submitted to the Ethics Committee with the supporting documents.
2. Proof of how you adhered to the Department of Basic Education (DBE) policy for research must be submitted where relevant.
3. In the event that the research protocol changed for whatever reason the Ethics Committee must be notified thereof by submitting an amendment to the application (Section E), together with all the supporting documentation that will be used for data collection namely; questionnaires, interview schedules and observation schedules, for further approval before data can be collected. **Non-compliance implies that the Committee's approval is null and void.** The changes may include the following but are not limited to:
 - Change of investigator,
 - Research methods any other aspect therefore and,
 - Participants
 - Sites

The Ethics Committee of the Faculty of Education does not accept any liability for research misconduct, of whatsoever nature, committed by the researcher(s) in the implementation of the approved protocol.

Upon completion of your research you will need to submit the following documentations to the Ethics Committee for your Clearance Certificate:

- Integrated Declaration Form (Form D08),
- Initial Ethics Approval letter and,
- Approval of Title.

Please quote the reference number **EC 19/05/01** in any communication with the Ethics Committee.

Best wishes

A handwritten signature in black ink, appearing to read 'Liesel Ebersöhn'.

Prof. Liesel Ebersöhn
Chair: Ethics Committee
Faculty of Education

APPENDIX B

Principal letter of consent



Date

Dear Principal

RE: Provision of consent for school to take part in study

My name is Kayla Haarhoff and I am currently enrolled as a master's student at the University of Pretoria. The research I wish to conduct for my master's dissertation titled: ***Strengthening Teacher Support to Learners Experiencing Dyscalculia in Grade 3*** involves investigating how teachers' knowledge and skills of supporting learners with dyscalculia can be strengthened in Grade 3. I want to invite your school to take part in the study.

The study will comprise of working with Grade 3 teachers in the form of individual semi-structured interviews and observing these teachers during the teaching of mathematics. I will specifically focus on how the teacher supports learners that experience difficulties to obtain mathematical concepts and skills. You are kindly requested to allow the selected Grade 3 teachers at your school to participate in the research study. The teachers will be invited to participate in the data generation phase of this study by taking part in an interview as well as observations. The interview and observation will be scheduled according to their availability. Interviews will take place at a venue convenient for all participants, whereas the observation will have to take place in the classroom. Interviews and observations should not take longer than one hour.

Please note that the name of the school and the teachers will always remain anonymous and confidential. The individual semi-structured interviews will be recorded on a voice recording

device for accurate data generation purposes. I will make use of an observation sheet and research journal to record the findings of the observation of the respective mathematics lessons.

Participation in this study is completely voluntary. Teachers are free to withdraw at any given point. You are most welcome to contact myself or my supervisors, if you have any queries regarding the study. The contact details are provided below.

Kayla Haarhoff Researcher	Dr Roy Venketsamy Supervisor	Miss Nadia Swanepoel Co-supervisor
<u>kayla.haarhoff@up.ac.za</u>	<u>roy.venketsamy@up.ac.za</u>	<u>Nadia.Swanepoel1@up.ac.za</u>

Teachers will be provided with the findings of this study so that they have the option to apply it in their classrooms to accommodate learners with mathematical learning difficulties. Furthermore, member checking was implemented to enhance the validity of the study. This research is imperative in order to identify ways in which teacher support can be strengthened to learners experiencing mathematical learning difficulties. Various research has proven that urgent attention should be given to learners' performance in mathematics, and this study will try to provide information by identifying support methods for teachers.

The process further requires that the Gauteng Department of Education (GDE) give permission to conduct the research study in a selected number of schools. Attached find a letter from the GDE granting their permission to conduct an interview and observe the teachers.

The University of Pretoria will remain custodians of all research findings. The University also needs to keep on record that all protocols in attaining this permission were followed. To this end, please complete the attached request that you acknowledge, together with the GDE, that the selected educators at your schools participate in the research study.

Yours sincerely

Ms K. Haarhoff

Date

APPENDIX C



PERMISSION FOR RESEARCH

I, _____, hereby give permission to Kayla Haarhoff to include selected Grade 3 teachers at my school to participate in her research study on ***Strengthening Teacher Support to Learners Experiencing Dyscalculia in Grade 3.***

Signature: _____

Date: _____

APPENDIX D



Teacher letter of consent

Date

Dear Grade 3 teacher

RE: Provision of consent for teachers to take part in study

My name is Kayla Haarhoff and I am currently enrolled as a master's student at the University of Pretoria. The research I wish to conduct for my master's thesis titled: ***Strengthening teacher support to learners experiencing dyscalculia in Grade 3*** involves investigating how teachers' knowledge and skills of supporting learners with dyscalculia can be strengthened in Grade 3.

I will make use of two data generation strategies. One of the strategies that I will employ, is an individual semi-structured interview. Each Grade 3 teacher that was approached to participate in the study will be interviewed individually. Moreover, the Grade 3 teachers will be observed during the teaching of a mathematical lesson. I will specifically focus on how teachers support learners that experience difficulties to obtain mathematical concepts and skills.

As a Grade 3 foundation phase teacher, your participation and assistance are highly valued in this regard. Please note that the name of the school and the teachers will always remain anonymous and confidential. The individual semi-structured interviews will be recorded on a voice recording device for accurate data generation purposes. I will make use of an observation sheet and research journal to record the findings of the observation of the respective mathematics lessons.

Participation in this study is completely voluntary. You are free to withdraw at any given point. Choosing not to take part in this study will not disadvantage your position in the working environment in any manner. The observations and interviews will be dealt with anonymously and confidentially. You, as the participant, will have the opportunity to verify the expressed views and transcripts of the interview and observation made by me, if so requested.

You are most welcome to contact myself or my supervisors, if you have any queries regarding the study. The contact details are provided below.

Kayla Haarhoff Researcher	Dr Roy Venketsamy Supervisor	Miss Nadia Swanepoel Co-supervisor
<u>kayla.haarhoff@up.ac.za</u>	<u>roy.venketsamy@up.ac.za</u>	<u>Nadia.Swanepoel1@up.ac.za</u>

Teachers will be provided with the findings of this study so that they have the option to apply it in their classrooms to accommodate learners with mathematical learning difficulties. This research is imperative in order to identify ways in which teacher support can be strengthened to learners experiencing mathematical learning difficulties. Various research has proved that urgent attention should be given to learners' performance in mathematics, and this study will try to provide information by identifying support methods for teachers.

The process further requires that the Gauteng Department of Education (GDE) give permission to conduct the research study in a selected number of schools. Attached find a letter from the GDE granting their permission to conduct an interview and observe the teachers.

The University of Pretoria will remain custodians of all research findings. The University also needs to keep on record that all protocols in attaining this permission were followed. To this end, please complete the attached request that you acknowledge, together with the GDE, that you will participate in the research study.

Yours sincerely

Ms K. Haarhoff

Date

APPENDIX E



PERMISSION FOR RESEARCH

I, _____, hereby give permission to Kayla Haarhoff to include me as a participant in in her research study on ***Strengthening Teacher Support to Learners Experiencing Dyscalculia in Grade 3.***

Signature: _____

Date: _____

APPENDIX F

Teacher interview schedule



Interview questions/prompts

(These serve only as a guideline and was further guided by the responses and engagement by teachers)

Dear Teacher

Thank you for agreeing to participate in the interview.

Your responses are voluntary and will be kept confidential.

You may ask questions before or during the time of participation. If you have any concerns regarding the data generation procedures, please notify me or my supervisor. Each participant will have the opportunity to verify the expressed views and the transcripts of interviews.

Thank you, your participation is sincerely appreciated.

Kayla Haarhoff

Interview questions for teachers

A. Background

Teaching and support for learners with dyscalculia	Answer
How old are you?	
Which ethnic group do you identify yourself with?	
What nationality are you?	
Are you currently involved in the teaching of Grade 3 learners this year?	
Do you have a teaching qualification? If yes, please indicate what type of qualification was obtained.	
Which quintile does your school represent?	
How many years have you been teaching Grade 3 learners?	5 years
	7 years
	9 years
	10+ years
How many learners have been experiencing dyscalculia in your class?	
How many learners in your class have mathematical learning difficulties?	
How many learners in your class experience a difficulty to comprehend mathematics?	

B. Interview questions for teachers

22. What is your understanding of the term 'mathematical learning difficulties'?

23. What is your understanding of the term 'dyscalculia'?

24. What is your understanding of the term 'mathematical anxiety'?

25. Are learners born with the ability to be competent in mathematics, or should this skill be taught to them? If the latter, which skills should be taught to learners?

26. What are some of the challenges to teaching and assessing learners with mathematical learning difficulties?

27. What do you think are possible reasons that learners experience mathematical learning difficulties?

28. Do you have learners in your class who show signs of experiencing difficulties to obtain mathematical skills?
29. Does the school have a process for referring learners for support and receiving support in mathematical learning difficulties?
30. Do you like mathematics? How does this influence the way you teach mathematics?
31. Do you make use of the CAPS or any other policies or guidelines to support learners in mathematical learning difficulties?
- 31.1 If yes, what do you use and how do you implement it in your classroom?
- 31.2 If no, is there a specific reason?
32. Do you support learners that experience difficulties to obtain mathematical skills?
- 32.1 If yes, how do you support these learners? Can you provide examples or show me resources that you use?
- 32.2 If no, is there a specific reason why you do not or cannot support these learners? Would you support learners if you had the opportunity?
33. Does your school make use of specific planning for the teaching and learning of mathematics? How would you rate this planning according to the teaching and learning of mathematics?
34. Do you use any of the following methods to support learners experiencing mathematical learning difficulties? Please elaborate on each of your answers, whether it is yes or no:
- 34.1 Differentiated teaching (planning lessons according to learners' learning styles and competencies)
- 34.2 Peer teaching and learning
- 34.3 Small group teaching
- 34.4 Individual teaching
- 34.5 Games
- 34.6 Media (technology, calculators, electronic appliances, online games, internet sources)
- 34.7 Lesson study (collaboration between teachers to plan for the learning and teaching of learners)

35. What kind of resources would you want or what should be in place in your classroom to support learners with mathematical learning difficulties?
36. Do you follow any steps or guides when teaching mathematics to Grade 3 learners?
37. Do you think that teachers are trained sufficiently to teach Mathematics and to support learners with mathematical learning difficulties? Why or why not?
38. What formal or informal training do you think teachers need to be able to effectively support learners with mathematical learning difficulties?
39. What other types of training or workshops do you think are important to develop the skills of effectively supporting these learners?
40. What are your perceived gaps (if any) in the current educational policies with regard to mathematical learning difficulties?
41. What is your understanding of the word 'pedagogical content knowledge'?
- 41.1 Do you think you have sufficient pedagogical content knowledge?
Why/why not?
42. What is your understanding of the word 'subject matter knowledge'?
- 42.1 Do you think you have sufficient subject matter knowledge?
Why/why not?

APPENDIX G

Teacher observation schedule



Observation questions

Dear Teacher

Thank you for agreeing to participate in an observation.

The findings will be kept confidential.

You may ask questions before or during the time of participation. If you have any concerns regarding the data generation procedures, please notify me or my supervisors. Each participant will have the opportunity to verify the expressed views and the transcripts of observations.

Thank you, your participation is sincerely appreciated.

Kayla Haarhoff

Observation of teachers

Date: _____

Time: _____

Observations	
Mathematical tasks	Comments
<ul style="list-style-type: none"> • What mathematical task or activity has the teacher presented? • Is it teacher – or learner-centred? • Are the learners engaged in the tasks or activity? • How are tasks presented? • How does the task or activity progress within the lesson? 	
Mathematical tools	Comments
<ul style="list-style-type: none"> • Which mathematical tools or resources has the teacher provided the learners with? • Does she provide any additional resources to learners experiencing mathematical learning difficulties? 	
Barriers to learning	Comments
<ul style="list-style-type: none"> • Are there learners that experience barriers or difficulties? • How does the teacher support these learners? 	
Perceived challenges	Comments
<ul style="list-style-type: none"> • What are some of the challenges to teaching and assessing learners with mathematical learning difficulties? • How does the teacher or the learner overcome these challenges? 	

Culture in the classroom	Comments
<ul style="list-style-type: none"> • What is the culture in the classroom? • How do the learners behave? • How does the teacher respond to misbehaviour? • How does the teacher respond to learners that give wrong answers? 	
<p>Open-ended (example: body language / ergonomics)</p>	