Cape Peninsula University of Technology

TEACHING AND LEARNING STRATEGIES TO ENHANCE ISIXHOSA-SPEAKING LEARNERS' MATHEMATICAL UNDERSTANDING IN ENGLISH GRADE ONE CLASSROOMS

by

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Thesis submitted in fulfilment of the requirements for the degree Doctor of Education in the Faculty of Education and Social Sciences at the Cape Peninsula University of Technology

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Wellington

September 2022

DECLARATION

I, Tanja Kotzé-Coetzer, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

21-09-2022

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ABSTRACT

This study was aimed at exploring, describing, and understanding how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. To date, there are still no proper mathematical registers for African languages. There is also a scarcity of teaching and learning strategies on what constitutes good mathematics practices in South African English Grade One classrooms to support isiXhosa Home Language learners with mathematical understanding. This study highlights some of the current teaching and learning strategies experienced and implemented by selected Grade One teachers in the Metro East Education District of the Western Cape. In an attempt to resolve the research problem, recommendations are given for effective dissemination strategies to support isiXhosa Home Language learners. A gap in the literature on descriptions of current support provided to isiXhosa-speaking learners within the mathematical proficiency model of Kilpatrick, Swafford, and Findell (2001) was identified. This research, therefore, intends to fill this knowledge gap. It is especially unclear what adequate teaching and learning strategies are utilised for isiXhosa-speaking learners to become truly proficient in using the English academic register for mathematical understanding in the context of South Africa. An adapted Interactive Qualitative Analysis (IQA) approach supported by exploratory, descriptive, and contextual research designs were employed. Using the purposive sampling technique, a sample was chosen from eleven Grade One teachers from public and independent primary schools in the Western Cape who taught mathematics to isiXhosa learners who received education in English. Data were collected through unstructured open-ended focus group interviews, semi-structured individual interviews, and lesson observations. The findings provide a clear description of current teaching and learning strategies utilised by selected Grade One teachers, as well as their resources and support, and their experiences with a lack of pre- and in-service training. Conclusions are made in terms of the intertwined theory of Vygotsky's (1978) learning theory and the five-stranded model of mathematical proficiency of Kilpatrick et al. (2001). Based on the findings, several recommendations were made regarding teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

OPSOMMING

Hierdie navorsingstudie was daarop gemik om Graad Een onderwysers se gebruik van onderrig- en leerstrategieë om isiXhosa-sprekende leerders se begrip van wiskunde in Engelse klaskamers te verbeter, te ondersoek, beskryf en te verstaan. Tot op hede, is daar nog geen behoorlike wiskunde taalregisters vir Afrikatale ontwikkel nie. Daar is ook ‘n skaarste aangaande riglyne oor wat goeie wiskundepraktyke in Engelse Suid-Afrikaanse Graad Een klaskamers behels om sodoende isiXhosa-sprekende leerders met wiskunde begrip te ondersteun. Hierdie studie beklemtoon sommige van die huidige onderrig- en leerstrategieë wat deur geselekteerde onderwysers in die Wes-Kaapse Metro Oos Onderwysdistrik ervaar en geïmplementeer word. In 'n poging om die navorsingsprobleem op te los, is aanbevelings daargestel vir die effektiewe verspreiding van onderrig- en leerstrategieë om die isiXhosa-sprekende leerder te ondersteun met wiskundige begrip. 'n Leemte was geïdentifiseer in die literatuur rakende beskrywings van huidige ondersteuning wat aan isiXhosa-sprekende leerders verskaf is binne die wiskundige-vaardigheidsmodel van Kilpatrick, Swafford en Findell. Dus poog hierdie navorsing om hierdie leemte in die literatuur te vul. Die gebruik van voldoende onderrig- en leerstrategieë vir isiXhosa-sprekende leerders om werklik vaardig te raak in die gebruik van die Engelse akademiese taalregister vir wiskundige begrip in die konteks van Suid Afrika, is veral onduidelik. Hierdie studie maak gebruik van ‘n aangepaste interaktiewe kwalitatiewe ontleding-stelselmetode (“Interactive Qualitative Analysis Systems Method”) benadering wat ondersteun word deur die verkennende, beskrywende en kontekstuele navorsingsontwerpe. Deur die doelgerigte steekproeftegniek te gebruik, is 'n steekproef gekies uit elf Graad Een-onderwysers van openbare en onafhanklike laerskole in die Wes-Kaapse Metro Oos Onderwysdistrik wat wiskunde onderrig aan isiXhosa-sprekende leerders in Engelse Graad Een klaskamers. Data is versamel deur middel van ongestruktureerde, oop-einde fokusgroeponderhoude, semi-gestruktureerde individuele onderhoude en leswaarnemings. Die bevindings verskaf ’n duidelike beskrywing van huidige onderrig- en leerstrategieë wat deur onderwysers gebruik word om isiXhosa-sprekende leerders se begrip van wiskunde te ondersteun. Bevindings rakende onderwysers se behoeftes aangaande voor- en indiensopleiding, asook ander struikelblokke, is uitgewys. Gevolgtrekkings is gemaak in terme van Vygotsky (1978) se leerteorie binne die verweefde wiskundige-vaardigheidsmodel van Kilpatrick, Swafford en Findell (2001). Op grond van hierdie bevindings is praktiese aanbevelings gemaak rakende onderrig- en leerstrategieë vir wiskunde-ondersteuning aan isiXhosa-sprekende leerders in Engelse Graad Een klaskamers.

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DEDICATION

To my parents,

Hennie and Sonja Kotzé,

who have constantly supported me throughout my studies.

Thank you for believing in me.

I am honoured to have you as my parents.

I love you with all my heart.

To my husband,

Rinus Coetzer,

who was constantly by my side.

Thank you for being my best friend, for your words of encouragement and endless patience (I know it wasn’t easy sometimes...).

You are a wonderful husband and I love you.

CONFIRMATION OF CRITICAL READER

22 August 2022

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Teaching and learning strategies to enhance isiXhosa-speaking learner's mathematical understanding in English Grade One classrooms

This is to confirm that I have critically read Tanja Coetzer-Kotze's PhD thesis entitled: *Teaching and learning strategies to enhance isiXhosa-speaking learner's mathematical understanding in English Grade One classrooms*

Professor Marc Schäfer
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Please feel free to contact me if you need any further information.

Yours sincerely,

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LIST OF ABBREVIATIONS AND ACRONYMS

AMESA	The Association for Mathematics Education of South Africa
ATP	Annual Teacher Plans
BELA	Basic Education Laws Amendment
BICS	Basic Interpersonal Communication Skills
CALP	Cognitive Academic Language Proficiency
CAPS	Curriculum and Assessment Policy Statement
CGCS	Council of the Great City Schools
COVID-19	Coronavirus
CPUT	Cape Peninsula University of Technology
DBE	Department of Basic Education
DBST	District Based Support Team
DCAS	Department of Cultural Affairs and Sport
DHET	Department of Higher Education and Training
DoE	Department of Education
ELL	English Language Learners
FP	Foundation Phase
HL	Home Language
HSRC	Human Science Research Council
IALL	Incremental Introduction of African Languages
IQA	Interactive Qualitative Analysis
IRR	Institute of Race Relations
ISP	Individual Support Plan
ITE	Initial Teacher Education
LiEP	Language in Education Policy
LOLT	Language of Learning and Teaching
MEED	Metro East Education District
MS	Microsoft
NCS	National Curriculum Statement
NCTM	National Council of Teachers of Mathematics
NEEDU	National Education Evaluation and Development Unit
NGT	Nominal Group Technique
RNCS	Revised National Curriculum Statement
SAMF	The South African Mathematics Foundation
SAMS	The South African Mathematical Society

SBST	School Based Support Team
SIAS	School Improvement and Support Policy
SID	Systems Influence Diagram
SRQ	Sub-Research Question
StatsSA	Statistics South Africa
TIMMS	Trends in International Mathematics and Science Study
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organisation
US	United States
USA	United States of America
WCED	Western Cape Education Department
ZDP	Zone of Proximal Development

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CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE RESEARCH

1.1 Introduction

South Africa's mathematics education performance is alarmingly deficient (Essien, 2018:48-49; Robertson & Graven, 2019:3; Pretorius, 2020). Pretorius (2020) asserts that South African learners' poor performance in mathematics is more prevalent among those who are not taught in their home language (HL) (Essien, 2018:48-49; Robertson & Graven, 2019:3). Although less than 21% of the population of the Western Cape speaks English as a first language, English remains the dominant educational language in South African schools (Gumede, 2017). In this regard, while the government encourages schools to have multilingual activities and to teach all learners in their HL as a way to accommodate them, learners who speak isiXhosa as their HL are still found in schools where the Language of Learning and Teaching (LOLT) is English (South Africa. Statistics South Africa [StatsSA], 2013; United Nations Educational Scientific and Cultural Organisation [UNESCO], 2016; Graven & Venkat, 2017:15; Gumede, 2017). According to Robertson and Graven (2019:604), language plays a critical role in a child's development; however, language is regarded as being among the reasons why schools in South Africa have some of the lowest mathematics standards worldwide (Gumede, 2017; Graven & Venkat, 2017:148; Pretorius, 2020). Another reason, according to Robertson and Graven (2019:604), is that teachers lack the necessary skills and pedagogical knowledge to teach both mathematics and a second language concurrently. Early childhood education is essential for the development of basic mathematical abilities and affection (South Africa. Department of Basic Education [DBE], 2011; Graven & Venkat, 2017:167). Thus, in South African classrooms, Grade One teachers have a significant impact on learners' development, and the pedagogical skills they use enable learners to have a better understanding of mathematics (Robertson & Graven, 2020:82; Essien, 2018:49; Kusumawati & Nayazik, 2018:111). In view of these issues, this research aims to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

The first chapter informs the reader about the current study's context by defining key terms and concepts, highlighting the research problem's background through a literature review of current and relevant research, and clarifying the theoretical framework of this study. This will be discussed in more depth in Chapter Two. Following that, the researcher will define the research problem, the research questions, and the purpose of this study. The first chapter only provides a short overview of the methodology which will be discussed in more detail in Chapter Three.

1.2 Clarification of key terms and concepts

The key terms used in this study are presented in Table 1.1 below.

Table 1.1: Clarification of key terms

Term	Clarification
Language barrier	According to this study, a *language barrier* exists primarily when Grade One learners are instructed in mathematics in a second and/or third language (i.e., a language that is different from that which is spoken at home). As a result, the learner is unable to comprehend what is being communicated, which thus impedes their academic success (Landsberg, Kruger & Swart, 2016).
Language of Learning and Teaching	The *Language of Learning and Teaching* (LOLT) relates to the primary mode of communication used in a school and/or classroom for learning and teaching, including assessment (South Africa. Department of Basic Education [DBE], 2010:3). The focus of this research is on Grade One isiXhosa HL-speaking learners who are receiving mathematics education in an English LOLT classroom.
Home language	In this study, the first language is the one that is frequently spoken at the learner's home (i.e., isiXhosa). This is the first language that a child acquires through parental exposure, and the first language in which they learn to think and construct meaning (South Africa. DBE, 2011a:11). This study took place in Grade One English classrooms throughout the Western Cape, keeping in mind that 65% of the South African population demands English to be the primary language of teaching and learning during the Foundation Phase (FP) (Gordon, Harvey & Human Science Research Council [HSRC], 2019), whilst only 19.6% of the population are English-HL speakers (Tibane, 2016:166; Graven & Venkat, 2017:15). As a result, this study focuses on learners receiving education in a language other than their Home Language in English Grade One classrooms.

English language learners	*English Language Learners* (ELLs) are learners who come from a variety of different HLs and require specialised instruction in both English and the academic language (Le Cordeur & Tshuma, 2019:106). In this study, the focus is on isiXhosa HL-speaking learners receiving mathematics education in English.
Language of mathematics	The *language of mathematics* is communicated through specialised mathematical vocabulary, graphic representations, and symbols (Jourdain & Sharma, 2016:46).
Mathematics register	The *mathematics register* refers to a collection of meanings that are part of the mathematics language and express mathematical meaning when the specialised language of mathematics is used for mathematical purposes (Ní Ríordáin, Coben & Miller-Reilly, 2015:11). The relationship between a natural language, such as English and mathematics, can be described in terms of the linguistic concept of register. Thus, mathematical language is regarded as a distinct register within a natural language, such as English, which is defined as "a collection of meanings associated with a specific function of language, as well as the words and structures that express these meanings" (Halliday, 1975:65; Le Cordeur & Tshuma, 2019:107).
Teaching and learning strategies	The term *teaching strategies* refers to a collection of instructional methods, learning activities, and materials used to aid in the learning process. These strategies are aimed at actively engaging learners, considering both their learning objectives and developmental needs (Khanal, 2015:36; Kusumawati & Nayazik, 2018:111). The purpose of this study was to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

Department of Basic Education	The DoE was a South African government department until 2009, when it was divided into the DBE and the Department of Higher Education and Training (DHET). The DoE was responsible for overseeing South Africa's education and training system, which included schools and institutions of higher learning. The DBE now collaborates with all schools from Grade R to Grade Twelve, as well as adult literacy and numeracy programmes. The mission of the DBE is to set up, maintain, and support a South African school system that is ready for the 21st century (South Africa. DoE, 2010:174).
Curriculum	Since 1994, the DoE has changed the curriculum numerous times to improve quality. Achieving outcomes-based education was the goal of the National Curriculum Statement (NCS) (Curriculum 2005). Even though it was costly and time-consuming, most schools accepted it without much difficulty. This has been evaluated and modified to reduce its complexity. The Revised National Curriculum Statement (RNCS) outcomes were condensed, focusing on fundamental skills, content knowledge, grade progression, and helping teachers (Zenex Foundation, 2013). The renamed DBE, however, focused on curriculum and systemic reform. The Curriculum and Assessment Policy Statements (CAPS) have taken the place of the RNCS (Coetzee, 2014).

The aforementioned key concepts served as a starting point for the literature review, which assisted the researcher in identifying the appropriate research problem and theoretical framework for the current study.

1.3 Background to the research study and literature review

Given that this research focuses on teachers teaching isiXhosa HL learners in English Grade One classrooms, it is critical to recognise that while children transition from their home to the school, their mother tongue serves as a valuable resource for their developing identities. The identity cultivated and developed in the environment at home could be completely opposite to the identity being developed in the classroom during the FP, particularly if a language other than the one used in the classroom predominates in the home environment (HSRC, 2011; Graven & Venkat, 2017:167). In addition to this, the

HSRC (2011) notes that the HL of learners, particularly in the FP, is critical in early childhood. Most learners' HL is their only means of communication in the classroom. The learners' sociocultural context, which includes indigenous knowledge, is also connected to their HL. Thus, the FP is critical because it is during this phase that the learner develops and thrives socially, intellectually, emotionally, morally and physically (Green, Parker, Deacon & Hall, 2011:110; Lenyai, 2011:70; Graven & Venkat, 2017:15-16).

As determined by Erikson's (1982) stages of psychosocial development, the FP learner is in the fourth stage of development, in which they must master the critical developmental task of "industry versus inferiority". When a young person encounters learning obstacles during this stage, he or she may experience feelings of inferiority. This experience is formed because of the child's realisation of his or her inability to complete specific classroom tasks. As a result, the developmental task at hand is associated with cognitive development. Cognitive development occurs rapidly during this stage of development. The capacity of learners to remember things is increasing, and as a result, they can process more information more quickly. As defined by the cognitive development theory of Piaget (Piaget & Inhelder, 1973:414; Woolfolk, 2007:69), "learners progress from pre-operational to concrete-operational thinking", whereas the social constructivism theory of Vygotsky (1978:57) "incorporates the effect of external influences on cognitive development, such as language, culture, and society". According to this theory, ELLs are at a disadvantage during this stage because they are expected to comprehend the curriculum in a language other than their mother tongue (Kotzé, 2016:5). Additionally, recognising the entwined relationship between communication and cognitive development, it is argued that a learner does not understand concrete logic during the pre-operational stage of cognitive development (Loftus, 2009). As a result, this learner may struggle with performing and manipulating cognitive tasks, as well as with information processing.

The preceding description indicates that language shapes learning and thinking, as it is involved in a number of distinct cognitive, emotional, and social factors (Collier & Thomas, 2012:155; Mulwa, 2014:266). As stated by the DBE (2010:5), a learner's language is the vehicle through which he or she learns to structure their thoughts and experiences. Language is thus regarded as critical as a medium of instruction and learning in South Africa's multilingual societies. Additionally, research has established a strong correlation between education in the HL and academic success (South Africa. DBE, 2010:5; Sosibo, 2015:179).

Reddy, Isdale, Juan, Visser, Winnaar and Arends (2016) argue that the current inadequacy of mathematics achievement in South African schools can be attributed to the reality that learners receive mathematics education in a language other than their mother tongue, which is a significant contributing factor to such poor performance. Pretorius (2020), campaign coordinator at the South Africa Institute of Race Relations (IRR), reported that only 55 000 of the 1.2 million Grade One learners who started school in 2005, passed mathematics in matric in 2017 with a pass mark of over 50%. In 2018, this number fell by a further 5 000, which means that only 50 000 matriculants passed mathematics with a mark of over 50%. In other words, less than 5% of learners who start Grade One achieve a good pass mark in mathematics twelve years later. In 2019 this was just 38.9% (Roodt & Pretorius, 2020:1). Pretorius (2020) said that while the matric pass rate rapidly improved over the past few years, it only provides a snapshot of the real picture. To measure the performance of the South African schooling system, the performance over a full 12-year period should be measured. When this is done, it shows massive holes in the education system which should be addressed very urgently.

Furthermore, the international benchmarks for South Africa’s poor mathematics performance are equally disturbing (Pretorius, 2020). The IRR’s recent “Freeing Education” report highlights that South African learners lag behind their global peers on a number of levels. South African learners, for example, ranked very poorly in the most current Trends in International Mathematics and Science Study (TIMMS) (Roodt & Pretorius, 2020:1). According to Spaull's (2019:3) review of South African learners' performance on such tests, 78% of Grade Four learners were incapable of reading with comprehension in any language, and 61% of Grade Five learners were incapable of carrying out basic mathematics skills. Similarly, South Africa did equally poorly in the Grade Eight mathematics ranking despite local Grade Nine learners competing against Grade Eight learners in other countries (Roodt & Pretorius, 2020:1). According to the 2015 TIMSS, only 31% of South African learners primarily spoke the LOLT at home. Those who spoke the LOLT at home performed significantly better on the tests than those who did not speak the LOLT at home (Reddy et al., 2016:8). In support of this argument, it is critical to ensure that HL inclusion should always constitute a valid part of the dialogue in the classroom; and that, particularly where there are differences in home and/or school language, it should be prioritised to ensure that there are opportunities for learners to develop proficiency in the language needed to learn and understand mathematics in the classroom. This said, the South African language policy, Incremental Introduction of African Languages (IALL), clearly states that, all FP learners (Grade One – Three) in the first three years of school must receive education in their mother tongue (Foley, 2010:3; South Africa. DBE, 2011b; Hoadley, 2012; Graven, 2014).

The reality is that, despite numerous studies recognising the critical nature of education in the mother tongue in South Africa, English remains the dominant language for instruction (Graven & Venkat, 2017:15; Essien, 2018:52). This may be viewed in light of the diversity of South African society. According to recent statistics, South Africa has a population of 58.8 million people, 80.7% of which are Black; 8.8% are Brown; 7.9% are White; and 2.6% are Asian. It's also worth noting that South Africa has at least eleven official languages, as each ethnic group is composed of distinct cultural groups, each of which communicates using a distinct language register or dialect (StatsSA, 2019:8). On the other hand, because English is regarded as the language of liberty and power, an increasing number of people favour its use as a means of communication (Planas, 2018:227; Robertson & Graven, 2020:79). In this regard, statistics from a census last conducted in 2018, the highest polling in history, showed that 65% of the South African population demands English to be the primary LOLT during the FP (Gordon et al., 2019). Consequently, teachers face significant challenges because of the diverse ways in which languages are used. Due to the study's focus on mathematics education in the Western Cape, it is important to note that 46.6% of the population in this province speak Afrikaans; 31.1% speak isiXhosa; and only 19.6% speak English (Tibane, 2016:166; Graven & Venkat, 2017:15). Even though the Western Cape Language Policy (South Africa. Department of Cultural Affairs and Sport [DCAS], 2013:1) encourages the use of the three main HLs (isiXhosa, Afrikaans, and English), isiXhosa learners continue to face challenges (Robertson & Graven, 2020:78-79). According to Robertson and Graven (2020:78-79), one reason for these ongoing difficulties is that isiXhosa learners are denied the opportunity to utilise their mother tongue as a linguistic tool for mathematical understanding and the requirement that they learn mathematics in a language in which they lack fluency (i.e., English).

Although the majority of Western Cape learners do not speak English as a first language, the DBE believes that English is preferred as a mode of communication in South Africa (South Africa. DBE, 2012). According to Robertson and Graven (2020:2), learning English allows learners to take advantage of social and economic opportunities. This is one reason why most black parents' desire for their children to receive an education in English, sacrificing their child's access to a quality education in the process by ignoring the language, pedagogical, and emotional barriers attached to it. As a result, ELLs are excluded from meaningful learning opportunities (Skutnabb-Kangas & Dunbar, 2010:11; Owen-Smith, 2014; Mulaudzi, 2016:164; Machaba, 2018:42).

Numerous studies have revealed that mathematics is a distinct language in and of itself, further complicating learning for the ELL (in this case, the isiXhosa-speaking learner) (Usiskin 1996:231-243; Setati, 2002:89; Moschkovich, 2010:1-28; Pimm, 2007:31; Barwell, 2009). This means that ELLs must overcome not only the LOLT (i.e., English), but also the language of mathematics. As a result, it is reasonable to assume that isiXhosa-speaking learners in an English LOLT classroom may encounter linguistic barriers when it comes to understanding the mathematical register. Additionally, learning mathematics entails developing fluency in the mathematics language. This category includes symbols, words, sentences, abbreviations, and modes of communication, reading, and argumentation (Setati, 2005:448). With this in mind, it is reasonable to anticipate that learners will require an additional scientific mode for writing too (Botes & Mji, 2010:125). Furthermore, it is often thought that mathematics is learned in two steps, namely: 1) learners need to comprehend concepts related to mathematics; and 2) learners must be able to show their understanding of these concepts, either orally or in writing. At first, by using two verbal languages, the teacher explains mathematical concepts in the form of a frequently spoken, everyday language, and a subject specific, language of mathematics. As such, learners need to be proficient in both these languages (Botes & Mji, 2010:125). However, when an African Language is used as the LOLT, it is implied by Van Laren and Goba (2013:174) that learning is hindered by inadequate vocabulary and grammatical conventions of native languages, which makes communicating ideas and concepts very difficult, which is a common misunderstanding. As a result of the language barrier, ELLs are hesitant to participate in classroom discussions (Mulaudzi, 2016:164). One could argue that schools that use English as a LOLT prevent ELLs from developing adequate mathematics skills. Educational limitations, such as low self-esteem and a limited comprehension of mathematics terminology used in the classroom, are frequently apparent among ELLs. As a result, these learners' mathematics achievement is negatively affected (Burton, 2013; Kioko, 2015; Mulaudzi, 2016:164).

To fully grasp the meaning of being proficient in the mathematical language, it is necessary to become acquainted with Kilpatrick, Swafford, and Findell's (2001) five-stranded definition of mathematical proficiency. To become proficient in mathematics entails five interrelated strands that need to be developed, namely: "procedural fluency, conceptual understanding, adaptive reasoning, strategic competence, and productive disposition". According to Kilpatrick et al. (2001:131), a *productive disposition* is the natural urge to find meaning in mathematics, considering it both practical and meaningful, trusting that consistent attempts at learning mathematics have positive outcomes, and seeing oneself as a successful learner of mathematics. Furthermore, the development of a productive disposition involves consistent opportunities for making meaning of mathematics, understanding the value of dedication, and enjoying the benefits of understanding mathematics (Kilpatrick et al., 2001:131). Thus, it is asserted that as other strands develop, so does a productive disposition. The understanding of how to become proficient in mathematics is consistent with South Africa's CAPS, which also asserts the creative aspect of mathematics and that a strong conceptual foundation needs to be developed to make meaning in mathematics (South Africa. DBE, 2011a:8). Additionally, as part of a recent initiative called "Teaching Mathematics for Understanding", the DBE has developed a *mathematics teaching and learning framework for South Africa* with the goal of laying a solid foundation for a new method of teaching mathematics, thereby transforming how mathematics is learned. This framework, in conjunction with the CAPS, is intended to serve as a guideline for South African teachers on how to teach mathematics for understanding by providing various options and ways of thinking about mathematics teaching, learning, and assessment. Hence, this framework is based on Kilpatrick et al.'s (2001) five strands of language proficiency to assist FP teachers in teaching mathematics for understanding (South Africa. DBE, 2018:3). In this regard, a learner's proficiency in mathematics entails the following:

- Conceptual understanding → Having the ability to comprehend your mathematical thinking;
- Strategic competence → the ability to put what you've learned into practice;
- Adaptive reasoning → the ability for reasoning about one's actions;
- Productive disposition → the ability to identify the necessity of engaging with a problem and solve it; and
- Procedural fluency → the confidence in one's ability to calculate (South Africa. DBE, 2012:11; South Africa. DBE, 2018:8).

Prediger, Erath, and Moser Opitz (2019:11) reassure us, however, that language is a critical tool and plays a significant part in mathematics education, both for conversational and conceptual purposes. In this particular respect, the implementation of the five strands of mathematical proficiency within the Mathematics Teaching and Learning Framework for South Africa does not stipulate the significance of teaching through the mother tongue during mathematics education and how teachers could provide further support in this regard. Thus, if teachers of mathematics do not have sufficient teaching and learning strategies in place, for example using learners' HL as a resource within these different strands, learners with limited fluency in the LOLT might find language a barrier to understanding and becoming proficient in mathematics (Robertson & Graven, 2020:82-83). Supporting this viewpoint, Cummins (1980) underscores the key role ELLs' HL plays in multilingual academic settings. Two components of his research seem to be particularly relevant to a multilingual context such as South Africa. First, he explains the difference between the "everyday" and "academic" registers of a language, and how much longer it takes bilingual learners to acquire competence in a new language in either register. Secondly, he emphasises the significant contribution that learners' HL literacy skills play in developing their academic competence in a language that is different to their mother tongue. In general, the demands regarding cognitive and linguistic communication associated with curriculum content are far higher, and the acronyms BICS ("Basic Interpersonal Communication Skills") and CALP ("Cognitive Academic Language Proficiency") coined by Cummins have been commonly used to help differentiate between the "everyday communicative competence" and the more difficult linguistically and cognitively "academic communicative competence". Therefore, the distinction between BICS and CALP is important. BICS is the ability to interact on an interpersonal basis about everyday issues. CALP refers to the academic language necessary to make sense of academic activities and interactions with texts (verbal or written) in abstract, context-free ways (Cummins 2008:71). With mathematics as the focal point of this study, the "language of mathematics" is considered to involve the language competence necessary and sufficient for proficient engagement through mathematical discourse (Moschkovich, 2010:3). In this sense, when the LOLT in the classroom is not that of the learner's HL, it is the responsibility of the teacher and his/her ability to identify the difference between the conversational aspects of the language of learners and the deeper aspects of proficiency that are more closely linked to conceptual and academic development (Kotzé, 2016:7). Therefore, teachers should be aware that the subject content, in this case mathematics, must be learnt at the same time with the language. This means that scaffolding, in addition to clear and specific language instruction, would be necessary to assist the ELL in simultaneously learning subject-specific knowledge and language proficiency (Rothenberg & Fisher, 2007:35). It should be acknowledged, however, that not all teachers are trained to use linguistic knowledge effectively in either the LOLT or the learners' HL for successful mathematics teaching and learning (Essien, 2018:55). Supporting this statement, current research has found that teachers are not confident in the proper use of multiple languages when teaching mathematics both epistemologically and pedagogically (Robertson & Graven, 2020:96).

Language planning has been one of the essential duties taken on in South Africa after 1994, with the government having the chance to reconstruct patriotic pride and re-establish the principles of honesty, respect for cultures and races, and greater appreciation of diversity. In this regard, as a means for the government to carry out this authority, the DBE resolved to develop language policies and identify strategies to improve the state of African languages (South Africa. DBE, 2010; Yu & Dumisa, 2015). Consequently, the Pan South African Language Board (PanSALB) was constituted in order to promote and develop African languages. PanSALB was established as a statutorily authorised body to oversee and enforce the implementation of all eleven official South African languages. To guarantee uniformity of terminology and to encourage multilingualism, the PanSALB has organised lexicography components for every official language (Edwards & Ngwaru, 2011; Mtsatse & Combrinck, 2018:22). However, even though planning for language seemed to be significant on the reunification agenda, it was eminent that much of the African language terminology was last worked on in the apartheid era and the same terminology is still in use today (Mtsatse & Combrinck, 2018:22). Furthermore, according to Webb (2013), nothing substantive has transformed regarding the state of African languages since 1996. In this regard, Mtsatse and Combrinck (2018:22) argue that the government appears to have provided far too little proof that South Africa's language policy has effectively developed African languages in terms of "graphisation" and "codification". Webb (2013) states that African languages haven't been used in a meaningful way outside of formal schooling structures, such as in parliament, court systems, academic institutions, schools, and the published media. Due to the lack of formal social systems in which African languages are used, it seems as though Afrikaans and English preserve a greater language status, whereas African languages continue to maintain a disparately similar status to what they had during the apartheid era (Mtsatse & Combrinck, 2018:22).

South Africa's language policies have been criticised for being excessively politicised, leading to ineffective implementation (Foley, 2004; Cele, 2004; Webb, 2013; Tshotsho, 2013). The reasons for the ineffective implementation are related to the challenges in equalising the needs of each of the eleven official languages and the relaxed linguistic growth of African languages, which include the uniformity of the languages and making them pertinent to the advancement of technology, science and literature (Mtsatse & Combrinck, 2018:22-23). According to Van Laren and Goba (2013:176), it is challenging to find precise, widely recognised terminology for mathematics translated from English into an African language, which makes the standardisation of African languages a continuous challenge (Edwards & Ngwaru, 2011; Mtsatse & Combrinck, 2018:23).

Prinsloo (2011) argues that the true focus of the South African debate on African languages should be the rights of language speakers, not the language itself. Additionally, there are diverse cultural and linguistic societies within communities, and due to migration, African languages and dialects are no longer restricted to a particular region, culture, or ethnic group (Mtsatse & Combrinck, 2018:23). Moreover, there are learners with more than one

HL in South Africa's new democratic classrooms (National Education Evaluation and Development Unit [NEEDU], 2013). In this regard, at home, languages may be spoken in their standardised form, or in dialects and/or combinations of dialects, and/or additional languages used. Due to changes in society, African languages have become different dialects with diverse rules in a single language (Prinsloo, 2011). Hence, the “dialectification” of African languages complicates the process of determining which dialect should be used as the standardised language for teaching and learning (Mtsatse & Combrinck, 2018:23).

To accommodate African languages in mathematics education, several dictionaries for mathematics in African languages have been developed to assist learners in Grades R – Nine to understand the basic scientific language for mathematics used in multilingual schools in South Africa (Van Laren & Goba, 2013:175). However, it seems as though there are only a few multilingual dictionary publications that include the mathematical terminology required for FP teachers teaching mathematics in multilingual classrooms (Van Laren & Goba, 2013:175). Nevertheless, while these multilingual dictionaries are available to learners, the state of mathematics performance in South Africa is still well below expectations (Essien, 2018:48-49; Robertson & Graven, 2019:3; Pretorius, 2020). Moreover, it should also be noted that it is not a simple or easy task to translate mathematical concepts into African languages (Morgan, Craig, Schuette & Wagner, 2014:8). When African mother tongue mathematics teachers reviewed some of the translations given in these dictionaries, the translations were found to be unsuitable (Van Laren & Goba, 2013:175). Despite numerous research-based efforts, South Africa's indigenous African languages have not advanced to the same level of academic and technical precision as Afrikaans and English have since 1994. While this would be perfect, the power and status of English as the language perceived to provide social and economic privilege makes it unlikely that academic registers in all African languages will be developed in the near future. As such, prolonged and structured investment is critical in establishing methods to ensure that African language speaking learners are given the necessary support to develop true proficiency in the academic register of English for mathematics (Robertson & Graven, 2020:96).

The implementation of South Africa’s language policy (IALL) is also seen in respect of shifting towards inclusive education. The overall purpose of full access to mainstream education is implied and clear in the development of international legislation, not just for learners with disabilities, but also for learners from poorer socio-economic backgrounds and different cultural backgrounds (Engelbrecht, Nel, Smit & van Deventer, 2016:1). To support this statement, the United Nations (UN) (2018:6) has endeavoured to guarantee high-quality and inclusive access to education, as well as promote the possibility for all learners to be lifelong learners. Additionally, the Ministry of Education states that inclusivity is provided by means of facilitating educational processes, structures, and methods of learning that fulfil the different learning styles of all learners, including those who do not speak the LOLT (South Africa. DoE, 2001:6–7). Nevertheless, concerns about equal opportunities to learn about becoming a successful academic participant remain problematic (UN, 2018:6; Engelbrecht et al., 2016:2). These concerns, in particular, relate to accessing some of the more influential aspects of knowledge (including mathematics) and the appropriate academic literacy needed to optimise the potential for learners to actually make sense of these influential aspects of knowledge (UNESCO, 2016).

Heugh (2017:4) postulates that where learners are taught in a way that varies from how their peers are taught, inclusive education cannot be effective. In line with this perspective, the idea that "…it is actually a process of fundamental change in a way a school community supports and addresses the individual needs of each learner" is encouraged by Dalton, McKenzie and Kahonde (2012:13). Therefore, to make mathematics classrooms more inclusive, the pedagogical repertoires of our teachers need to be augmented with sufficient teaching and learning strategies (Robertson & Graven, 2019:90).

The researcher intended to identify *recent research* where language was a challenge to learning mathematics, multilingual South African classrooms where learners receive education in a second and/or third language, with a particular emphasis on the Grade One learner in the FP, as well as the responsibility of the Grade One teacher in supporting ELLs. By accessing Research Gate, Sabinet, Eric, and EBSCOhost, a literature review was conducted. The focus of Van Laren and Goba's (2013) study was the contentious topic as to how FP pre-service teachers (i.e., student teachers) are prepared to teach maths in a second language in multilingual classrooms, while Essien's (2018) study examined the influence that language has on teaching and learning mathematics during the early grades. Dalton et al. (2012) and Engelbrecht et al. (2016) reported on South Africa's implementation of inclusive education. Mulaudzi's (2016) study, on the other hand, focused primarily on second language as a barrier to the achievement of mathematics in FP schools. The scholars found that FP teachers need to develop strategies to enable learners to interact confidently in multilingual classrooms during mathematics activities. Furthermore, Graven's (2016) study investigated strengthening the arrangements for mathematical learning through "math clubs" with a focus on Grades Three and Four. Robertson and Graven (2018) explored the use of a transdisciplinary framework in and through a second language to examine mathematics classroom talk. Another paper by Robertson and Graven (2019) discussed the role of language in mathematics education in Grade Four multilingual South African classrooms, specifically whether or not the learners' mother tongue should be utilised for the teaching and learning of mathematics. As a recommendation to their research, Robertson and Graven (2020) found a strong desire and need to investigate alternative approaches to address the barriers that the LOLT creates in our multilingual classrooms by rather looking at ways in which language can become a resource to make sense of mathematics. These studies discussed here indicate that there is evidence to start thinking about what "good practice" could look like in the South African context, building on what is already happening in classrooms and considering the reality of those classrooms. On the other hand, Graven and Venkat (2017) collected a rich set of national and international research-based contributions focusing on improving mathematics teaching and learning in primary education. These scholars found that most research conducted in South Africa focuses only on what is currently "wrong" with the teaching, rather than concentrating on how to improve mathematics teaching and learning. Subsequently, the findings of these recent studies discussed above highlight the need to develop a set framework for teachers to work from in order to support isiXhosa-speaking learners' understanding of mathematics in English Grade One classrooms.

The current research was conducted within the background of the constitutional right, section 29(2), which states that a learner has the opportunity to obtain his/her education in a language they choose (South Africa, 1996:11). It examined what part language plays in the sense-making process of mathematics, as well as other recent findings in the research. The reality that a significant number of learners in South African classrooms fail to understand mathematics, the lack of information regarding what "good practice" in South African multilingual FP classrooms might look like, together with the aforementioned legislation and policies that are an ongoing concern for implementation, served as the basis for the study's focus. As a result, there is a need to determine how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

The following section summarises the theoretical framework that was selected for the purpose of this study, which was informed by the literature review presented above.

1.3.1 Theoretical framework

To enable the researcher to select an appropriate theoretical framework, she was looking for a theoretical framework that could demonstrate how mathematics is learned for proficiency from the perspective of English language learners (i.e., isiXhosa-speaking learners) learning mathematics in a language in which they are not fluent (i.e., English LOLT). In this regard, Vygotsky's (1978) theory of learning serves as the basis for several recent research projects by theorists and other researchers (Arzarello 2006; Sfard, 2012; Barwell, 2016; Kotzé, 2016:13-14; Presmeg, Radford, Roth & Kadunz, 2016:11-15; Robertson & Graven, 2020; Das, 2020:106-107). This theory contends that interpersonal interactions are the result of thought, highlighting the importance of language in cognitive development. This is based on the idea that a person's ability to comprehend and end up making sense of the context in which they find themselves is obtained through communication as well as socio-cultural experiences, which in turn influences their cognitive development (Robertson, 2017:54; Das, 2020:105-106). Before elaborating any further, the researcher thinks it is necessary to define language within the context of mathematics education.

Work by Halliday (1974; 1993), Schleppegrell (2007; 2011), O'Halloran (2011), and Moschkovich (2015), among others, demonstrates that the academic register, which contributes to learners' cognitive academic language proficiency, extends significantly beyond simply terminology. In this regard, mathematical symbolism is found in mathematics education literature, as are specialised representations of mathematics such as drawings, charts, gestures, and other methods of communication applied in different contexts (Arzarello, 2006; Schleppegrell, 2007:139-159; O'Halloran, 2005; 2011:217-236; Jourdain & Sharma, 2016:50-51; Robertson, 2017:19; Robertson & Graven, 2020:95). When teaching mathematics to ELLs and learning mathematics in various native languages, another perception of language is encountered.

According to Halliday (1974), the term 'mathematics register' is a specific communication method of a social practice. Halliday (1978:2) states that "at the most basic level, this means that we account for the simple reality that people talk to each other". This perspective on language in mathematics recognises the structures (i.e., terms and phrases) but emphasises the meaning exchanged between people. When evaluating language in this way, three key questions arise: 1) What exactly is going on? 2) Who are the people involved? and 3) What is the role of language? The answers to these questions determine the language register. Thus, the mathematics register is comprised of both mathematical terminologies distinctive to the discourse of mathematics and unique applications of everyday vocabulary with mathematical meanings.

Research by Pimm (1987) explored the connections language has with mathematics and argues that the link between language and mathematics can be described by means of a mathematical language register. The mathematics register, in this sense, is a specialised language consisting of a collection of meanings to communicate mathematically. This implies that a mathematics register is not just a collection of words, and its development is not just a process of adding new words. Therefore, as part of learning mathematics, it is crucial to become fluent in the language of mathematics and be able to speak, read, and write it. Furthermore, the mathematical register uses symbols, vocabulary, sentences, acronyms, and methods to communicate, disagree, read, and write. (Halliday, 1978; Pimm, 1987; Culligan, 2015:2-3). As a result, the mathematics register describes the mathematical discourse.

Sfard (2012) claims that mathematical discourse is a type of communication that transcends language. According to Gee (1996:131), discourse is defined as "language-in-use". This means that there is more to discourse than just the spoken and written forms of language and using mathematical terminology. Discourses involve communities, perspectives, values, and perceptions and are integrated into sociocultural practices (Moschkovich, 2012b). Additionally, mathematical discourse is also cognitive in nature, as it involves thought, symbols, techniques, and interpretations. In different practices, words, expressions, and written materials have various meanings, functions, and objectives. In this way, mathematical discourses are found in practices that are linked to communities, while mathematical discourse practices include activities, definitions for expressions, concentration, and goals (Moschkovich, 2012a:95).

Building on the work of these scholars, it is believed that language and the understandings individuals create in discourse, which involves multiple semiotic systems such as verbal communication, writing, body language, visual representations, and so on, enable the learning of mathematical concepts and are critical when investigating mathematics teaching and learning (Saussure, 1959; Vygotsky, 1997; Arzarello, 2006; Sfard, 2008:81; Radford & Sabena, 2015:168; Presmeg et al., 2016:19).

The researcher was directed by the aforementioned starting point to settle on Vygotsky's (1978) theory of learning, embedded within the five-stranded model of mathematical proficiency of Kilpatrick et al. (2001:5, 117) as the theoretical framework for this study. The mathematical proficiency model developed by Kilpatrick et al. (2001) is defined by Ramollo (2014:14) as "different strands that include the knowledge about the relationship between the teacher, the learner, and the content and embrace the context to successfully learn mathematics". In line with this framework, the needs of ELLs (i.e., isiXhosa-speaking learners) to become proficient in mathematics should be supported within each strand. In order to define what competent mathematics teaching and learning implies, it is necessary to note that mathematical proficiency is built on five interconnected strands. Within the context of this research study, Kilpatrick et al. (2001:5) explains these strands as follow:

1. *Conceptual understanding* → In the context of mathematics education, one can make sense of mathematics concepts, procedures, and relations.
2. *Procedural fluency* → Adaptability, precision, effectiveness, and appropriateness in applying rules and procedures in a mathematical classroom.
3. *Strategic competence* → The capability to successfully plan, interact, and represent maths problems in the classroom.
4. *Adaptive reasoning* → The capability to reasonably justify, describe, and reflect on one's pedagogical approaches.
5. *Productive disposition* → The regular opportunities that are provided to make meaning of mathematics, to practice patience, and to enjoy the rewards of mathematical understanding.

These strands can assist the teacher to understand how to successfully teach mathematics to diverse learners in a variety of learning environments. To better support ELLs' cognitive processes and communication skills, this will assist the teacher in gaining an appreciation for pedagogical expertise during mathematics lessons. The following skill sets are required for this level of proficiency:

- The teacher is familiar with the learner's language and mathematical knowledge, which they bring to class.
- The teacher is aware of the language requirements imposed by the learning activities that learners are expected to complete within each strand.
- The teacher can provide whatever scaffolding is necessary to aid ELLs in acquiring and applying concepts, skills, and abilities as they engage in those activities.
- The teacher can assemble and implement a diverse range of semiotics to support learners in acquiring mathematical proficiency (Kilpatrick et al., 2001:5-6; Presmeg et al., 2016:19).

To conclude, Vygotsky's multi-semiotic approach to learning and cognitive development demonstrates the importance of language and communication. When a teacher provides "scaffolding", he/she is providing assistance tailored to the individual learner's needs to help them achieve their learning goals (zone of proximal development [ZPD]) (Papalia & Feldman 2011:34; Presmeg et al., 2016:19). Scaffolding in this study is focused on the isiXhosa-speaking learners' needs, with the goal of assisting the learner in becoming proficient in mathematics. This implies that the teacher should be able to assemble and implement a wide variety of semiotics to aid the learner's development of mathematical proficiency (Kilpatrick et al., 2001:370; Presmeg et al., 2016:19). The teacher must also be capable of anticipating and guiding learners' errors. Furthermore, as described by the interconnected strands of proficiency, the scaffolding should focus on all of the various strands through which teachers teach each learner to become proficient in mathematics (Kilpatrick et al., 2001:5, 339-340).

This study's background, together with the theoretical framework, brought forth the starting point for the conceptualisation of the research problem discussed in the next section.

1.4 Problem formulation

This study's research topic places the emphasis on teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. An initial literature review served as the basis for this study's research problem, which was formulated as follows (Babbie & Mouton, 2009:99):

The Western Cape Language Policy (South Africa. DCAS, 2013:1) promotes the use of the formal HLs for teaching and learning, namely, English, Afrikaans, and isiXhosa. However, despite numerous studies showing the value of receiving education in the HL in South Africa, English remains the language of instruction. In this regard, a 2018 census revealed that 65% of South Africans want English to be the primary language of instruction during the FP. Moreover, it is noted that less than 5% of Grade One learners pass mathematics in matric. It is argued that the current low mathematics achievement in South Africa is a result of learners not receiving education in their mother tongue. Keeping this in mind, the use of language in Grade One is critical because this is when the learner begins to develop physically, intellectually, emotionally, morally, and socially. It is also stated that there is a shortage of teachers who can teach mathematics and a second language simultaneously. Despite numerous research-based initiatives, the country's indigenous African languages have been unable to achieve the same academic and technical precision as Afrikaans and English. The reality remains that there are still no proper mathematical registers for African languages. The few African dictionaries available, including isiXhosa, lack suitable translations. As such, to make teaching mathematics more diverse, it is necessary to develop and incorporate adequate teaching and learning strategies into teachers' pedagogical repertoires so that the African language-speaking learners get the support they need to become truly proficient in using the English academic register for mathematical teaching and learning. There is, however, a scarcity of research about what constitutes good mathematics practice in South African English Grade One classrooms for isiXhosa-speaking learners. This study's purpose was to investigate how Grade One teachers are using teaching and learning strategies to support isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

Based on the research problem presented above, the following research questions were formulated to guide this study.

1.5 Research question and sub-questions

The research question was developed premised on a review of the literature and the formulation of the problem (Grinnell, Williams & Unrau, 2010:38-39). For this study, the following main research question was devised to address the research problem:

- "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?"

The following sub-research questions (SRQs) were composed to help answer the main research question:

- SRQ 1: "What are Grade One teachers' understandings of mathematical language?"
- SRQ 2: "What are Grade One teachers' understandings of teaching and learning strategies to enhance mathematical understanding?"
- SRQ 3: "What are Grade One teachers' experiences of teaching and learning strategies to enhance mathematical understanding?"
- SRQ 4: "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?"

The main aim of this study, and the objectives that are required to answer the research questions, are presented below.

1.6 Aim and objectives

The terms "aim" and "objective" in research are defined as the aspirations of the researcher (Fouché & De Vos, 2011:94; Cohen, Manion & Morrison, 2018:278-279). The *aim* of the research explains the outcomes that the researcher hopes to achieve when concluding the study, whereas the *objective* of the study describes the actions that the researcher would therefore take to achieve this desired outcome (Cohen et al., 2018:278-279). Table 1.2 below summarises the aim and objectives of this study:

Table 1.2: Aim and objectives of this study

Research aim
This research study aims to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.
Research objectives
1. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' understandings of mathematical language are.
2. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' *understandings* of teaching and learning strategies are to enhance mathematical understanding.
3. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' *experiences* of teaching and learning strategies are to enhance mathematical understanding.
4. To use a qualitative data collection method to establish *how* (describe) Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.
5. To use a qualitative data analysis method to determine *what* (explore) teaching and learning strategies could be developed to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.
6. To conduct a literature review based on the findings of the study.
7. To make inferences based on the evidence gathered.
8. To make recommendations to teachers in terms of teaching and learning strategies that could assist isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

In the following section, the researcher discusses the methods employed to achieve the study's aim and objectives.

1.7 Research methodology

This section summarises the methodology utilised to solve the research problem and answer the research questions. To ensure qualitative data verification, Chapter Three will give a detailed explanation of the methodology implemented.

This study's aim was to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. Qualitative research was the most appropriate approach for solving the research problem as well as answering the research questions. This method was chosen specifically for the purpose of gathering data on current English Grade One classroom practices (McMillan & Schumacher, 2014:370–371).

Additionally, the purpose of the research influenced the choice of the research design. The researcher chose to work with a qualitative research design, which assisted with the sampling, data collection, and analysis (Fouché & Schurink, 2011:312). According to Maxwell (2016:214-215) and Cohen et al. (2018:303), qualitative researchers frequently combine designs to achieve the best fit for the study's purpose. The purpose of interpretive research is to gain a better understanding of how individuals perceive social phenomena with which they interact (Rehman & Alharthi, 2016:55). As a result, this study was designed using a qualitative research approach in conjunction with the interactive qualitative analysis (IQA) systems method of Northcutt and McCoy (2004). The researcher selected the *IQA systems method* as she wanted to acquire data of the constructed meanings of the participants of current mathematics practices (i.e., Teachers teaching mathematics in English Grade One classrooms) (McMillan & Schumacher, 2014:370-371).

This design intended to provide a focal point to create a better understanding of the research problem (McMillan & Schumacher, 2014:348). It also allows for participants' voices to be heard, such as the teacher participants in this study. The researcher chose a *case study design* because she wanted to investigate the data within a particular setting. A case study method focuses on a specific geographical region or a small percentage of participants. Case studies explore and investigate current real-world phenomena in their true nature by conducting a comprehensive analysis in the context of a small series of situations or circumstances as well as their interrelations (Gay, Mills & Airasian, 2012:446).

The size of the study's population was based on the research question, which included a selection of Grade One teachers in the Western Cape. A *purposeful sampling* technique was used to intentionally select participants who would be better suited to answering the research question (Creswell, 2014:185-186; 2018). As a result, this study's sample size was a subset drawn from the representative sampling frame (i.e., a subset of the entire population) from which the data was obtained (Taherdoost, 2016:20).

The researcher gathered data through open-ended focus group interviews in order to create an interview framework based on the categories and themes derived from the participants during the interview. This framework assisted the researcher in collecting data during semi-structured individual interviews as well as classroom observations (Bargate, 2014:13). This method assisted the researcher by allowing the research participants to interactively engage with the data collection as well as the data analysis. Thus, “rather than asking the researcher to identify the categories of meaning, the IQA process exploits the participants’ own definitions of meaning by using those very categories as the outline of the interviews” (Northcutt & McCoy, 2004:199). The individual interviews gave the researcher an overview of the individuals’ understandings, perceptions, and lived experiences of using strategies for teaching and learning to enhance isiXhosa-speaking learners’ mathematical understanding in English Grade One classrooms (Bargate, 2014:13). The field observations supplied the researcher with explanations of patterns among elements of a system, as well as comparing systems (i.e., observing how mathematics was actually implemented in the participants’ classrooms in relation to what they mentioned during their interviews) (Northcutt & McCoy, 2004:50).

The data was analysed in three stages. The first stage of data analysis involved identifying themes and short descriptions of the participants' brainstormed thoughts, perceptions, experiences, and feelings that took place through the unstructured open-ended focus group interviews, which informed the framework for the individual interviews. The second stage of data analysis involved examining the transcribed semi-structured individual interviews for patterns. Stage three entailed the analysis of the data in an attempt to obtain a sequential outlook as to what really occurred during each of the interviewed participants' mathematics lessons. The data analysis of the individual interview transcriptions was compared to the data analysis of the field observations from the mathematics lessons using John Stuart Mill’s Analytic Comparison technique (Neuman, 2014:493).

For this qualitative research study, the researcher used five categories of validity to validate the obtained data, namely: "descriptive-, interpretive-, theoretical-, generalizability-, and evaluative validity" (Maxwell, 2016:243-246). In addition, Thomson's (2011:77-82) classification of transferability was also applied.

The researcher adopted Babbie (2007:65), Strydom (2011:126), and Kumar's (2014:212) ethical considerations for this study, namely: "participant anonymity, confidentiality, information protection, and informed consent". These are described in more detail in Chapter Three.

The structure of the thesis is outlined next to give the reader a 'road map' of what is to come.

1.8 Outline of chapters

This study consisted of the following five chapters:

Chapter One introduced the topic under investigation and presented a brief literature review that provided a background of the study. Furthermore, the research problem, questions, aim, and objectives were also introduced, along with the research methodology that was employed to conduct the research.

Chapter Two provides a literature review on the topic under study which in turn is used to articulate and formulate the findings presented in Chapter Four.

Chapter Three contains a detailed explanation of how the research methodology was implemented, as well as a scientific foundation for the methodology's implementation.

Chapter Four discusses the research findings and articulates and formulates these with the literature review.

Chapter Five provides a summary, conclusion, and recommendations for teaching and learning strategies that could help isiXhosa-speaking learners in English Grade One classrooms better understand mathematics.

1.9 Conclusion

Chapter One introduced the topic of this study which set out to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. The main elements of the research process were also presented. The theoretical framework that underpinned this study, and related literature pertaining to the topic, are discussed next.

CHAPTER TWO
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

Chapter Two provides a backdrop of the theoretical framework and the literature review that was used to articulate and formulate the findings presented in Chapter Four. This chapter will focus on the following:

- Vygotsky's learning theory;
- Kilpatrick, Swafford, and Findell's five-stranded model of mathematical proficiency;
- The interconnection between Vygotsky's learning theory and the five strands of mathematical proficiency of Kilpatrick et al.;
- Understanding the relationship between language and mathematics;
- Teaching and learning mathematics in South African classrooms;
- Challenges experienced by ELLs of mathematics;
- Challenges experienced by teachers of ELLs learning mathematics; and
- Strategies to support ELLs' understanding of mathematics.

2.2 Theoretical framework

The empirical part of this study's research was interpreted using Vygotsky's learning theory and Kilpatrick et al.'s five-stranded model of mathematical proficiency, both of which focus on the interconnection between cognitive development and developing children's mathematical proficiency in general. In the sections below, the researcher provides literature on each of these aspects that will be used to explain the results of the empirical research.

2.2.1 Vygotsky's learning theory

A time of great intellectual and social upheaval occurred after the Russian Revolution. It was during this time that Vygotsky (1962; 1978; 1981) produced his most important contributions to sociocultural theory. He did it under the profound influence of Marx's claim that the capacity to design and use tools distinguishes humans from other species of animals. According to Vygotsky, human history consists of the generational transmission of cultural artifacts such as language, number systems, and writing. In his theory of cognitive and social development, Vygotsky compared the use of physical and cognitive tools such as sign systems (Kozulin, 1990; van der Veer & Valsiner, 1991). The use of a sign system reorganises thought in much the same way that the use of a physical tool reorganises activity by enabling new achievements. He believed that exposure to a variety of cultural artifacts and sign systems facilitates the cognitive development of children (Vygotsky, 1978). Vygotsky emphasises that knowledge and understanding of an artifact, such as a number system, does not merely augment a pre-existing cognitive ability. He asserted instead that children learn to reason numerically as they internalise their culture's numbering systems. This example supports Vygotsky's overall reasoning that the minds of young children develop as they acquire sign systems and other artifacts. Therefore, Vygotsky argued that children benefit most from one-on-one instruction in the use of cognitive tools such as language and number systems (Vygotsky, 1981). Consequently, he came to view the correlation between social activity and cognitive development as part of a larger correlation between cultural norms and cognitive development. Vygotsky's theory of cognitive development made it possible to comprehend how social activity influences individual cognition and its variation. He stated, "Social relations, real relations of people, stand behind all higher functions and their relations" (Vygotsky, 1931:106). Understanding cognition requires reference to its embedded social and cultural context (Wertsch & Rupert, 1993).

According to Vygotsky (1931:106), learners develop more complex cognitive abilities through mediated, collaborative, and social activities. Through this process, they move away from clear forms of mediation and toward more implicit (implied) forms of mediation, such as inner speech, which reduces their reliance on other individuals and increases their independence in terms of remembering, comprehending, and using cultural resources (Walshaw, 2017:294). In other words, the ZPD describes the learner's current or actual level of development as well as the level that is easily achievable using mediating semiotic and environmental tools and competent adult or peer facilitation (Vygotsky, 1931:106). The suggestion is that when learners collaborate with others, they learn more effectively, and it is through such collaborative efforts with more capable individuals that learners acquire and comprehend new concepts, psychological tools (i.e., such as signs, symbols, texts, formulae, and most fundamentally, language), and skills. The ZPD provides a viable explanation for the relationship between a learner's learning and cognitive development if tools facilitate comprehension (Vygotsky, 1931:106; Shabani, 2016:2). Thus, it is argued that a learner's development is always determined by his or her ability to learn (Shabani, 2016:2). To simplify, Vygotskian thinking does not advocate for a one-way approach in which learners reflect on their daily classroom experience to promote the idea that reasoning and thought originate through social relations. Learners actively generate knowledge through these interactions, rather than being silent or being acted upon. Thinking and reasoning originate from practical activity in a social context and in relation to the activity's cultural, historical, and physical reality (Shabani, 2016:2). In addition to these specifications, the immediate context and the learner's prior knowledge, skills, and motivations also influence the learning process (Shabani, Khatib & Ebadi, 2010:238). Thus, it is believed that language as a cultural tool and the understandings individuals create in classroom discourse (LOLT) is supported by the scaffolds of various semiotic systems such as verbal communication, writing, body language, pictures, and so on, to make sense of mathematics (Saussure, 1959; Vygotsky, 1997; Arzarello, 2006; Sfard, 2008:81; Presmeg et al., 2016:19).

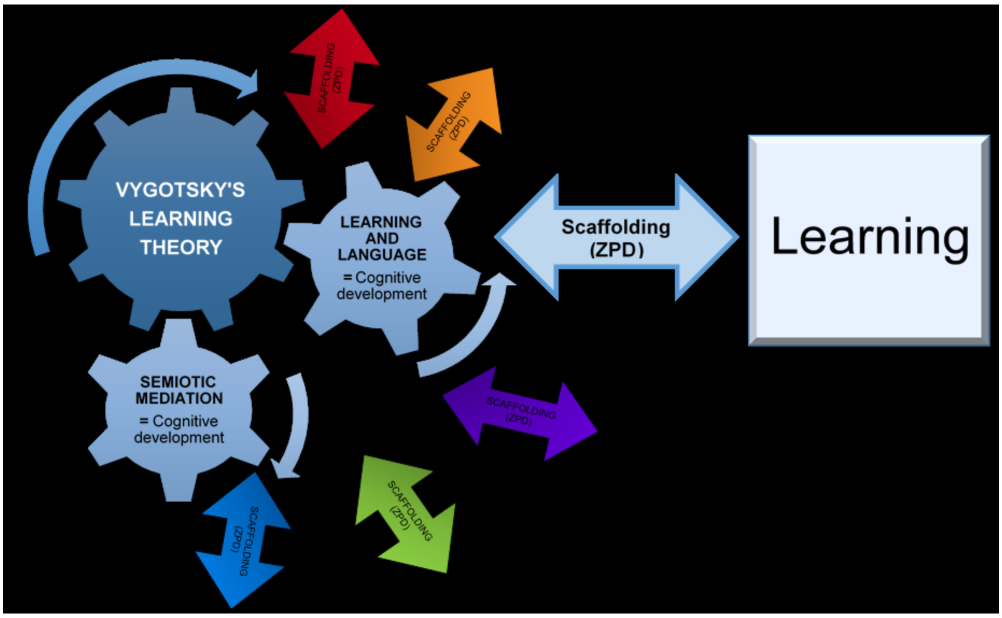

Figure 2.1: Scaffolds are displayed to support learning

2.2.2 Kilpatrick et al.'s five-stranded model of mathematical proficiency

After continuous reports in the media claiming insufficient instruction, poor curriculum design, and low test results, there is a growing concern that young learners in the United States of America (USA) lack the mathematical skills required by society (Kilpatrick et al., 2001:13). Along the same lines, South Africa's mathematics education performance, to date, is alarmingly deficient (Essien, 2018:48-49; Robertson & Graven, 2019:3; Pretorius, 2020). In addition, a rich set of national and international research-based contributions focusing on improving mathematics teaching and learning in primary education found that most research conducted in South Africa only focuses on what is currently "wrong" with the teaching of mathematics rather than how to improve mathematics teaching and learning

(Graven & Venkat, 2017). On the other hand, Kilpatrick et al. (2001:9–14), with the support of the National Science Foundation and the United States (US) Department of Education, attempted to address their country's conflicts by providing a more comprehensive picture of what the mathematics was that young learners needed to learn, how they require it, and how it could effectively be educated to them. In this regard, Kilpatrick et al. (2001) proposed five "intertwining strands" of mathematical proficiency, namely: "conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition". These five strands were created in order to adopt a holistic, combined view of effective mathematics learning, which also influenced the initiative of the South African DBE, which introduced the latest *Mathematics Teaching and Learning Framework for South Africa* that is based on these five strands (South Africa. DBE, 2018:3). According to Kilpatrick et al. (2001:116), "[T]hese strands are not independent but represent different aspects of a complex whole, leading to the concept of entangled strands" (see Figure 2.2). Each of these five components is described below.

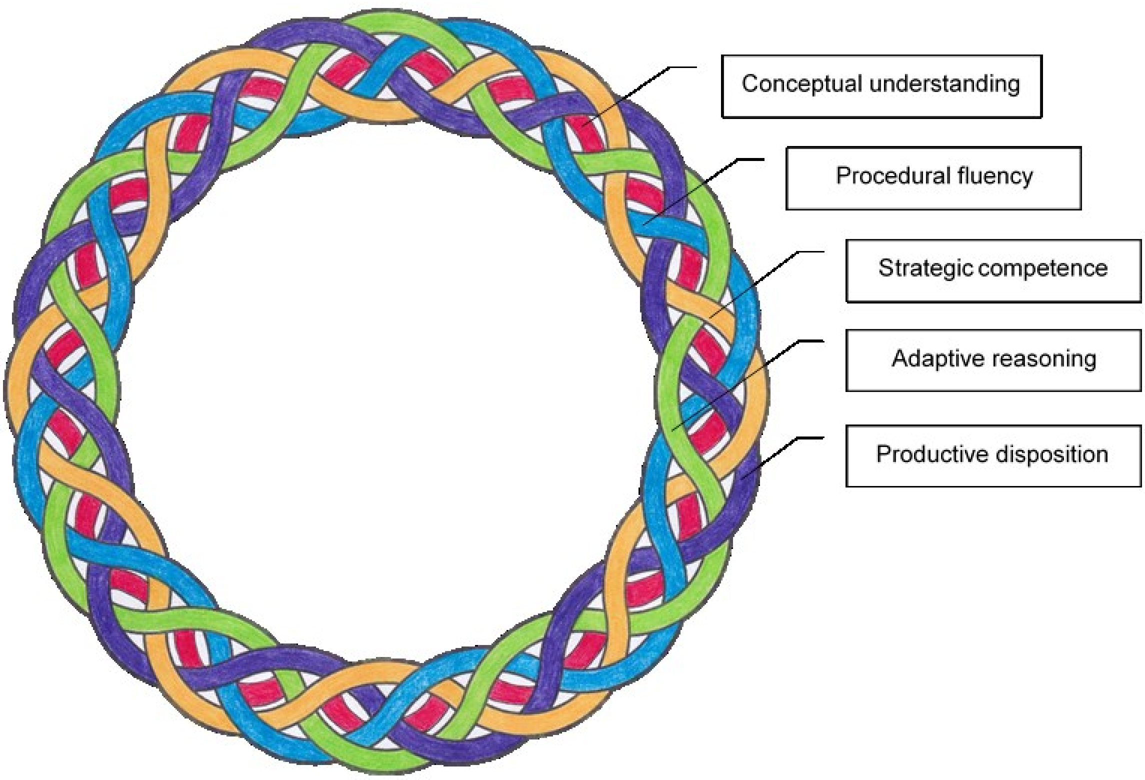

Figure 2.2: Intertwined strands of mathematical proficiency (adapted from Kilpatrick et al., 2001:5)

- The learner's understanding or skill of mathematical concepts, processes, and relationships is known as "**conceptual understanding**". A learner with conceptual understanding has the ability to: a) repeat previously learned concepts; b) organise artifacts according to whether or not their specifications represent the concept; c) supply examples of previously learned concepts or non-examples of previously learned concepts; d) display concepts using diverse mathematical representations; e) link concepts; and f) create the necessary circumstances and/or terms for a concept. In this regard, Kilpatrick et al. (2001) point out the important indicators of conceptual understanding, which include the capacity to express the mathematical situation in diverse ways, and an understanding of the ways in which various representations can be beneficial for disparate purposes. The level of learners' conceptual understanding is related to the depth and breadth of connections they can make. Methods for promoting conceptual understanding include mathematical modelling, mathematical terminology, and concept mapping (Yulian & Wahyudin, 2018:2).
- Examples of "**procedural fluency**" include the understanding of the procedure, when and how to apply it successfully, and the abilities required to execute the procedure flexibly, accurately, and efficiently. As a result, skills for the procedure's consistency include the learners' ability to: a) know the procedure; b) utilise the procedure; c) select procedures; d) estimate the outcome of a procedure; e) adjust or improve the procedure; and f) develop procedures. Learners can learn how mathematics is structured and how to solve routine problems by learning the algorithm as a common procedure (National Council of Teachers of Mathematics [NCTM], 2014:1-2).
- The ability to formulate, display, and solve maths problems is referred to as "**strategic competence**". In this regard, a learner's ability to: a) understand the problem by describing their current state of knowledge and the question(s) being posed; b) introduce a variety of representations of a mathematical problem (numerical, symbolic, verbal, or visual); c) select an appropriate method for addressing the problem; and d) double-checking the solution of the problem to ensure it is correct, are indicators of strategic competence. According to Kilpatrick et al. (2001), adaptability is the most important aspect required during the problem-solving process. The breadth of knowledge required to solve non-routine problems can help a learner's strategic competence become more adaptable (Yulian & Wahyudin, 2018:3).
- The capacity for "**adaptive reasoning**" includes the abilities of reflection, explanation, and justification, as well as the ability to think logically about relationships between concepts and situations. Adaptive reasoning skills include the ability to: a) speculate; b) provide reasons or evidence for an argument's facts; c) draw inferences from an

argument; d) examine an argument's reliability; and e) identify patterns in a mathematical concept (Council of the Great City Schools [CGCS], 2016:8).

- A "**productive disposition**" is the propensity to engage in productive behaviours; the perspective that mathematics is feasible, practical, significant, and worthwhile; and having the confidence and perseverance for mathematical understanding. Therefore, indicators of this productive disposition include learners who are: a) enthusiastic; b) not easily discouraged; c) self-assured; and d) inquisitive (Yulian & Wahyudin, 2018:3).

A learner with a high productive disposition can improve their mathematical proficiency with regard to conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning. Those learners with abilities in conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning, on the other hand, usually develop productive dispositions (Kilpatrick et al., 2001; Yulian & Wahyudin, 2018:2-3). Thus, due to their interdependence, the five components of mathematical proficiency cannot be developed independently.

Teaching for mathematical proficiency, on the other hand, necessitates the same interwoven strands for teachers as it does for learners. Thus, according to Kilpatrick et al. (2001:10) and Ayuwanti (2021:665), teachers teaching for mathematical proficiency need: "a) conceptual understanding of the core knowledge of mathematics, learners, and pedagogical strategies required for teaching; b) procedural fluency in carrying out basic instructional procedures; c) strategic competence in planning effective instruction and solving problems that arise while teaching; d) adaptive reasoning in rationalising a decision; and e) a positive attitude (productive disposition) toward mathematics, teaching, learning, and improving mathematics practice". Hence, professional training programmes for teacher preparation and development that are effective help teachers understand the mathematics they teach, how their learners learn it, and how to facilitate it (Kilpatrick et al., 2001:10). Therefore, teachers should be able to adapt to what they have and/or are learning in order to address issues that arise in their classrooms (Svensson & Holmqvist, 2021:3).

2.2.3 The interconnection between Vygotsky's learning theory and the five strands of mathematical proficiency

As the majority of South African learners come to school speaking a language other than the LOLT (e.g., isiXhosa learners enrolled in English LOLT classrooms), which poses a challenge for mathematics teaching and learning to most learners, the learning theory of Vygotsky and the five strands of mathematical proficiency of Kilpatrick et al. (2001) were intertwined to fit the context of South Africa (Essien, 2018:48-49; Robertson & Graven, 2019:3).

When comparing Vygotsky's learning theory and Kilpatrick et al.'s five strands of mathematical proficiency, the development of cognitive proficiencies is a key similarity. Vygotsky’s learning theory embedded within Kilpatrick et al.'s five strands of mathematical proficiency is particularly appropriate for this research because learners with limited fluency in the LOLT may find language to be a barrier to understanding and becoming proficient in mathematics (Robertson & Graven, 2020:82-83). According to Prediger et al. (2019:11), intellectual tools, such as language and/or other physical tools, play a crucial role during teaching and learning for both conversational and conceptual purposes. Thus, Vygotsky's theory of learning demonstrates, within each strand, "the significance of language in learning and cognitive development". In this regard, the teacher employs intellectual and/or physical tools (depending on the learner's individual needs) as scaffolds (support strategies) to assist learners to enhance their mathematical understanding (Presmeg et al., 2016:19). The figure below depicts the interaction of Vygotsky's learning theory required within the five-stranded model of Kilpatrick et al. as an intertwined combination for learning mathematics for proficiency.

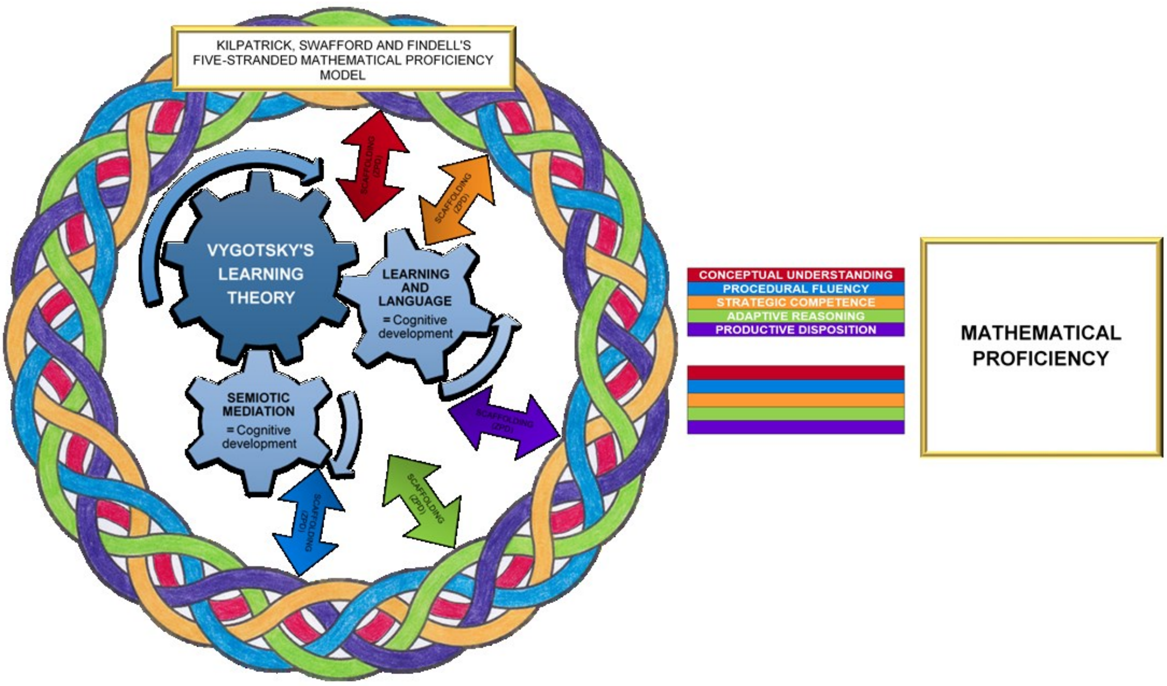

Figure 2.3: The interaction between Vygotsky's learning theory and the five-stranded model for mathematical proficiency

2.3 Understanding the relationship between language and mathematics

Mulaudzi (2016:165) points out the important role of language for successful mathematical teaching and learning to take place. However, he stresses that the LOLT, through which mathematics is learnt, lays the foundation for mathematical teaching and learning to develop in that language. Extensive research acknowledges the impact of different linguistic characteristics on cognitive development. Although it seems that literature regarding the relationship between language and mathematics may be very complicated with inconsistent views, there is a shared viewpoint which advocates that thinking takes place within some or other language (Robertson, 2017:3). Lev Vygotsky emphasised that language and thought are directly linked and inseparable from each other (Vygotsky, 1962:4). Therefore, it can be assumed that external speech brings a thought to life, whilst inner speech focuses energy on words to help in the processing of a thought. In light of the latter assumption, the following question is posed, namely: Does the form of language that is being used influence the thought process itself? However, it can be postulated that the deed of a thought has its own structure, and that the act of transmitting the thought to language is difficult. This is not an unconscious process since thinking only develops and expresses itself through words. Externally, signs mediate thought, and internally, word meanings mediate thought (Vygotsky, 1962). Bruner (1975) stresses the importance of language as a medium for thought, including its impact on cognitive development. As a result, thinking is strongly intertwined to language and must conform to it (Robertson, 2017:54).

Mathematics has its own unique way of using language and conveying information, which is known as the *mathematics register* (Lee, 2006; Pimm, 1987). Thus, within an ordinary language (i.e., “any language that has evolved naturally in humans through use and repetition without conscious planning or premeditation”), mathematical language is viewed as a distinct "register" (Le Cordeur & Tshuma, 2019:107). Although the special vocabulary used in mathematics is one feature of the mathematics register, it is also the unique language to describe and/or explain a particular type of mathematical situation (Jourdain & Sharma, 2016:44-45; Le Cordeur & Tshuma, 2019:107). The mathematics register, on the other hand, is about much more than solely vocabulary and technical language. It also involves phrases, words, and strategies of reasoning in a given context, all of which are communicated using natural language (i.e., English) (Pimm, 1987). The specialist language's grammar and vocabulary are a means of communicating a wide variety of ideas. Therefore, each language has its own specific mathematical register, which encompasses different ways in which mathematical sense-making is communicated in that language (Ní Ríordáin et al., 2015:11; Le Cordeur & Tshuma, 2019:107).

As can be seen, mathematics' complex "register" is similar to that of a language, and as such, it requires learning skills similar to those utilised in acquiring any other language. In correlation to this viewpoint, in order to increase inclusion in mathematics classrooms, Robertson and Graven (2019:20) believe that mathematics teachers must find ways to incorporate second language teaching and learning strategies into their pedagogical repertoires. This brings a new dimension to learning mathematics and strengthens the notion that mathematics content cannot be taught without the use of language. Learning mathematics automatically includes the acquisition of the mathematics register (Setati, 2005). According to Meaney (2005:129), this helps learners to easily communicate their mathematical thinking; "without this fluency, learners are constrained in their ability to develop or reshape their mathematical understandings". Learners will be able to listen, query, and discuss, as well as read, record, and engage in mathematics once they have mastered the mathematics register. Likewise, registers can be used in a number of fields, but they can also be used in any LOLT. In a learning setting, mathematics and the registers of everyday language may be impeded, often in subtle ways. As a result, learners must be able to identify each of these registers in order to determine which is being used at any given time, which is a daunting challenge for many ELLs in multilingual classrooms. Thus, it is important to be aware of how various languages and registers work, as well as the reality that the use of multiple languages and registers can assist a learner’s growth in mathematical understanding (Ní Ríordáin et al., 2015:11).

Understanding can be interpreted as a real or possible cognitive experience. These mental encounters are referred to as "acts of understanding", as opposed to "an understanding", which is the ability to experience an "act of understanding" (Sierpinska, 1994:1). Such "acts of understanding" take place at a specific time and for a brief period of time. With regard to education, understanding is often linked to longer periods of cognitive processing. The essential steps in this "process of understanding" are defined by "acts of understanding", while the achieved "understandings" are the foundations for further development (Sierpinska, 1994). Understanding is also correlated with meaning and/or understanding why for many people (Piaget, 1978). Further compounding the topic's uncertainty is that understanding can be defined in terms of meaning, and meaning can be defined in terms of understanding. To be consistent in describing the relationship between meaning and understanding, it is considered that "the object of understanding" is the same as the "object of meaning" (Sierpinska, 1994:23). Thus, the idea or thought is the foundation of our understanding, and the signs that show these ideas or thoughts are what we try to figure out (or understand). Bruner (1975) and Vygotsky (1962) describe how language and thought are intertwined. In this regard, they state that while our thoughts help us understand, language helps us better understand mathematics. When learners understand, they move from reading what the text says to understanding what it means (Sierpinska, 1994).

Cummins's (1979) Threshold Hypothesis, which contributed to the evolution of his "Developmental Interdependence Hypothesis", focused on the relationship between a learner's two (or more) languages in great depth. The Interdependence Hypothesis suggests that a learner's achieved level of proficiency and use of their first language would affect the development of their proficiency and use of their second language. Cummins (1980) also stresses the value of recognising that the two languages are both used for interaction and are both internally stored together (Common Underlying Proficiency). Thus, the influence of the first (and second, third, etc.) language of learning for mathematics is important and needs to be scrutinised when conducting an investigation on second or third language learners (Ní Ríordáin et al., 2015:12). According to Morgan, Tang, and Sfard (2011:113–118), it is necessary to investigate how a language's syntactical structure affects mathematical activity and reasoning.

In addition, mathematics is considered to be a form of discourse and communication (Sfard, 2012). Rymes (2016:5) defines discourse as "language in use". Gee (1996:131) further explains that discourse is "a socially accepted association among ways of using language, other symbolic expressions, and artefacts of thinking, feeling, believing, valuing, and acting that can be used to identify oneself as a member of a socially meaningful group or social network, or to signal (that one is playing) a socially meaningful role". According to this explanation, discourses are more than just using technical terms and verbal and written language. In this regard, communities, perspectives, values and beliefs, and pieces of work are all part of discourses (Ní Ríordáin et al., 2015:12). To emphasise the viewpoint that discourses are rooted in sociocultural practices, Moschkovich (2012a:95) uses the term "mathematics discourse practices" and describes them as "social, cultural, and discursive because they arise from communities and mark membership in different discourse communities". Furthermore, mathematical discourses are also cognitive in nature since they include the use of thinking, signs, tools, and meanings. Words, phrases, and texts have various meanings, uses, and purposes depending on the contexts in which they are used. Mathematical discourses take place within the context of practices, which are linked to communities. It is further noted by Moschkovich (2012a:95) that mathematical discourse practices are formed by actions, sense-making, focus of attention, and goals, and are rooted in social practices. Consequently, the discourse of mathematics includes multi-semiotic systems (e.g., speech, text, gestures, symbols, visual images, etc.) (Schleppegrell, 2007:139–159; O'Halloran, 2011:217–236; Robertson & Graven, 2020:95). Arzarello, Paola, Robutti, and Sabena (2009) also refer to these multi-semiotic systems as semiotic bundles, which they describe as "originating from neuroscience studies that emphasized the role of the brain's sensory-motor system in conceptual knowledge, communication, and the use of multiple modes to communicate and express meanings". Within this viewpoint, a semiotic bundle is defined as:

> [A] set of signs created by one or more individuals engaging with one another and that change over time. Usually, a semiotic bundle consists of the signs generated by a learner or group of learners while solving a Maths problem or discussing a Maths question. Perhaps the teacher is also involved, in which case the semiotic bundle could also comprise the signs constructed by the teacher (Arzarello et al., 2009:100).

Making sense of mathematical discourse therefore requires a large amount of "semiotic integration" (Robertson, 2017:19). According to O'Halloran (2011:218), mathematics draws on three key semiotic resources needed as a foundation for thinking about, communicating about, and expressing mathematical ideas and knowledge. As mathematics also uses symbols (e.g., +/-/x/÷/=) and visual images (e.g., graphs and diagrams), the combination thereof in text makes mathematical understanding more complex than ordinary types of text (Robertson, 2017:19-20). Hence, mathematical discourse is more than just making meaning of these three semiotic resources (O'Halloran, 2011:234). As a result, the significance of meaning across all three multiple semiotic resources is critical in mathematical discourse (O'Halloran, 2011:235).

2.4 Teaching and learning mathematics in South African classrooms

Multilingualism is an educational phenomenon that can be found in classrooms all over the world. However, only major regional or national languages are employed in most classes, frequently for pragmatic or political reasons (Gandara & Randall, 2019:62). In the multilingual context of South Africa, these classrooms include the presence of historically multilingual communities (Barwell, Chapsam, Nkambule & Setati-Phakeng, 2016, Gandara & Randall, 2019:62). This said, most of South Africa's learners are learning mathematics in English, as this is the dominant language that the learners' parents are "buying into" as the medium of instruction (Robertson & Graven, 2020:83). Thus, there are many learners in South African schools who are not fluent in the LOLT, which is English (Setati, Molefe & Langa, 2008:15; Dale, 2015:27; Robertson, 2017:77; Robertson & Graven, 2018:3).

Mulaudzi (2016:164-165) and Essien (2018:55) state that English classrooms where mathematics is not taught in learners' HL constitute contexts where there is a need for meaningful pedagogy on mathematics learning as well as the development of specialised skills that assist learners with various possibilities to learn mathematics in such classrooms. In this regard, Essien (2018:50) explains Cummins' (1979) argument that constructive cognitive development is attained once a learner reaches a specific level of linguistic competence in their second language. For this reason, it can be anticipated that learners with insufficient language proficiency are deprived of cognitive development. Consequently, a learner's HL should first be developed sufficiently before he/she can benefit cognitively from both their HL and the second language. This argument highlighted the importance of proficiency in learners' HLs for teaching and learning mathematics (Gandara & Randall, 2019:61–62).

However, according to findings in a thorough review of scientific research conducted between 2006 and 2016, Essien (2018:49-50) found that learners in South African classrooms whose HL is different from the LOLT are not familiar with the linguistic structures they come across during mathematics instruction. In this regard, learners need to become familiar with the structure of the mathematical language. This, however, means that these learners must learn mathematical concepts and also the language in which these concepts are embedded. As a result, the teachers are faced with the challenges of achieving a balance between English as the LOLT and the language of mathematics.

While there is an undeniable interrelationship that prevails between language and the teaching and learning of mathematics, confronting language challenges head on in South African classrooms can be less useful than expected (Morgan et al., 2014:13). Drawing on studies of learners learning mathematics in South Africa, Dicker (2015:67) argues that mathematics is better supported when teachers are educated to be sensitive and accept learners' diversity. In relation to this argument, Robertson and Graven (2020:96) further highlight their viewpoint that teachers need to be encouraged to acknowledge learners' HL for educational access and that it is perfectly acceptable to accommodate learners in more than one language, pedagogically. Essien (2018:55) and Sugimoto (2018:4) also point out that there is a lack of evidence identifying how teachers are qualified to use learners' linguistic knowledge effectively for successful mathematics learning.

For several years, the contextualisation of multilingual learning has been a cause of concern (Ryan & Parra, 2019:153). At a UNESCO symposium on education issues in post-colonial countries, a paper by linguist Michael Halliday (1974) claimed that, while the colonial language was still employed as the LOLT in most of these countries, there was an increasing demand and political preference to adopt local languages. A lot of local languages lacked a mathematical register, raising serious concerns about mathematics education's future development (Morgan et al., 2014:14). Furthermore, a recent literature review by Essien (2018:55) in the South African context shows that a mathematics register in indigenous languages is not yet fully developed. However, even though examining a language's "capabilities" and the problems faced by learners has helped answer questions about which language should be used for teaching and learning mathematics, teachers still face political and linguistic issues resulting from colonialism.

The practical questions of which language to use in the classroom cannot be completely answered unless the greater socio-political position of language is addressed. The difficulties posed by multilingual contexts are not just cognitive. When learners come from diverse linguistic backgrounds, relational elements of discourse are also heavily compromised. This is due to the relations of power related to linguistic differences, which are consistently political and are often parallel with linguistic differences because of cultural differences. In the sense of multilingual South Africa, Setati's work draws a significant distinction between what she refers to as "epistemological access to mathematical ideas" that may be activated by teaching and learning in a learner's HL and "access to social, economic, and political progress" activated by developing greater levels of proficiency in a global language such as English (Setati, 2008:115). In this regard, the article by Planas and Setati-Phakeng (2014:883–893) builds on the history of Setati-Phakeng's work in the context of South Africa and Planas' work in the context of Catalan to acknowledge the power relations at work and propose a constructive approach to confront them. They demonstrate how language can be viewed as a right, a challenge, or a resource, and they advocate the value of seeing language practices as open to negotiation (Morgan et al., 2014:15).

As global population migration rises, teachers around the globe are increasingly confronted with multilingual classrooms. The cultural, linguistic, and economic backgrounds, on the other hand, are vastly different. In addition to language issues, several of these contexts also include complicated issues of social distress, political and social isolation, and cultural diversity. Learners in South African schools and around the globe are not only studying mathematics, but also growing into citizens of their own countries and the world. The importance of language in each of these areas cannot be overlooked or easily overcome. Even though much work is being done to map out the scope and establish a cohesive understanding of the theoretical diversity brought to work in this field, there is still space for further intercommunication (Morgan et al., 2014:15; Robertson & Graven, 2020:95-97).

2.5 Challenges experienced by ELLs of mathematics

Regardless of the conceptual and linguistic difficulties posed by the complex terminology required to convey mathematical understanding, issues relating to the LOLT policy decisions are rapidly gaining attention. In this regard, attention is especially drawn to the continued challenges learners encounter when the use of their HL as a linguistic resource for learning mathematics is denied, and they are instead required to learn mathematics through a second language in which they have no fluency (Robertson & Graven, 2020:78-79). Consequently, language is frequently identified as a barrier to learning mathematics, particularly in South African classrooms (Dicker, 2015:66; Mulaudzi, 2016:168; Ledibane, Kaiser & Van der Walt, 2018:1; Essien, 2018:48-49; Robertson & Graven, 2019:3).

It is noted by Essien (2018:49) that the FP (Grades R – Three) is extremely important for developing the foundation for mathematics. Learners' HL is seen as the resource most likely to improve the conceptual and epistemological access of a learner to mastering core basic language and mathematics proficiencies (Robertson & Graven, 2020:2). Building on this viewpoint, recent studies claim that learners are significantly disadvantaged when they are receiving education in a language which is not that of their mother tongue, and as a result, these learners' potential to thrive mathematically is jeopardised (Essien, 2018:49; Robertson & Graven, 2019:79).

An increasing demand for learners' linguistic skills has quickly gained attention in mathematics lessons (Ní Ríordáin et al., 2015:9; Sosibo, 2015:179; Jourdain & Sharma, 2016:44; Sugimoto, 2018:1-2; Robertson & Graven, 2020:78-79). In addition to listening, reading, and speaking the language of mathematics, learners at all grade levels must also be able to write about their mathematical activities (Essien, 2018:55; Le Cordeur & Tshuma, 2019:107). It is not just mathematical concepts that learners need to understand; they also need to show that they can apply their mathematical knowledge to real-world situations and convey what they've learned to others (Ní Ríordáin et al., 2015:13; Robertson, 2017:79). The ability to reason at higher cognitive levels during mathematical communication, on the other hand, is difficult for many learners. This is often caused by interference from everyday language within the mathematical register (Schleppegrell, 2011:73–112; Ní Ríordáin et al., 2015:13).

2.5.1 Mathematical registers

The difficulty of working inside English language registers is one of the primary challenges that ELLs face in their capacity of learning mathematics in an English LOLT classroom (Robertson & Graven, 2020:95-96). The mathematical register is defined by Halliday

(1978:195) as a set of meanings suitable for a specific language feature, together with the terms and structures expressing these meanings. Thus, a register of mathematics is a sense of meanings belonging to the language of mathematics. Multiple registers are used in mathematics lessons. To be successful in mathematics, learners must not only be familiar with and knowledgeable in their everyday English register, but they must also be fluent in multiple mathematical registers (Moschkovich, 2005:121–144; Schleppegrell, 2011:73-112; Essien, 2018:50). Strong linguistic and metalinguistic skills are required for mastery of the mathematical registers and the ability to switch between them. These skills are compulsory for enabling learners to communicate with their peers and deal with more advanced mathematics (Mandy & Garbati, 2014; Planas & Setati-Phakeng, 2014:883–893; Robertson & Graven, 2020:78-79).

Mathematical registers can cause a great challenge to an ELL as a new type of language must be learned and mastered (Setati, 2008:103-116). This is a particular challenge in South Africa where mathematics achievement is insufficient due to language proficiency shortcomings of ELLs since they need to learn a specialised mathematical language in order to grasp the content of the mathematics curriculum (South Africa. DBE, 2011b; Mulaudzi, 2016:165; Sibanda & Graven, 2018:11; Robertson & Graven, 2020:79-80). Not only must the ELL attempt to learn in English and at the same time learn to speak English, but the learner must also work within the English mathematical register without having yet mastered everyday English (Mandy & Garbati, 2014; Essien, 2018:55; Robertson & Graven, 2020:79). Therefore, in order to grasp mathematics in a classroom where the LOLT is English, ELLs may need additional time to process the information as opposed to English-mother tongue speakers (Setati, 2008:103-116; Mulaudzi, 2016:165). As a result, these learners may fall behind in learning mathematics since they may spend too much time trying to comprehend and move between various registers (Jourdain & Sharma, 2016:45; Machaba, 2018:42).

In addition, the ability to be proficient in mathematics means that learners need to understand the specialised terminology used in mathematics (Moschkovich, 2005:121–144; Mulaudzi, 2016:166–167; Robertson & Graven, 2020:96). This mathematical terminology is not used in everyday English registers and, therefore, ELL speakers get confused and struggle to understand (Dicker, 2015:66-67; Jourdain & Sharma, 2016:45). The technical terms and vocabulary of mathematics are not only important for learners' ability to understand and interpret mathematics, but they also have a major impact on their mathematical development in the future (Robertson & Graven, 2020:79). In this regard, learning to operate in multiple registers causes additional challenges for ELLs. This is especially true when learning vocabulary, where the meaning of words varies across registers (Mulaudzi, 2016:164; Robertson, 2017:16).

2.5.2 Everyday English versus Mathematical English

Concerning mathematical teaching and learning, learners already have an existing vocabulary. Although ELLs may be familiar with some words in the LOLT, they might carry different meanings when used in the context of mathematics (Morgan et al., 2014:7). Machaba (2018:42) argues that learners who are not proficient in the LOLT will find it difficult to differentiate between the correct mathematical meaning of a familiar word and everyday English expressions. These words include words such as: volume, multiplication, parallelogram, operation, average, even, degree, and odd (Ní Ríordáin et al., 2015:14; Dicker, 2015:66-67). It is therefore critical that both the learner and the teacher discuss the various meanings and interpretations of mathematical terms in order for them to be aware of what is meant and understand specific linguistic forms (Mulwa, 2014:267).

Furthermore, other than those words used in everyday English, mathematics also incorporates a variety of its own new terms (Le Cordeur & Tshuma, 2019:107). Thus, if learners want to become successful in mathematics, they need to learn these terms and their basic mathematical meanings and how they are applied in context. Often, because of word origin and the lexical properties of a language, these words don’t follow a logical mathematical pattern that is obvious in everyday English (Bezuidenhout, Henning, Fitzpatrick & Ragpot, 2019:5). In this regard, the English number system is not completely transparent for numbers eleven to ninety-nine, as the numbering units for "ones" and "tens" are not explicitly stated. For example, it is not possible to conclude from the number "thirty-seven" that there are three tens and seven ones (Sun & Bartolini Bussi, 2018:35-70). In an African language, such as isiXhosa, the numbering units are not implicit for "ones" but for "tens". When naming numbers greater than ten in isiXhosa, the tens are qualified first (i.e., the number of tens is given), and then the units are added using the connective concord na-(ana+isixhenxe = anesixhenxe), which can be translated as "with". Thus, in isiXhosa, thirty-seven is spoken as: tens-that are three-that are "with" seven (amashumi amathathu anesixhenxe) (Mostert, 2019:69). According to Mark and Dowker (2015), the transparency of numbers has an impact on certain aspects of mathematics in the FP.

2.5.3 Language translation

Not only do ELLs have to navigate between a variety of vocabulary in mathematical registers and change meanings between registers, but they also have to deal with a wide variety of mathematical vocabulary that may not exist in their HL (Jourdain & Sharma, 2016:45). Van Laren and Goba (2013:174) argue that indigenous languages do not possess specific mathematical terms. Thus, when translations happen in African languages, learning is hindered by weak vocabulary and grammatical conventions that make it challenging to express concepts and thoughts. Furthermore, few published multilingual dictionaries provide appropriate translations for mathematical terms in African languages, which are required for preparing FP teachers for the mathematics classroom (van Laren & Goba, 2013:175-176; Chikiwa & Schäfer, 2019:136). In relation to this viewpoint, Jourdain and Sharma (2016:45) suggest that “special programmes in English mathematical discourse are necessary with the aim of linking the underlying meanings of mathematical concepts in English to the HL of ELLs”. Furthermore, Mostert (2019:72) is also of the opinion that it is necessary to invest in research that informs the development and translation of FP mathematics learning and teaching texts. According to Mahofa (2014:99), although translations have been utilised to support learners in their conceptual understanding, it is argued that teachers should also caution the ongoing use of translations as it could cause learners to squander time and become less motivated to learn. In this regard, Mahofa's (2014:99) study found that teachers who frequently resort to translation to explain mathematical ideas to learners develop a negative attitude toward learning mathematics and answering questions in English.

2.5.4 Reading mathematics

Mathematical language is communicated by means of mathematical words, symbols, phrases, and representations that are visual (South Africa. DBE, 2011a:8; Sosibo, 2015:179). Mathematics is a language that expresses concepts of mathematics that cannot be explained in everyday language. Hence, reading mathematical texts is challenging, particularly for ELLs who must understand and process information in both the language of English and the language of mathematics simultaneously (Sibanda & Graven, 2018:3). According to Bohlman and Pretorius (2008:43–44), mathematical text is often hierarchical and cumulative, such that the interpretation of each statement is essential for the understanding of subsequent statements. Thus, misreading or misunderstanding a specific step has serious implications for overall understanding.

Paetsch, Felbrich, and Stanat (2015:19-29) found that learners must master the skills of reading and solving word problems. They also believe that merely interpreting words or extracting arithmetic functions might not be enough; learners must learn to read with comprehension in order to grasp what is required of them mathematically. In an overview of research results and instructional approaches by Prediger, Erath, and Moser Opitz (2019:2-4), they claim that the systematical structure of sentences, relational phrases, sentence order, and logical links that learners read would hamper cognitive understanding. Riccomini, Smith, Hughes, and Fries (2015:238) point out that there are different classifications of mathematical vocabulary that are possible depending on the linguistic characteristics of a particular language. These classifications are described below as potential areas of difficulty.

> a) meanings are context dependent (i.e., foot as in 12 inches vs. the foot of the bed); b) mathematical meanings are more precise (i.e., product as the solution to a multiplication problem vs. the product of a company); c) terms specific to mathematical contexts (i.e., polygon, parallelogram, imaginary number); d) multiple meanings (i.e., side of a triangle vs. side of a cube); e) discipline-specific technical meanings (i.e., cone as in the shape vs. cone as in what one eats); f) homonyms with everyday words (i.e., pi vs. pie); g) related but different words (i.e., circumference vs. perimeter); h) specific challenges with translated words (i.e., mesa vs. table); i) irregularities in spelling (i.e., obelus [÷] vs. obeli); j) concepts may be verbalized in more than one way (i.e.,15 minutes past vs. quarter after); and k) learners and teachers adopt informal terms instead of mathematical terms (i.e., diamond vs. rhombus) (Riccomini et al., 2015:238).

Paetsch et al. (2015:19-29) emphasise that learners' ability to read in the LOLT is critical to their achievement in most academic disciplines, and if learners aspire to success in mathematics but are consistently hampered by reading issues, dissatisfaction and low self-esteem are likely consequences.

2.5.5 Code switching

Code switching involves the transition between languages in a single conversation, which involves the switching of a word, phrase, sentence, or a variety of sentences (Moschkovich, 2005:125; Mulaudzi, 2016:165). In Mahofa's (2014:30) study, code switching is defined as a means by which teachers alternate between the LOLT and the learners' mother tongue to convey meaning during the process of learning. However, the use of code switching by learners and the attitudes of teachers in this regard may have consequences for ELLs. There are multiple reasons why ELLs may want to code switch, including seeking for clarity and providing explanations (Moschkovich, 2002; Jegede, 2011; Ní Ríordáin et al., 2015:19). The use of code switching can promote peer and learner-teacher interaction by involving ELLs (Kagwesage, 2013:31). It is also argued that code switching allows learners to use their HL as a resource, which may contribute to their willingness to participate during classroom conversations and share their ideas with others (Kasmer, 2013; Mahofa, 2014:41; Planas & Setati-Phakeng, 2014:883-893).

When teaching mathematics, ELLs who are incompetent in the use of the LOLT may fall back on code switching in order to clarify their understanding and express their thoughts and ideas (Planas & Setati-Phakeng, 2014:883-893). Angateeah (2013:8) agrees that to be able to communicate effectively during mathematics discourse, learners should be allowed to use their HL for thinking and their social and cultural backgrounds as tools for mediation, which will enable them to develop new concepts and methods for understanding. However, code switching adds another layer of challenges to ELLs as code switching does not only take place between languages but also between registers. Consequently, ELLs find themselves working between several registers in both English LOLT and their HL (Jourdain & Sharma, 2016:47). To complicate the understanding of mathematical concepts further, Machaba's (2018:46) study found that some concepts are entirely new for some learners. For example, 'pyramid' is not available in the African languages and therefore the LOLT cannot be code switched. Furthermore, recent research in South Africa by Bezuidenhout et al. (2019:2) found that learners do not have a stable set of linguistic tools that they can use to mediate mathematical concepts while code-switching. According to a study by Mahofa (2014:34), when learners switched between languages during difficult mathematical problem solving, their confidence was boosted. Such linguistic difficulty for ELLs emphasises the need for instruction that is specifically tailored to meet the needs of ELLs.

Moreover, there is also the possibility that teachers have a misconception about code switching (Robertson & Graven, 2020:4). Mahofa (2014:31) points out that some teachers are of the opinion that code switching is harmful and asserts that learners will end up not being able to communicate proficiently in both languages. For example, in a study of isiXhosa learners learning mathematics in South Africa, for example, Robertson and Graven (2020:4) found that black South African teachers are uneasy with code switching because they feel that they are "smuggling" the HL into their classrooms. Hence, these teachers think that code switching is illegal because they are only supposed to teach the LOLT, which is English. This clearly indicates the negligence of the DBE to sufficiently brief teachers on the principles underpinning the South African Language in Education Policy (LiEP), because code switching is fully aligned with the LiEP's support of additive bilingualism (Robertson & Graven, 2020:4; Jourdain & Sharma, 2016:47; Planas & Setati-Phakeng, 2014:883–893). According to Ledibane et al. (2018:4), the learning of mathematics may be hampered by a teacher's attitudes and belief systems. In this regard, a study that was conducted by Chikiwa and Schäfer (2016:244–255) investigated teachers' use of code switching between English and isiXhosa learners and found that code switching was not consistent and not done with accuracy. Furthermore, these researchers also argue that teachers are not prepared to develop their own vocabulary of mathematics and participate in new movements for the successful teaching of mathematics. Maluleke (2019:2) is of the opinion that a more complete understanding of the possibility of using code switching in South African schools is vital to inform all stakeholders in the sector of education regarding the possibilities of code switching.

However, while code switching has been recognised as a valuable resource for improving mathematical understanding, it may eventually result in a loss of fluency in the second language, especially if learners are aware that they can substitute their native language for temporary solutions (Setati & Adler, 2000:265-266; Jegede, 2011; Mwaniki, 2014). A study by Robertson and Graven (2020:91–92) found that isiXhosa-speaking learners were taught in their mother tongue (i.e., isiXhosa) during their FP (Grades One – Three), but when the LOLT switched to English instruction of mathematics in Grade Four, the learners had limited fluency in mathematics vocabulary in English, forcing the teacher to resort to the learners' HL (isiXhosa).

2.5.6 Word problems

Some learners (i.e., ELLs) have difficulty understanding word problems because the problems often involve words (i.e., English LOLT) that are not typically found in mathematical registers (Jourdain & Sharma, 2016:47). In this regard, learners from diverse cultural or linguistic backgrounds will often encounter difficulties in understanding word problems because of a lack of familiarity with these terms (Ní Ríordáin et al., 2015:12-13). Thus, when learners struggle with unfamiliar words or syntax before attempting to solve a mathematical problem, it could have a negative effect on their ability to learn in class and invalidate assessment measures (Jourdain & Sharma, 2016:47). In a South African study, African immigrant learners reported that they struggle to understand text in mathematical word problems because they do not understand the LOLT (Mahofa, Adendorff & Kwenda, 2018:32).

Jourdain and Sharma (2016:48) further alluded to the reality that learner progress may be hampered if problems take place in unfamiliar contexts (Jourdain & Sharma, 2016:48). According to Barwell (2011:1), "[L]earners need to learn how to read mathematics word problems by learning to read between the lines and understand what they are expected to do mathematically and to be given opportunities to practice mathematizing word problems if they are to be successful in solving word problems". Barwell (2011) continues by arguing that "an open approach to mathematical word problems should be adopted to engage learners in understanding, mathematizing, analysing, and communicating in the context of meaningful situations and problems". This means that the language context should be accessible to the learner so that they can focus on the mathematics rather than dealing with the complexities of the language context (Raoano, 2016:69; Jourdain & Sharma, 2016:48). Dicker (2015:66-67) gives the example of a word problem that contains the word "volume" for “measurement”. In this regard, the word "volume" can be confusing to learners because in everyday English it means "the level of sound".

In addition, this isn't to suggest that word problems aren't useful; it rather stresses the importance of designing problems that are accessible and fulfil the needs of learners (Jourdain & Sharma, 2016:48). According to Chikiwa and Schäfer (2019:128), a visual representation of the context may limit the misunderstanding of word problems. Learners can obtain a better understanding of specific concepts by using them in a real-world context, which is why using word problems in the classroom has a variety of advantages. Instead of using word problems to show how well a learner knows and understands a computational property, they should be used to help learners make sense of and understand a problem (Moscardini, 2010:130-138).

2.6 Challenges experienced by teachers of ELLs learning mathematics

In the view of inclusive education, teachers are required to acknowledge learners’ HLs and to adopt a multilingual approach for equal access to education, both epistemologically and pedagogically (UNESCO, 2016:5; Robertson & Graven, 2020:96). Teachers in South African classrooms therefore need to utilise sufficient teaching strategies (i.e., using learners’ HL or other resources) to support ELLs in the teaching and learning of mathematics (Robertson & Graven, 2020:82; Graven, Phakeng & Nyabanyaba, 2016; Mulaudzi, 2016:164). However, Engelbrecht et al. (2016:2) note that in South Africa, achieving the vision of a fully inclusive education system has always been challenging, and the outcomes of implementing inclusive education are still in doubt. This said, in a recent study undertaken by Gervasoni and Peter-Koop (2020:1) regarding inclusive mathematics education, they highlight their finding that not much research has been done regarding the question of "how to realise inclusive mathematics education in schools". However, their review did mention one South African study where language was researched as an including or excluding factor for the teaching and learning of mathematics. This South African study conducted by Robertson and Graven (2020:97) argues that multilingualism as a resource in the mathematics classroom, as well as assisting ELLs in gaining language proficiency in the LOLT, is still a difficult task for teachers. They claim further that teachers’ confidence in the principled use of multiple languages in the mathematics classroom should be restored, both epistemologically and pedagogically, in order to make mathematics teaching and learning more inclusive. Nevertheless, it is also important to note that, in contrast, little has yet been done by district offices to support teachers regarding strategies for handling the challenge of teaching mathematics in and through a second language (Robertson, 2017:342).

Recent research highlights the linguistic challenges that teachers face when teaching mathematics, such as deciding which language(s) to use for teaching; mediating understanding when learners interact in different languages and levels of proficiency; allowing learners to talk without deviating from the discussion; and deciding where to draw the line between what is a proper type of mathematical discourse in terms of meaning and form (Gandara & Randall, 2019:62).

With regard to teachers' decisions on what language to use, Dicker (2015:66) mentions that teachers are challenged in South African classrooms, struggling to recognise and confront their learners' language needs. According to Gandara and Randall (2019:62), some teachers choose to teach mathematics in English because of the language's status as an international language or the opportunities it provides for learners. Furthermore, despite the numerous tensions that this decision on what language to use entails, most South African teachers choose to teach using the conventional language, namely English (Barwell et al., 2016). However, in contrast to these statements, Barwell et al. (2016) argue that some teachers, learners, and parents prefer mathematics to be taught in a local language for better understanding. Thus, it is believed that learners learn better when they are taught in a language that they are familiar with (i.e., their mother tongue) (Global Education Monitoring Report, 2016; Gandara & Randall, 2019:62).

In terms of mediating understanding when learners interact in different languages and levels of proficiency, teachers need to effectively teach and scaffold two languages (Ledibane et al., 2018:1). According to Robertson (2017:164), teachers are challenged to successfully identify each learner's ZPD and know how to help them progress to the next level of proficiency. Meira and Lerman (2009:217) argue that a ZPD is "frequently fragile", and a lot depends on a teacher's "ability to listen to and revise her interpretations of a specific dialogic situation". In this regard, this kind of give-and-take and flexibility seems to be missing when there is a lot of teacher-centred instruction taking place. As a result, the likelihood of teachers and learners participating in constructive interactions is reduced (Robertson, 2017:164).

Focussing on the teachers' challenge to give learners opportunities to talk without deviating from the discussion, it was found that although some teachers are aware of the important value of dialogic talk, they find this approach challenging to facilitate (Taylor & Lelliot, 2015:255). In Hoadley's (2012:189) study it was noted that teachers are hostile to modification – not willing to move from a teacher-centred approach to a more learner-centred approach (Hoadley, 2012:189). According to van der Veen and van Oers (2017:1), classroom talk is often dominated by the teacher, and learners' participation in talk is limited to short responses. Consequently, this leaves very little space for learners' shared thinking and reasoning, which is a key strategy for mathematics development and understanding. Cirillo (2013) argues that giving learners the opportunity to talk offers them the chance to participate verbally in their intellectual struggles regarding mathematical ideas publicly and to observe and listen in return to their peers conducting the same process of thinking. Specifically referring to mathematics, South Africa's NCS states that one of the "essential mathematical skills" that learners should acquire is the ability to "communicate, think, reason logically, and apply the mathematical knowledge gained" (South Africa. DBE, 2011a:8-9). However, in contrast to these assertions, it was discovered that teacher-dominated talk is still prevalent in South African classrooms (Robertson, 2017:46).

In a study by Edmonds-Wathen (2017:37), she stated that, in the context of Australia, inexperienced and underqualified teachers have been compelled to "learn on the job" because of a scarcity of appropriately qualified teachers. According to Robertson and Graven (2020:86), teachers in South Africa find themselves in a comparable predicament. They argue that a key reason for South African learners' poor performance in mathematics is that the important role of language in education is overlooked in curriculum and teacher-training courses, leading to poor language awareness and, as a result, inadequate teaching strategies that lead to language difficulties in all curriculum areas. According to Essien (2018:57), teachers who have the opportunity to practice teaching mathematics in other languages are better equipped for teaching in South Africa's multilingual context (and are better equipped to deal with the dual challenge of achieving a balance between both English as a LOLT and the language of mathematics simultaneously). However, research by Robertson and Graven (2019:604) affirms that there is a scarcity of teachers who have adequate skills and pedagogical knowledge to manage both the teaching of mathematics and the teaching of a second language simultaneously. To support these claims, Alex and Roberts (2019:71) argue that much more research is needed to improve primary school mathematics teaching and learning as there hasn't been a focus on the extent to which South Africa's Initial Teacher Education (ITE) programmes prepare teachers with the discourse required to teach mathematics in African languages (Alex, Roberts & Hlungulu, 2020:12).

2.7 Strategies to support ELLs' understanding of mathematics

A strategy explicitly in relation to the field of learning mathematics can be described as theories concerning the nature of mathematics and the learning of mathematics. These theories are specific techniques that a learner purposefully implements to promote and enhance mathematical learning (Khanal, 2015:36). Furthermore, Kusumawati and Nayazik (2018:111) argue that a mathematics learning strategy is a strategic plan for implementing mathematics learning activities in order to achieve the desired outcomes. It determines the approach, method, model, media, technique, and learning strategy that are most appropriate. The learning strategy is selected not only based on the assessed skill or ability of the learner but also because of the instructional materials, learners' prior knowledge, available time and resources, and the character and experience of the teachers. To develop an effective learning strategy, the teacher must be familiar with the various types of learning methods and their associated benefits and drawbacks. Thus, it is critical for teachers to understand individual learning differences and to accept the need to adopt a holistic approach by modifying their own teaching style and utilising a variety of learning strategies (Khanal, 2015:9).

Furthermore, in terms of language learning strategies, scholars have different views about the definition, yet most of them believe that language learning strategies are the steps, behaviours, and techniques that learners use to improve and promote their language learning. These language learning strategies are concerned with how learners cope with the knowledge they are presented with and the strategies they employ (Hardan, 2013:1725). Furthermore, language learning strategies vary greatly and are classified into distinct categories. O'Malley and Chamot (1990) classify language learning strategies into three categories, namely: 1) cognitive; 2) metacognitive; and 3) socio-affective. Oxford (1990) also classifies language learning strategies, separating them into two primary categories, namely: direct and indirect strategies, which are further sub-divided into six sub-categories. Memory, cognitive, and compensatory strategies are examples of direct strategies, while metacognitive, emotional, and social strategies are examples of indirect strategies.

Attributable to the varying perspectives on language learning strategies and a lack of clear language learning strategies relevant to mathematics learning in the early years (Essien, 2018:49), Bock and Mheta (2014:272) emphasise the importance of exercising caution while developing or improving teaching strategies and curricula. With regard to the purpose of this study, Kusumawati and Nayazik (2018:111) emphasise the critical role and responsibility of teachers in implementing appropriate teaching and learning strategies to improve ELLs' mathematical understanding.

2.7.1 Mathematical reasoning strategy

Moschkovich (2010:1-28) recommends that the application of mathematical reasoning must not be limited to the basic reasoning learned in class. Rather, all learners, as well as ELLs, must be motivated to solve problems by using methods and strategies they are most comfortable with, whether it be verbal communication, writing, body language, or pictures (Khanal, 2015:52; Presmeg et al., 2016:19). Learners' mathematical knowledge of mathematical processes improves when multiple methods and strategies for solving mathematical problems are promoted and acknowledged (Riccomini et al., 2015:237; Raoano, 2016:15; Maffia & Sabena, 2016). Moreover, by adopting a variety of strategies that ELLs, for example, may bring to the classroom, these learners can be seen as experts among their peers. This will take place at the same time as teaching everyone the mathematical language (terminology) and vocabulary necessary for each topic (Jourdain & Sharma, 2016:48).

Doing mathematics requires learners to employ extensive use of language. Thus, when teaching ELLs, it is critical that teachers acknowledge and accept their dual role as both language and mathematics teachers (Jourdain & Sharma, 2016:48; Robertson, 2017:119). According to Jourdain and Sharma (2016:48), this allows learners to meet the language required for mathematics and, as a result, reason successfully in an environment where the LOLT is English.

2.7.2 Home language strategy

Acknowledging and promoting the use of ELLs' HL during the teaching and learning of mathematics is a crucial strategy for supporting their development in mathematics. Learners' HLs should be recognised as a resource rather than a barrier in order to best support learners, just as their various mathematical strategies should be valued (Moschkovich, 2010:1-28; Planas & Setati-Phakeng, 2014:883-893; Graven & Pausigere, 2017:3-5; Essien, 2018:50; Planas, 2018:215-229; Prediger et al., 2019:437-455; Robertson & Graven, 2020:78). According to Mulaudzi (2016:167), learners acquire mathematical vocabulary faster when they are able to access their HL for better understanding.

According to Jourdain and Sharma (2016:49), learners' mathematical learning and language development can be aided by using intentional strategies from their HLs. According to the authors, one possible strategy is to use a learner "word bank" (i.e., a maths word wall) that translates mathematical terms into the HL. However, according to van Laren and Goba (2013) and Essien (2018:55), translating English terms into African language terms is not easy. Furthermore, the dictionaries that have already been developed in South Africa provide incorrect mathematical terms in the African languages. In this regard it should be noted that similar translations were previously made into dictionaries and/or learner companions in South Africa but provided incorrect mathematical terms in African languages (van Laren & Goba, 2013; Essien, 2018:55).

Besides incorporating learners' HLs, the use of familiar everyday English vocabulary is also crucial. Prior to developing the academic language used in mathematics, ELLs commonly develop everyday conversational English proficiency first (Moschkovich, 2010:3; Lee, Lee & Amaro-Jiménez, 2011; Robertson & Graven, 2020:88). Consequently, using familiar everyday English terms is helpful to evoke ELLs' understanding of the mathematical English terms.

2.7.3 Visual representations and manipulatives strategy

According to Gravemeijer (2011:1-2), in mathematics education, we use manipulatives, either physical objects or visual representations, to help learners make connections to what they already know by means of scaffolding and communicating their own ideas. Furthermore, learners that don't have the language skills equal to their mathematical ability will benefit from visual support strategies (Nguyen & Cortes, 2013:392-395; Chikiwa & Schäfer, 2019:127). Learners who are unable to ask questions in English or those who might lack the courage to ask the class teachers for guidance can find answers with the help of visual aids such as drawings, diagrams, and posters (Nguyen & Cortes, 2013:392-395).

The use of physical objects can also help ELLs understand word problems and other complex mathematical concepts (Nguyen & Cortes, 2013:392-395; Dicker, 2015:72). Hence, visual aids and manipulatives may assist in the contextualisation of mathematics. Considering that the academic language of mathematics is mostly abstract and challenging for ELLs to comprehend, the use of visual aids is very important (Moschkovich, 2002; Dicker, 2015:67; Chikiwa & Schäfer, 2019:130). Nguyen and Cortes (2013:392-395) view the use of manipulatives as a successful strategy for ELLs, as the language load of mathematics is minimised when manipulatives are used for such learners. Hence, learners can learn by seeing and physically manipulating objects.

2.7.4 Collaborative learning strategy

Collaborative learning is an effective tool and is particularly beneficial for ELLs. When ELLs work in collaboration with a peer, they receive the opportunity for guidance and interaction, which helps them learn more effectively (Khanal, 2015:72; Sibanda & Graven, 2018:5). ELLs benefit from collaboration because it encourages them to ask questions and make errors in a safe space where they can receive feedback that is direct and immediate. Moreover, learners' mathematics learning is aided as they participate in authentic conversation and interaction. This is particularly the case when ELLs are paired with a peer who is more proficient in the English language. Therefore, ELLs' understanding and development of mathematics can be supported by the strategic use of versatile grouping to meet individual needs (Ngyuen & Cortes, 2013:392–395; Mahofa et al., 2018:34).

2.7.5 Word origins strategy

Word originations are utilised by older learners to assist them in making connections between mathematical words. Likewise, it is stated that learners may gain insight into a word's structure and meaning by learning its origin. Consequently, the probability of the word being remembered increases (Jourdain & Sharma, 2016:49). The word "trigonometry", for example, can seem new at first, but when broken down into manageable chunks, it can be related to existing concepts: "tri- for three, -gon for form, and metr- for measurement". Thus, once a learner realises it is about triangles and measurements, they will be able to understand it better than just the word itself, mostly if they've worked with those three components before (i.e., triangles, measurements, and shapes) (Benjamin, 2011).

2.7.6 Puzzles and games strategy

Introducing developmentally appropriate and mathematically challenging games into your classroom in a fun way – through playing games – supports young children's early mathematics learning (Arthur, Badertscher, Goldenberg, Moeller, McLeod, Nikula & Reed, 2017:21). Crossword puzzles are good for establishing ties between mathematical terms and their definitions since they enable learners to make associations backwards (Dicker, 2015:68). Card games were found to help learners connect verbal, symbolic, and visual representations of similar values and concepts (Riccomini et al., 2015:244). For the "I have... Who has..." game type, a set of cards with mathematical terms, signs, and illustrations can be displayed. This game is simple to incorporate into any level of mathematics classroom and takes very little time to play, encouraging the study of factual knowledge and concepts (Jourdain & Sharma, 2016:50-51).

According to Rudd, Lambert, Satterwhite and Zaier (2008:77), when teachers emphasise the vocabulary of mathematics and explain mathematical ideas in an entertaining and interactive manner, learners are driven to acquire concepts beyond what is normally anticipated for their age.

2.7.7 Word problem strategy

The linguistic challenges of word problems are still an important issue to look into (Fatmanissa & Kusnandi, 2017:88). Word problems are a combination of mathematics and language. Teachers and learners who understand that word problems are made up of multiple semiotic systems (such as audio, gestural, linguistic, spatial, and visual), vocabulary, grammar, and complex syntax, can help them deal with the difficulties that come with word problems. Thus, when teachers deal with mathematics word problems, they should think of word problems as language objects that should be looked at from different perspectives than just a mathematical operation. Teachers can use the ideas below as a starting point to come up with their own ways to help learners with their linguistic problems (Fatmanissa & Kusnandi, 2017:88).

Tasks that are meaningful bring mathematical terminology and context together. Learners must be able to understand both the terminology and the context in order to be successful. Using non-verbal modelling such as visual representations or role-playing may make it easier for all learners to access more abstract language (Dicker, 2015:69). This motivates and encourages the ELL to memorise concepts and practice speaking skills in a fun way (Chou, 2021).

Furthermore, Raoano (2016:76-77) and the CGCS (2016:11) suggest that learners be taught to solve mathematics problems in a step-by-step (structured) manner to help them understand and solve word problems more effectively.

1. Read through the whole problem first to make sure you understand what it means and how to solve it.
2. The second step focuses on understanding the word problem, thus putting vocabulary knowledge to use and considering problem demands. What information is important and what information is unnecessary? Is it possible for the learner to rephrase the problem in their own words before translating the English into mathematics?

3. Solve the word problem by choosing and implementing effective problem-solving strategies.
4. Reflect and double-check the solutions' correctness.

Moreover, using the ELL's familiar contexts and stories will help to bridge certain language gaps (Fatmanissa & Kusnandi, 2017:76). Allowing learners to share their stories and use them in mathematical problem solving helps them understand the meaning of the contexts and also shows them that their cultural resources are important and valuable. Teachers who are successful in interacting with these learners' prior knowledge and cultures show them that they are valued (Raoano, 2016:69).

Additionally, if learners are allowed to write their own word problems, it may help them learn English because it promotes both mathematical and language learning. In addition, word problems that are self-written ensure that familiar contexts are utilised (Jourdain & Sharma, 2016:51). Mahofa (2014:20) argues that learners would be able to solve word problems without difficulty if teachers were able to provide adequate assistance or instruction in coping with word problems.

2.7.8 Technology strategy

Educational videos are one type of technology that has revolutionised education. In the 1980s, educational videos made their first appearance in the classroom. Since then, rapid advancements in communication and technology have transformed them into an infinite resource (Rajadell & Garriga-Garzón, 2017). According to Rajadell and Garriga-Garzón (2017), "with the advancement of digital technology and easy access to streaming video channels via the Internet, video has progressed from being an important element to being considered a teaching methodology, with an increase in the number of settings that use dynamic images as a captivating element for learners' attention, to the point where some authors argue that it is much more efficient than other methodologies based on books or text material".

Using educational videos in a mathematics classroom has a number of benefits for ELLs (Khan, 2011). Learners could benefit from the assistance of a tutor in this regard, but they may not be able to afford one. As a result, learners can receive free quality instruction on free YouTube channels that addresses both procedural skills and conceptual understanding through educational videos. Learners, unlike tutors, can pause and repeat the video without feeling as if they are wasting someone's time (Khan, 2011). Moreover, teachers typically find that learners lack conceptual, procedural, and/or mathematical comprehension.

Unfortunately, due to limited classroom time, teachers may not be able to review the skills necessary for learners to properly understand the next concept. In this situation, educational videos could be very useful. Learners can gain a better understanding of basic concepts by watching educational videos and practicing relevant problems, preparing them to explore more complex concepts (Rajadell & Garriga-Garzón, 2017).

2.8 Conclusion

This chapter reviewed relevant literature pertaining to the topic of the study in preparation for the findings discussed in Chapter Four. The literature review focused on the theoretical framework that underpins this study, the relationship between language and mathematics, mathematics education in the context of South Africa, challenges encountered by ELLs in mathematics, as well as the challenges encountered by teachers of ELLs learning mathematics. Additionally, this chapter also illuminated strategies to assist ELLs with the understanding of mathematics. The methodology used to collect the data that informed the findings will be discussed in the chapter that follows.

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This research study's focus is on teaching and learning strategies utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. This focus was presented in Chapter One and is based on the research study's background (§1.3). Chapter One also addressed the research problem, which emphasised the scarcity of research about what constitutes good mathematics practice in South African English Grade One classrooms for isiXhosa-speaking learners (§1.4). Chapter One also briefly discussed the research methodology that was employed to solve the research problem. Chapter Three will give an in-depth explanation of the methodology that was implemented for this research study.

With the intention of addressing the research problem, the researcher formulated the following research question:

> "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?"

Furthermore, the researcher formulated the following SRQs to assist her to answer the main research question, namely:

- SRQ 1: "What are Grade One teachers' understandings of mathematical language?";
- SRQ 2: "What are Grade One teachers' *understandings* of teaching and learning strategies to enhance mathematical understanding?";
- SRQ 3: "What are Grade One teachers' *experiences* of teaching and learning strategies to enhance mathematical understanding?" and
- SRQ 4: "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?"

Moreover, these research questions were based on the study's aim, which was to explore, describe, and understand how Grade One teachers use teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. With this aim, the researcher hopes to contribute to a base of knowledge from which teaching and learning strategies could be developed for Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding. For the researcher to achieve this within a methodological framework, she first had to determine the research objectives related to the aim of this research study. Following the research objectives, she then had to determine the task objectives, indicating the steps that had to be followed to provide a clear pathway to realising the methodology for this research study. The research objectives for this research study are illustrated in the table below:

Table 3.1: Research objectives for this study

Research objectives	Task objectives
1. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' understandings of mathematical language are.	⇒ To select a sample of participants who can answer the research question. ⇒ To get in touch with educational authorities and teachers who are willing to be part of the research, giving them information about the study and inviting them to take part.
2. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' **understandings** of teaching and learning strategies are to enhance mathematical understanding.	⇒ To acquire permission from the education authorities to conduct the research.
3. To use a qualitative data collection method to establish *what* (explore) Grade One teachers' **experiences** of teaching and learning strategies are to enhance mathematical understanding.	⇒ To get the willing participants signed informed consent. ⇒ To develop statements for the unstructured, open-ended focus group interviews. ⇒ To use the IQA Systems Method for the focus group interviews.
4. To use a qualitative data collection method to establish *how* (describe) teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.	⇒ To use the themes from the IQA focus group interview to build an interview framework for the follow-up field observations and semi-structured individual interviews. ⇒ To conduct observations of mathematics lessons. ⇒ To conduct the semi-structured individual interviews guided by the interview framework derived from the focus group interview.

5.	To use a qualitative data analysis method to determine *what* (explore) teaching and learning strategies could be developed to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.	⇒ To audio record the unstructured open-ended focus group interviews and semi-structured individual interviews. ⇒ To make field notes of the observations of the mathematics lessons. ⇒ To transcribe the collected data. ⇒ To analyse the transcripts of the data.
6.	To conduct a literature review based on the findings of the study.	⇒ To do a literature check by using current and relevant literature as a backdrop to articulate and formulate the findings.
7.	To make inferences based on the evidence gathered.	⇒ To interpret the findings, relate the findings to the theoretical framework, and draw an inference based on the interpretation.
8.	To make recommendations to teachers in terms of teaching and learning strategies that could assist isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.	⇒ To develop a list of recommendations based on the findings, conclusions, and review of the literature.

In light of these objectives described above, the following section will discuss the research methods employed to assist the researcher with solving the research problem and answering the research questions.

3.2 Interactive Qualitative Analysis (IQA) research methodology

Mohajan (2018:4–5) defines 'research methodology' as a set of approaches, procedures, and techniques that complement one another and "fit" the research questions and purpose. Northcutt and McCoy's IQA Systems Method framework (2004) is a qualitative research methodology that aims to provide a framework for qualitative inquiry that is systematic, rigorous, and trustworthy. IQA is an appropriate design for researchers that are interested in examining how phenomena are socially constructed (Northcutt & McCoy, 2004). In contrast to other forms of qualitative inquiry, IQA entrusts participants with the analysis and interpretation of their data. By conducting a thematic content analysis on the collected data, they are able to articulate their perceptions of the phenomenon and determine what themes or affinities have emerged, as well as the connections between them. The result of the IQA procedure is a Systems Influence Diagram (SID), which is a visual illustration of how the participants experience the phenomenon from their point of view. Furthermore, because the participants interpret the data rather than the researcher, the IQA Systems Method limits the researcher's "subjectivity" and any potential form of biasness (Barnard, 2011:186). As a result, the concerns about trustworthiness, dependability, and confirmability are virtually eliminated in this regard. Based on these descriptions, the researcher chose to work with Northcutt and McCoy's IQA Systems Method framework as the design for this study. However, to adequately answer the research question and SRQs, the researcher had to adapt the original IQA Systems Method framework to better suit the purpose of this current study.

As the typical IQA research flow usually consists of four distinctive research foci (i.e., research design, focus group interviews, face-to-face interviews, and a report of the findings) (Northcutt & McCoy, 2004:44), this study's research process consisted of six different foci as a means to adequately address the research problem. Although the researcher employed all four of these foci in accordance with the original IQA research flow, she did, however, add five adaptations to the original IQA process. Figure 3.1 below is a simplified diagram of this research study's adapted IQA methodology and processes that were implemented.

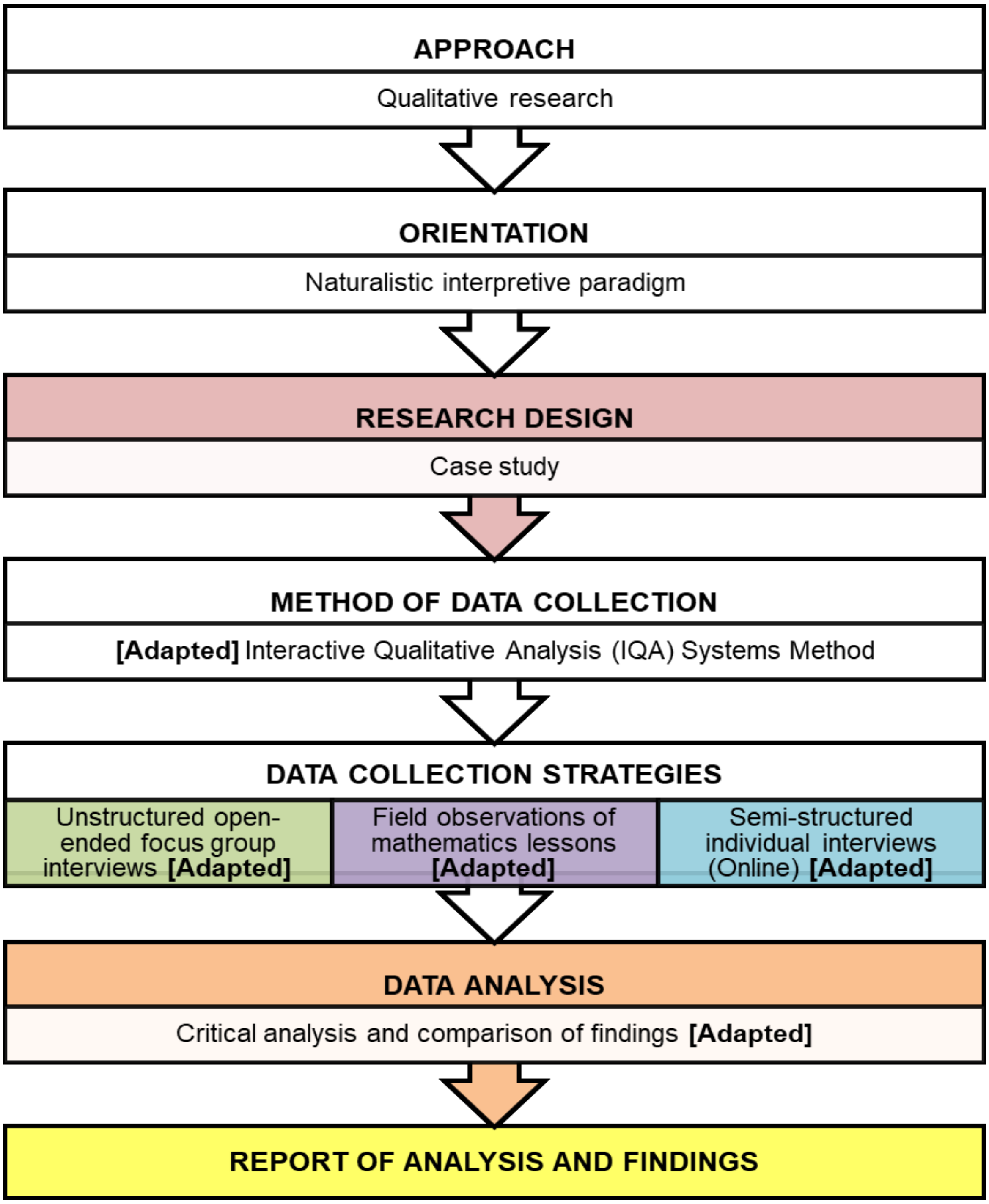

Figure 3.1: Adapted IQA methodological flow of the study

Figure 3.2 below provides a detailed visual representation of the adaptations (as illustrated in Figure 3.1 above) that were made to the original IQA research flow to suit the purpose of this current research study.

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 1: RESEARCH DESIGN	⇒ Research problem ⇒ Research questions ⇒ Research statements ⇒ Population and sampling	⇒ No adaptation ⇒ No adaptation ⇒ No adaptation ⇒ No adaptation
FOCUS 2: UNSTRUCTURED OPEN-ENDED FOCUS GROUP INTERVIEW	⇒ Research statements ⇒ Individual generation of participants' perceptions, experiences, and feelings ⇒ Silent group brainstorming and clarification of response	⇒ No adaptation ⇒ No adaptation ⇒ No adaptation
	⇒ Analysis of themes ⇒ Inductive and deductive coding ⇒ Theoretical coding ⇒ Theme describing process ⇒ Interview framework	⇒ No adaptation ⇒ No adaptation ⇒ **Adaptation (1)** – Theoretical coding was abandoned and replaced with field observations of mathematics lessons [see "Focus 3"] ⇒ No adaptation of the theme describing process, but the organisation and management thereof were supplemented by John Stuart Mill's Analytic Comparison technique (Neuman, 2014:493) – **(Adaptation 2)** ⇒ No adaptation
FOCUS 3: FIELD OBSERVATIONS OF MATHEMATICS LESSONS	⇒ Not part of original IQA processes	⇒ **Adaptation (3)** – Field observations were added to the IQA method.
FOCUS 4: SEMI-STRUCTURED INDIVIDUAL INTERVIEWS	⇒ Interviews	⇒ No adaptation but face-to-face interviews were replaced with online interviews – **(Adaptation 4)**
FOCUS 5: DATA ANALYSIS	⇒ Theoretical coding to compare the meanings of the themes.	⇒ **Adaptation (5)** – John Stuart Mill's Analytic Comparison technique (Neuman, 2014:493).
FOCUS 6: REPORT OF ANALYSIS AND FINDINGS		⇒ No adaptation

Figure 3.2: Adaptations of the original IQA research flow (adapted from Barnard, 2011:183)

Each foci and the necessary adaptations presented in Figure 3.2 above, where applicable, is described in more detail below.

3.2.1 Focus 1: Research design

Research component	Steps in the IQA process	Indication of <u>adaptation</u> or <u>no adaptation</u> of the original IQA research flow
FOCUS 1: RESEARCH DESIGN	⇒ Research problem	⇒ No adaptation
	⇒ Research questions	⇒ No adaptation
	⇒ Research statements	⇒ No adaptation
	⇒ Population and sampling	⇒ No adaptation

Figure 3.3: Focus 1: Research Design of the adapted IQA research flow

The first focus of Northcutt and McCoy's (2004:44) IQA research flow is recognised as the research design of the IQA study. The IQA research design includes a variety of tools that assist with the articulation of the study's research problem, identifying a group of people (i.e., constituencies) with a shared interest in the problem, and stating research questions implied by the problem statement. In line with Northcutt and McCoy's (2004:44) steps in the original IQA process, the researcher conveys these steps without any adaptation (§3.5).

3.2.2 Focus 2: Unstructured, open-ended focus group interview

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 2: UNSTRUCTURED OPEN-ENDED FOCUS GROUP INTERVIEW	⇒ Research statements ⇒ Individual generation of participants' perceptions, experiences, and feelings ⇒ Silent group brainstorming and clarification of response	⇒ No adaptation ⇒ No adaptation ⇒ No adaptation
	⇒ Analysis of themes ⇒ Inductive and deductive coding ⇒ Theoretical coding ⇒ Theme describing process ⇒ Interview framework	⇒ No adaptation ⇒ No adaptation ⇒ **Adaptation (1)** – Theoretical coding was abandoned and replaced with field observations of mathematics lessons [see "Focus 3"] ⇒ No adaptation of the theme describing process, but the organisation and management thereof were supplemented by John Stuart Mill's Analytic Comparison technique (Neuman, 2014:493) – **(Adaptation 2)** ⇒ No adaptation

Figure 3.4: Focus 2: Unstructured open-ended focus group interview of the adapted IQA research flow

The second focus of the IQA research flow involves the unstructured, open-ended focus group interview. The procedural steps for this focus are very distinct. These steps include the analysis of themes; inductive and deductive coding; theoretical coding; theme describing; and an interview framework. Although the researcher diligently followed the original IQA procedural steps as recommended when collecting data (§3.5.2.1), she did, however, make the first adaptation by abandoning the theoretical coding process. In this regard, the researcher merely added field observations of classroom visits as an additional component (i.e., Foci 3) of data analysis to the original IQA flow. The purpose of the original IQA's theoretical coding process is to "explore the meanings of the themes and their systematic relationships" based on "Total Quality Management (TQM) techniques that were designed to capture knowledge from organizational members to solve problems and improve industrial processes" (Northcutt & McCoy, 2004:4). However, as this study is rooted in an interactive, naturalistic, interpretive qualitative research case study (§3.5), the researcher wanted to explore, describe, and understand the participants' (i.e., Grade One teachers) perceptions, experiences, and feelings of the phenomenon in its natural context (i.e., using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms) and not identify systems relationships (cf. Barnard, 2011:183). The second adaptation in this component entailed the theme describing process. The theme describing process was similarly implemented according to the original above-mentioned IQA procedural steps, but the researcher supplemented the organisation and management thereof with John Stuart Mill's Analytic Comparison technique (Neuman, 2014:493) (§4.3.1 and Table 4.3, four categories of themes from the two open-ended focus group interviews).

3.2.3 Focus 3: Field observations of mathematics lessons

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 3: FIELD OBSERVATIONS OF MATHEMATICS LESSONS	⇒ Not part of original IQA processes	⇒ **Adaptation (3)** – Field observations were added to the IQA method.

Figure 3.5: Focus 3: Field observations of mathematics lessons of the adapted IQA research flow

As stated earlier, Northcutt and McCoy's (2004) IQA research flow was adapted by adding another data collection method, which became the third focus of the adapted IQA methodological flow of this current study, namely field observations of mathematics lessons (§3.5.2.2). The reason for this third adaptation was to determine whether the IQA data collected during the unstructured open-ended focus group interviews and semi-structured individual interviews was consistent with the data collected during the observations of the mathematics lessons (Barnard, 2011:188, 197). This triangulation also ensured the credibility of the findings (§3.9).

3.2.4 Focus 4: Semi-structured individual interviews

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 4: SEMI-STRUCTURED INDIVIDUAL INTERVIEWS	⇒ Interviews	⇒ No adaptation but face-to-face interviews were replaced with online interviews – **(Adaptation 4)**

Figure 3.6: Focus 4: Semi-structured individual interviews of the adapted IQA research flow

The fourth focus consists of semi-structured individual interviews. Although the individual interviews were carried out in the same manner as the original IQA research flow, the researcher made a fourth modification by replacing the individual face-to-face interviews with online interviews (§3.5.2.3). This adaptation was solely motivated by the COVID-19 pandemic's restrictions and difficulties in working in close proximity with the participants (Moises & Torrentira, 2020:79).

3.2.5 Focus 5: Data analysis

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 5: DATA ANALYSIS	⇒ Theoretical coding to compare the meanings of the themes.	⇒ **Adaptation (5)** – John Stuart Mill's Analytic Comparison technique (Neuman, 2014:493).

Figure 3.7: Focus 5: Data analysis of the adapted IQA research flow

As previously stated, the foundation of this study is an interactive, naturalistic, interpretive qualitative research case study (§3.2.2). Hence, the researcher wanted to explore, describe, and understand the participants' (i.e., Grade One teachers) perceptions, experiences, and feelings of the phenomenon in its natural context (i.e., using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms) and not identify systems relationships. Therefore, the researcher made a final adaptation to the original IQA method by adding a fifth focus of data analysis using John Stuart Mill's Analytic Comparison as an analytical tool (Barnard, 2011:223; Neuman, 2014:493). The reason for this addition was for the researcher to verify if there were patterns of shared agreements and/or disagreements amongst themes between the transcriptions of the semi-structured individual interviews and the transcriptions of the observations of the mathematics lessons (§4.3.1 for a description of this data analysis technique) (Neuman, 2014:493).

3.2.6 Focus 6: Report of analysis and findings

Research component	Steps in the IQA process	Indication of adaptation or no adaptation of the original IQA research flow
FOCUS 6: REPORT OF ANALYSIS AND FINDINGS	⇒ Analysis and findings	⇒ No adaptation

Figure 3.8: Focus 6: Report of analysis and findings of the adapted IQA research flow

No adaptations were made to the final component of Northcutt and McCoy's (2004:44) original IQA research flow, namely reporting the data analysis and findings (cf. Chapter Four, Data analysis and findings).

3.3 Qualitative research approach

According to Hammersley (2013:12), "[Q]ualitative research is a method of social inquiry distinguished by a flexible and data-driven approach; the use of relatively unstructured data; an emphasis on the critical role of subjectivity in the research process; detailed investigation of a small number of naturally occurring cases; and the use of verbal rather than statistical approaches". Cohen et al. (2018:278–279) further elaborate on the latter description and add that qualitative research employs data collection strategies and aims to provide an objective analysis of subjective meanings. It is predicated on the premise that reality is constructed socially and that variables are complex and difficult to quantify. Moreover, McMillan and Schumacher (2014:348) define qualitative research as an effort to investigate answers to research questions, and to narrate these questions from the participants' perspectives in a particular context. Thus, as the aim of this study was to explore, describe, and understand Grade One teachers' perceptions, experiences, and feelings about using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms, this study followed a qualitative research approach.

This study's qualitative approach was chosen due to its explorative nature and was further informed by Creswell's (2014:185–186; 2018) characteristics of qualitative research. In this regard, these characteristics highlight the qualities of systems, processes, and meanings of "real events by recording what people say (with words, non-verbal communication, and tone), observing specific behaviours, studying written documents, or examining visual events" (Neuman, 2014:8). These characteristics by Creswell (2014:185–186; 2018), as well as their significance to this study, are detailed in Table 3.2 below:

Table 3.2: Characteristics of the qualitative research approach in the IQA research approach

Characteristics	**Relevance to the study**
Utilising a non-probability sampling technique with a purposive sampling method	One of the aims of the research was to collect data from selected Grade One teachers who teach mathematics to isiXhosa-speaking learners in English Grade One classrooms. The researcher used a purposive sampling technique as it enabled her to purposefully choose the participants whom she knew would have in-depth knowledge and experience regarding the main research question and SRQs.
Qualitative data attempts to answer the research question and SRQs	Data was gathered by the researcher through two focus group interviews in order to build an interview framework. This framework guided the researcher to collect data during observations of mathematics lessons and semi-structured individual interviews as well. The transcripts from the field notes of the mathematics lesson observations and the audio recordings of the individual interviews included verbatim and non-verbatim reports about the participants' perceptions, experiences, and feelings.

Employing inductive and deductive analysis of the data and developing an interpretation (synthesis) which is creative	Data analysis occurred in three successive stages. The first stage of data analysis transpired interactively with the participants of the unstructured open-ended focus group interviews. During this interactive engagement, the focus group participants brainstormed and wrote up on cards [inductive analysis] their thoughts, perceptions, experiences, and feelings regarding the research statements [based on the SRQs]. The brainstorming activity was followed by a deductive analysis activity whereby the participants sorted and clustered the written cards [individual thoughts] into groups, which formed the themes. The written themes were furnished with descriptive paragraphs, which formed the interview framework. The second stage of the data analysis took place when the transcribed semi-structured individual interviews were analysed with the aim of identifying patterns. The third stage entailed the analysis of the transcripts of the field observations of mathematics lessons to gain a chronological perspective on what transpired in each of the individual interviewed participants' lessons when they taught mathematics. A synthesis [conclusion] was developed by comparing the data analysis of the individual interview transcriptions to the data analysis of the field notes from the mathematics lessons. After collecting and analysing the data, the researcher conducted a literature check by using current and relevant literature as a backdrop to articulate and formulate the findings.
Practicing mindfulness and empathic neutrality	This study's focus which was on constructing the meaning attached to the research topic from the perspectives, experiences, and feelings of the participants' point of view, rather than the researcher's meaning thereof, assisted the researcher in being neutral to this study's data analysis.

The qualitative research characteristics discussed above assisted the researcher in shaping the study's orientation (philosophical worldview), which framed the choice and implementation of the research design of this current study.

3.4 Interpretivism as a philosophical worldview

According to Okeke and van Wyk (2015:236), the philosophical worldview (paradigm) underpinned by a research study is described as the fundamental beliefs or assumptions that direct a researcher to their choice of inquiry. This means that each researcher approaches his/her research with a variety of interwoven and sometimes conflicting philosophical assumptions and viewpoints. The philosophical assumptions that enquirers make before choosing to conduct a research study are the starting point for the research design process (Creswell, 2014:187–189). In this regard, it is necessary that researchers bring their own worldviews or sets of beliefs to the research study as it influences the way in which they will conduct and write their study (Creswell, 2014:31; Chandra & Shang, 2019:93–95).

For this research study, the researcher opted to work within the interpretive paradigm. This paradigm enabled the researcher to listen to and describe the perceptions, experiences, and feelings of Grade One teachers within their natural context (Okeke & van Wyk, 2015:103; Walia, 2015:124). According to Rehman and Alharthi (2016:55), the idea of qualitative and interpretive research "is based on the same philosophical assumption that reality is ever changing and constructed by individuals interacting with their social worlds". Cohen et al. (2018:20) further state that the interpretive paradigm is concerned with the individual and seeks to understand their individual experiences within their reality.

Nevertheless, all theories built within the framework of the interpretive paradigm appear to be interpretivist (Cohen et al., 2018:19). Thus, the interpretivist is convinced that individuals cannot be separated from their actions as they are intentional and innovative in their actions (Cohen et al., 2018:19–20). According to Cohen et al. (2018:19), "[T]he social world should be studied in its natural state, without the intervention of, or manipulation by, the researcher". In this regard, naturalistic reality is related to the interpretive paradigm and is described by Okeke and van Wyk (2015:357) as "multiple, constructed and holistic". The interpretive paradigm's multiple realities focus on various individuals' realities as created by their experiences. As a result, qualitative research is more centred on "social constructionism" and believes that multiple realities are socially constructed through personal and collective interpretations of the same context. This approach emerges in this research study as a result of the researcher's involvement (as a non-participant observer) during lesson observations in the contexts of those individuals while conducting research (McMillan & Schumacher, 2014:345–346).

The researcher believes that her knowledge, experiences, and values shape her perception of reality. These realities might be the same or perhaps different from those of Grade One teachers, because these participants might have had other experiences to frame their realities. Using an interpretivist's point of view, it is important for the researcher to describe the participants' frames of reference from the "inside" and not the "outside" (Cohen et al., 2018:19). Consequently, to get a better sense of how participants thought about the world around them, the researcher obtained such experiences through lesson observations and individual interviews. In line with this description, Cohen et al. (2018:20) argue that interpretivists believe that people's behaviour is shaped by their natural environment and that these behaviours are experiences that take place in a specific context (i.e., mathematics lesson).

This said, people are the starting point for interpretive researchers who want to understand their perspectives on the reality around them (Cohen et al., 2018:19–20). According to Cohen et al. (2018:19), interpretive research is characterised by a "focus on action" that is related to the participants' experiences. In this regard, both the researcher and the participants were involved in the interpretive research paradigm, as it is impossible for the researcher to construct a clear meaning of an overall picture of what is happening in the classroom on her own (Cohen et al., 2018:17–18). Thus, in order for the researcher to avoid making her own assumptions, she needed to engage with the participating teachers to truly understand their perspectives, experiences, and feelings when teaching mathematics to isiXhosa-speaking learners in their English Grade One classrooms (Okeke & van Wyk, 2015:90–91; Cohen et al., 2018:20).

The research design chosen for this study is discussed next.

3.5 IQA case study research design

Gay et al. (2012:446) view a research design as a strategy for attempting to resolve the research problem. As discussed in the preceding sections (§3.3; 3.4), the research approach and philosophical worldview both influenced the choice of design as well as the methodological methods and techniques deemed most appropriate to answer the research question and SRQs.

The researcher conveyed the same IQA design steps as described by Northcutt and McCoy (2004) in the original IQA research flow (§3.2.1). In line with these steps, it is common to start off with a problem statement when thinking about the design of your research study, which is an eagerness for the researcher to learn more about a vague and inadequately defined phenomenon (Northcutt & McCoy, 2004:53). Thus, the first step of the IQA research design was to establish the main purpose of this research study, which was to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. To address the research problem, the researcher formulated the research problem into a single question, namely:

- "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?"

As a means to put the phenomenon in context regarding teachers' perceptions, experiences and feelings about the utilisation of teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics in English Grade One classrooms, the researcher also embarked on phrasing the following SRQs:

- SRQ 1: "What are Grade One teachers' understandings of mathematical language?"
- SRQ 2: "What are Grade One teachers' *understandings* of teaching and learning strategies to enhance mathematical understanding?"
- SRQ 3: "What are Grade One teachers' *experiences* of teaching and learning strategies to enhance mathematical understanding?"
- SRQ 4: "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?"

Based on the research questions above, the researcher developed research statements (issue statements) that were used during the silent brainstorming sessions of both focus group interviews. The statements were read to the participants to stimulate them to think about the concept being researched, and then to help them organise their thoughts into a reasonable number of themes and/or categories. The researcher used the following research statements to elicit the participants' perceptions, experiences, and feelings:

- Tell me what you think or feel or call to mind when I use the term 'mathematical language'.
- Tell me about your *understandings* of teaching and learning strategies to enhance mathematical understanding.
- Tell me about your *experiences* of teaching and learning strategies to enhance mathematical understanding.

- Tell me how you are using teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics in your classroom.

For the purpose of this study's research design and an attempt to address the research problem above, it is important to note that in a qualitative study, the research design is a reflexive process that runs through every stage of the research study. Therefore, the researcher may reconsider or adapt her design decisions to better fit the aim of answering the research question (Maxwell, 2016:214–215; Cohen et al., 2018:303). According to Bargate (2014:11), there are multiple perspectives of reality in qualitative research, which are subjective and susceptible to researcher bias because the researcher actively participates in the research process and analyses the data, building an understanding of a complex set of processes while reporting on the views of the participants. This procedure raises concerns about rigour, trustworthiness, and reliability that plague qualitative research. However, IQA (Northcutt & McCoy, 2004) is a unique method of qualitative research that aims to reduce the power dynamics and biases that have typically been associated with qualitative research (Du Preez & Stiglingh, 2018:159). This means that participants in IQA are actively involved in the data collection and analysis process (Bargate, 2014:11). Thus, due to this study's interpretive philosophical stance, which focuses on "subjectivity" and the researcher's "personal engagement", particularly to "understand actions" and "interpret the specific" context in reality (Cohen et al., 2018:19–20), the researcher subsequently utilised Northcutt and McCoy's (2004:44) IQA Systems Method. Thus, in view of the researcher's interpretive philosophical stance, the IQA Systems Method restricts her "subjectivity" and limits any possible form of biasness (Barnard, 2011:186).

Northcutt and McCoy (2004:199) explain that the letters "I" and "A" in IQA indicate, on the one hand, the interactive engagement, as well as, on the other hand, the collaborative analysis, between the researcher and the research participants during the process of data collection and data analysis. In light of this collaboration, Northcutt and McCoy regard the researcher as being both a facilitator and an analyst, whereas the participant is both a source of data and an analyst (2004:199). Thus, the adapted IQA method (§3.2) enabled the researcher to provide opportunities for the research participants to interact with the data collection and data analysis (Bargate, 2014:11). The IQA method added authenticity to this study by allowing the research participants to express their understanding, meaning, beliefs, and perceptions about the research phenomenon, which were then documented as themes of categories on the interview framework (Northcutt & McCoy, 2004:199).

Hence, for this research study, the adapted IQA methods were combined with a case study for the purpose of interactive qualitative inquiry. According to McMillan and Schumacher (2014:370-371), interactive qualitative inquiry is an in-depth study employing face-to-face methods to collect data from people in their natural context, interpreting phenomena from the participants' meanings and perspectives. Case study research allows for complex situations to be explored and understood. It is a reliable research method, especially when a comprehensive in-depth inquiry is necessary (Gulsecen & Kubat, 2006; Okeke & van Wyk, 2015:456; Cohen et al., 2018:188). In their true nature, case studies explore and investigate current real-life phenomena by means of a thorough context-specific analysis of experiences or circumstances and their relationships (Chetty, 2013:41). It also shows and represents the real world, making you feel like you're in that specific reality (Cohen et al., 2018:188).

Additionally, there are several advantages to using a case study as a mode of interactive qualitative research. Firstly, the analysis of the data is frequently carried out within the context of its use and within the circumstances in which the activity is taking place (Yin, 2003; Cohen et al. 2018:292). Secondly, different approaches in terms of intrinsic, instrumental, and collective techniques to case studies allow for several sources of data collection. Thirdly, rich in-depth qualitative accounts from case studies help researchers understand and describe data as it is in the real world, as well as the complexities of phenomena that aren't always shown in experimental research (Okeke & van Wyk, 2015:226; Cohen et al., 2018:376-377; Mohajan, 2018:20).

In line with both McMillan and Schumacher (2014:370-371) and Creswell (2018), the participants who participated in this research study represent a case because they share the same bounded system of connections by means of being Grade One teachers who teach mathematics to isiXhosa-speaking learners in English Grade One classrooms. This case study made it possible for the researcher to conduct rich, in-depth descriptions of the case; analyse the themes; and, at the end, interpret the findings. Furthermore, both McMillan and Schumacher (2014:370-371) and Cohen et al. (2018:375) stress the role of the phenomenon in a case study. They argue that a "case" involves a thorough investigation of a "small sample" and an in-depth analysis of a specific phenomenon rather than the number of individuals who were sampled. In this regard, the researcher chose only a small sample of eleven participants for this case study. In support of this argument, Yin (2009:18) and Cohen et al. (2018:217) acknowledge the importance of case studies in understanding the experiences of a specific group of individuals, but in addition, these experiences take place within a specific context too. Hence, descriptive case studies put forth an overall description of a phenomenon within its context. Therefore, the nature of this case study is descriptive and interpretative.

However, case study research is also unique because it can involve a variety of different ways of collecting data (McMillan & Schumacher, 2014:369; Cohen et al., 2018:387). According to Cohen et al. (2018:387), many case studies depend on mixed methods and various data. Although observations and participant observations are often the leading methods in case studies, they are not the only sources of information. Yin (2009:101-113) and Cohen et al. (2018:387) argue that methods such as documents, archival records, interviews, direct observations, participant observation, and physical artefacts are additional strategies defined as techniques that are chosen to assist the researcher in the interpretation, development, or validation of data gathered through participant observation and in-depth interviews. With regard to Northcutt and McCoy's adapted IQA Systems Method as advocated by Barnard (2011:182), the IQA Systems Method employs data collection strategies such as unstructured open-ended focus group interviews ("to produce a systematic representation of a phenomenon from participants' experiences of the phenomenon being studied") and semi-structured individual interviews ("to further probe individual meanings of the themes and its descriptive paragraphs"). The strength of the adapted IQA Systems Method approach rests in the researcher's ability to make an adaptation by using field observations as another strategy to collect data. By employing this additional strategy, the researcher was able to determine whether the IQA data collected during the open-ended focus group interviews and semi-structured individual interviews were consistent with the data collected during observations of mathematics lessons.

During this research study, the researcher conducted two unstructured, open-ended focus group interviews with a total of eleven Grade One teachers (i.e., six Grade One teachers participating in Focus Group One, and five Grade One teachers participating in Focus Group Two). The COVID-19 pandemic's restrictions on social distancing (§3.11) were the reason for conducting two separate unstructured open-ended focus group interviews rather than one. Additionally, there should have been twelve teachers participating in this study, but one of the participating teachers withdrew herself on very short notice prior to the focus group interview. However, the researcher decided to commence with only eleven participants (§3.11). Next, the researcher observed the mathematics lessons of six of the eleven individual participants (i.e., three Grade One teachers from Focus Group One, and three Grade One teachers from Focus Group Two). Thereafter, six semi-structured individual interviews were conducted with the same six teachers whose mathematics lessons were observed. These strategies of data collection enabled the researcher to listen to, capture, and describe the research phenomenon from the participants' point of view within their most natural context (i.e., in the Grade One classroom), without the researcher's interference or manipulation of events (Cohen et al., 2018:377; Chetty, 2013:41-42). This method was used to ensure that the researcher had rich, in-depth data that accurately reflected reality and produced a structured sequence of events that occurred during the data collection process of unstructured, open-ended focus group interviews, lesson observations, and semi-structured individual interviews.

The implementation of the research design is further deliberated on in the subsequent sections.

3.5.1 Population and sampling

For the researcher to attain the data that supported her in answering the research question, she first had to determine the population and sample size that formed part of her research study. According to Taherdoost (2016:18), in endeavouring to answer the research question, it is unlikely that the researcher is required to collect data from all cases. Therefore, only a sample needs to be collected. As researchers do not always have the time or the resources to analyse an entire population, they therefore apply a sampling technique to reduce the number of cases. In this regard, the researcher chose a representative sample that allowed her to collect data relevant to addressing the research question. The sample for this study was a subset chosen from the representative sampling frame (i.e., a subgroup from the entire population) from which the data were collected (Taherdoost, 2016:20). The researcher decided to use a non-probability sampling method, which is commonly related to case study designs and qualitative research studies (Okeke & van Wyk, 2015:295). Besides, case studies tend to focus on small samples and are designed to investigate a real-life phenomenon rather than make statistical assumptions about the overall population (Mohajan, 2018:11-12; Cohen et al., 2018:375). Table 3.3 below explains the sampling terms and how they were used in this study.

Table 3.3: Sampling concepts

Sampling concept	Description	Implementation
Population	Taherdoost (2016:18) describes the population of a research study as a complete set from which the sample is drawn.	All Grade One teachers in the Western Cape.
Sample	A sample is made up of a sub-group or elements of the population being reviewed for definite inclusion in the research study (Taherdoost, 2016:20; Cohen et al., 2018:202).	A sample was chosen for inclusion in this study from the above-mentioned population. The researcher purposefully selected schools with isiXhosa HL-speaking learners in English Grade One classrooms and Grade One teachers that she deemed best equipped to answer the research question (Creswell, 2018:125; Okeke & van Wyk, 2015:295). Based on the descriptive and explanatory research design, the researcher identified the following criteria for inclusion in this research study: • The researcher decided on four primary schools in the Western Cape to help answer the research question. The researcher believed that these four schools employed teaching and learning strategies that assisted isiXhosa-speaking learners to better understand mathematical concepts in English Grade One classrooms. • The DBE categorises schools into two different sectors, namely: independent and public schools. Therefore, the researcher envisaged that rich and in-depth data would be rendered by including both sectors of schooling. Due to the COVID-19 pandemic's influence on qualitative data collection methods, the researcher could only get one independent primary school on board. Hence, the researcher selected three public primary schools and one independent primary school in the Metro East Education District (MEED). The MEED was chosen for the following two reasons: Firstly, the MEED is the district in the Western Cape where most of the isiXhosa HL-speaking learners are found in English-language

		classrooms. Secondly, the researcher is familiar with the schools (both public and independent) in this district. During the practical teaching experiences of students in 2019, the Grade One teachers in this district supported and guided the students regarding implementing some mathematical teaching and learning strategies in their lessons. As a result, the researcher predicted that the Grade One teachers in this district would contribute to a thorough understanding of teaching and learning strategies that could aid isiXhosa-speaking learners' understanding of mathematics. • Grade One teachers of English-LOLT classrooms that teach mathematics to isiXhosa HL-speaking learners.
Sampling method	According to Cohen et al. (2018:217-218), the non-probability sampling method is obtained from the researcher who focuses on a specific group, well aware that this group does not represent the entire population, but rather represents itself. In this regard, it is not required of participants to be representative nor generalisable (Taherdoost, 2016:22). Furthermore, Northcutt and McCoy (2004:85) emphasise that the participants selected for a focus group interview share some collective experience, work, or related background, and that they have something significant in common with the phenomenon.	• The aim of this research study was to explore, describe, and understand Grade One teachers’ use of teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. However, due to the emphasis on individual (i.e., selected) teachers’ perspectives, this study is not representative nor generalisable. • The researcher purposefully selected eleven Grade One teachers to participate in two focus group interviews. The first focus group represented six teachers from one public primary school in the MEED. The second focus group represented five participants from two primary schools and one independent primary school in the MEED (§3.5). • Selecting the original eleven teacher participants (see Table 3.4), the researcher chose Grade One teachers that were easy to come by and were able to provide the researcher with a comprehensive picture of what Grade One teachers' perspectives, experiences, and feelings are about using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

		• At the end of the unstructured open-ended focus group interviews, only six participants were randomly selected to further participate in the lesson observations and semi-structured individual interview sessions (§3.6.3; 3.7.3). These participants represent Grade One teachers from each of the four schools, both public and independent (see Table 3.5).
Sampling technique	A purposive sampling technique is defined by Cohen et al. (2018:218-219) as an approach in which specific situations, individuals, or occurrences are purposefully chosen by the researcher. The sample is selected based on the researcher's assessment of who she believes would be appropriate to answer the research question and provide essential information that could not be obtained otherwise.	As part of the purposive sampling technique, the researcher opted to include the criteria above as part of the sample. This was to make sure that all the participants could answer the research question as they all experienced and lived the same things related to the research topic.

Table 3.4 below represents an overview of the two IQA groups selected for this research study (i.e., Group One and Group Two) and the data collection methods employed, which will be discussed in detail in the sections that follow.

Table 3.4: IQA participants and groups

GROUP	FOCUS	DATA COLLECTION METHODS		
		Unstructured open-ended focus group interviews	Field observations of Grade One mathematics lessons	Semi-structured individual interviews
GROUP ONE	Research group from public sector	Participant 1 Participant 2 Participant 3 Participant 4 Participant 5 Participant 6	Participant 1 Participant 3 Participant 5	Participant 1 Participant 3 Participant 5
GROUP TWO	Research group from public and independent sector	Participant 7 Participant 8 Participant 9 Participant 10 Participant 11	Participant 7 Participant 9 Participant 11	Participant 7 Participant 9 Participant 11

The six participants who were randomly selected to engage in the field observations and semi-structured individual interviews (§3.6.3, 3.7.3) are listed in Table 3.5, along with their demographic information.

Table 3.5: Demographic description of the six participants

Participant	Gender	Age	Qualification	Years' experience	How many learners in the classroom	How many learners are not receiving education in their HL	Teachers' own first language
1	F	30	B. ED FP	2	37	15	English
3	F	24	B. ED FP	8 weeks	37	10	English
5	F	28	B. ED FP	3	37	15	English
7	F	25	B. ED FP	3	29	2	Afrikaans
9	F	62	DIPLOMA	40	30	3	English
11	F	30	B. ED FP	8	35	10	English

In the next step, the researcher planned how she opted to collect the data from the participants that were included in the sample above.

3.5.2 Adapted IQA method of data collection

In section 3.2, the researcher discussed how she adapted Northcutt and McCoy's IQA research flow to fit this current study. The following discussion focuses on a more detailed explanation of the adapted IQA methods of data collection within the adapted IQA research flow of Northcutt and McCoy (2004). Following this discussion, the researcher will go into greater detail about how she used the adapted IQA data collection methods with each group (i.e., Group One and Group Two) (§3.6; 3.7).

The purpose of this study was to collect data in order to address the research questions (§3.1). McMillian and Schumacher (2014:2) define data as "the outcomes of research that serve as the basis for interpretations and conclusion". In this study, the researcher collected data on selected Grade One teachers' experiences using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. The researcher gathered this information by employing an adapted IQA method of data collection. In this regard, original IQA studies usually collect data using two methods, such as unstructured open-ended focus group interviews and semi-structured individual interviews (Northcutt & McCoy, 2004). However, in this study, the researchers added a new data collection method, namely field observations of mathematics lessons (§3.2.3).

Figure 3.9 below is a simplified diagram of this study's adapted IQA data collection process that was represented in the adapted IQA research flow diagram earlier (see Figure 3.2). The sections outlined in red indicate where the adaptations specifically to the IQA data collection process of this study were made and are described in detail below.

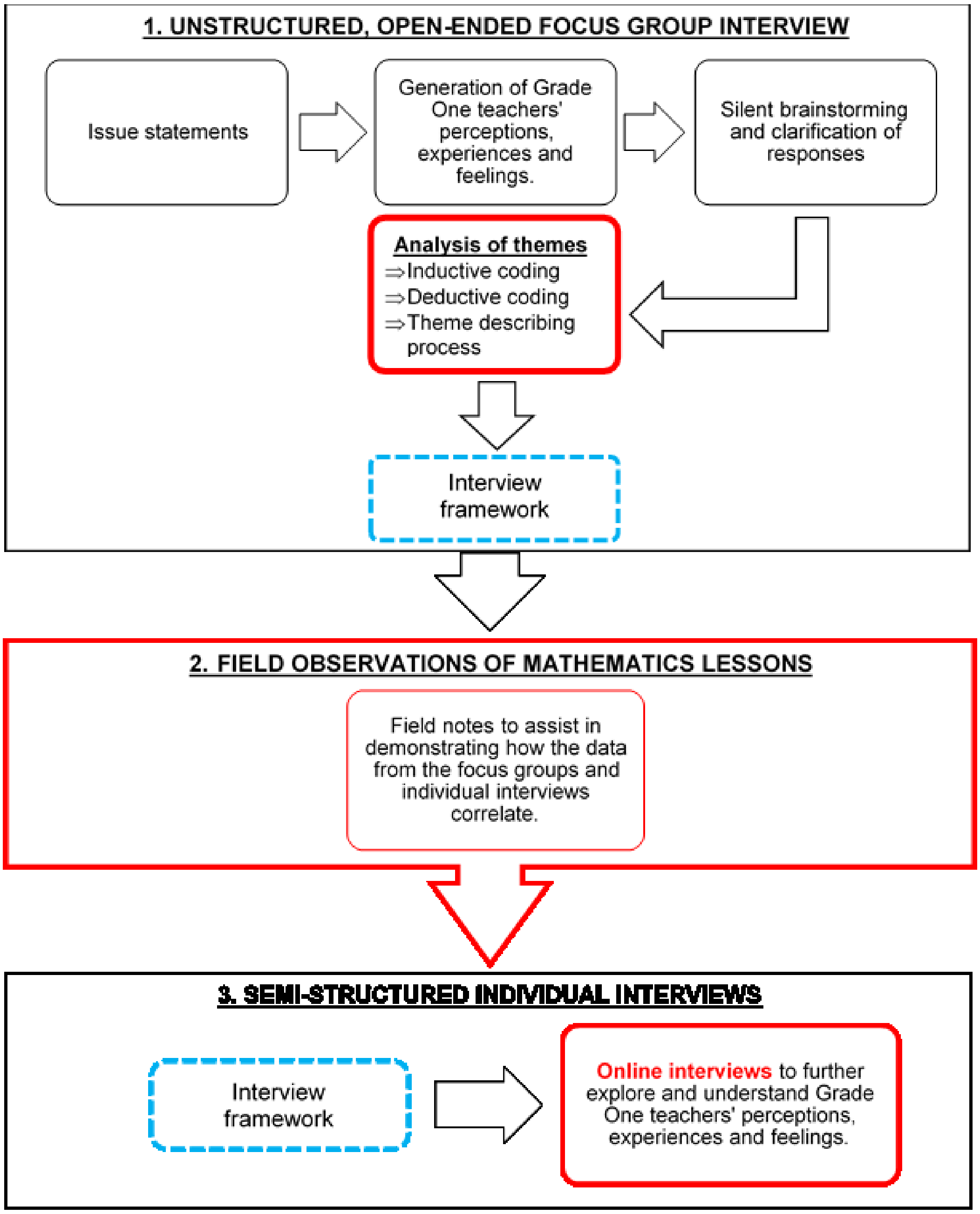

Figure 3.9: Adapted IQA data collection process

3.5.2.1 Unstructured open-ended focus group interviews

In accordance with Northcutt and McCoy's (2004) original IQA data collection methods, the first step in collecting data involves an unstructured, open-ended focus group interview. IQA employs interviews with focus groups to develop a structured representation of a phenomenon based on the participants' experiences with the phenomenon under investigation. IQA is predicated on the premise that those closest to the phenomenon being investigated, referred to as participants (or constituents in IQA terms), are best equipped to create a structured representation of the answer to the research question (Bargate, 2014:11-12). In this regard, the first step of the IQA data collection process for this study entailed two unstructured open-ended focus group interviews (§3.5) on separate days whereby all the participants shared their personal perceptions, experiences, and feelings about a shared phenomenon. While the researcher adhered to the original IQA procedures for conducting focus group interviews, she abandoned the theoretical coding process (§3.2.2).

The first activity involved in the IQA focus group was silent brainstorming. Hence, each participant of the focus group interview first received a few felt tip markers and a stack of index cards and Prestik. The participants were asked to silently brainstorm and then write as many thoughts, feelings, and experiences about the research statement as possible on each card separately (§3.5 for the research statements). When the participants generated their perceptions, experiences, and feelings on the cards, this was referred to as "inductive coding" (also known as "open" or "emergent coding"). Each card represented a distinct belief, experience, knowledge, or feeling (Northcutt & McCoy, 2004:98). After the participants generated as many thoughts on their cards as they could, the researcher asked the focus group, with no word being uttered amongst the participants, to place their cards on the walls using the Prestik. After the cards were all placed on the wall, the researcher read each card aloud to clarify the meaning of each. Then, in line with Northcutt and McCoy's (2004:47) original IQA process, the participants became actively involved in a silent inductive coding activity when the researcher invited them to look at each other's cards. Again, they were asked to silently sort and cluster the cards into groups of similar meanings. Thus, the participants move, sort, and shift the cards into a cluster group until everyone is happy with the categories or groupings (Northcutt & McCoy, 2004:98). Then, when the participants stopped sorting or rearranging the cards, the researcher took it that the participants had used up all their ideas for grouping the cards. The reason why the brainstorming and clustering activities are done in silence is to ensure that every participant's ideas, feelings, thoughts, and experiences are genuine, and that the participants do not influence one another (Northcutt & McCoy, 2004:91). Grouping of the cards is followed by theme naming (or affinity naming) and the revision process, which is referred to as "deductive coding". As Northcutt and McCoy (2004:99) refer to affinities, the researcher prefers to call the affinities 'themes', as it already involves data analysis, whereby the given names (themes) match the meaning the participants have intended. Thus, during deductive coding, the participants, for the first time, started sharing headings with each other, labelling each group (theme) and rearranging any cards that were still miscategorised into the applicable group. According to Northcutt and McCoy (2004:98), after the themes were improved and frequently reorganised by the group members, they are motivated to narrow the meanings of the themes and their categories. Northcutt and McCoy regard this process of sorting and clustering the cards as an interactive deductive coding activity to analyse themes. The illustration below depicts a structured example of inductive and deductive coding groups and themes.

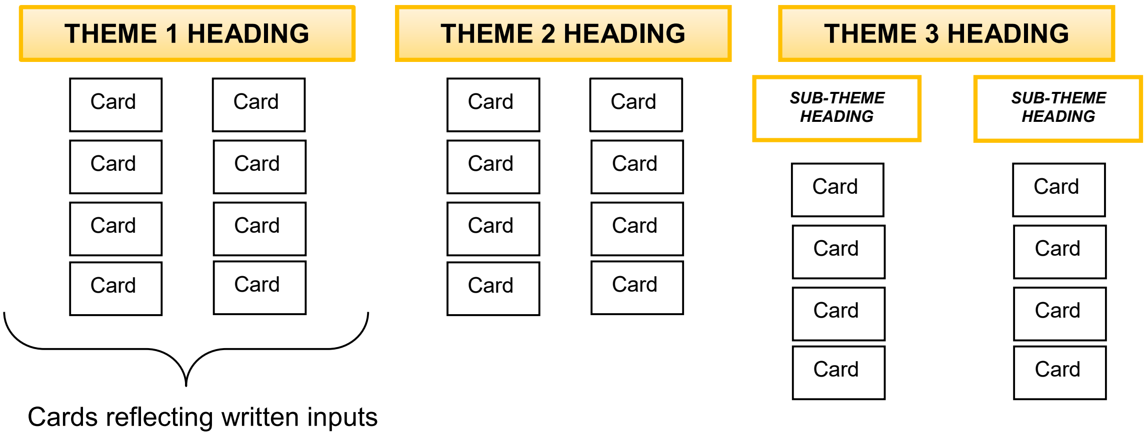

Figure 3.10: Theme headings

The researcher read every theme's heading with all their cards, which had been grouped under it, to the participants as a means to clearly define each theme. Then, the participants were asked to collaboratively write a summarised descriptive paragraph for each theme. The point was to depict the essence of each theme and its cards, reflecting the written inputs (Northcutt & McCoy, 2004:98-99).

The data collected from the two focus group interviews guided the researcher in compiling two separate interview frameworks, which were utilised to steer the lesson observations and semi-structured individual interviews in the IQA data collection process. In this regard, the field observations of mathematics lessons were the second step in the adapted IQA data collection process.

3.5.2.2 Field observations of mathematics lessons

The researcher added the additional data collection method of field observations of mathematics lessons (§3.2.3) by abandoning the theoretical coding procedure described above during the focus group interview. During this step, the researcher observed the participants' (i.e., Grade One teachers') perceptions, experiences, and feelings about the phenomenon in its natural context (i.e., English Grade One classrooms). According to McMillan and Schumacher (2014:376), by observing the participants' behaviour in their natural context, the researcher obtains a much richer and in-depth understanding of the phenomenon under investigation. Furthermore, King and Mackey (2016:219) argue that gathering data from a variety of sources (i.e., adding field notes of observations) assists the researcher in confirming the findings of a study. In this regard, the researcher used transcribed field notes of what she observed during the mathematics lessons of the teacher participants to determine whether the IQA data collected during the unstructured open-ended focus group interviews and semi-structured individual interviews was consistent with the data collected during the mathematics lesson observations.

Consequently, adapting the IQA data collection methods by adding the lesson observations helped the researcher to gain a deeper understanding of the teachers' experiences of using teaching and learning strategies in English Grade One classrooms to enhance isiXhosa-speaking learners' understanding of mathematics in practice. In support of this adaptation, Bloomberg and Volpe (2016:254) assert that in order to gain a thorough understanding of the phenomenon under investigation, it is critical to employ multiple data collection methods. In addition, various methods of data collection enhance triangulation. McMillan and Schumacher (2014:376–378) argue that qualitative field observations necessitate detailed descriptions of events, people, actions, and objects in settings.

3.5.2.3 Semi-structured individual interviews

After the field observations of mathematics lessons, the IQA semi-structured individual interviews were conducted as the final step in the adapted IQA data collection process for this current study. Cohen et al. (2018:506) regard individual interviews as a means for participants to share their experiences of the reality around them as they experience it as an individual. As a result, the researcher obtains a thick, in-depth description of the participant's reality from their point of view (Northcutt & McCoy, 2004:199). According to Creswell (2018), individual interviews are also utilised together with other data collection strategies as a means for additional probing to verify meanings created in a previous data collection strategy. In this regard, the themes that were established by the IQA focus group interview were utilised to create the IQA interview framework. Thus, the themes identified in the interview framework guided the interview questions for the semi-structured individual interviews (Northcutt & McCoy, 2004:48). During the semi-structured individual interviews, the researcher conveyed the same open-ended questions around the focus group's descriptions of each theme to the participant and then initiated a conversation by stating, i.e., "Tell me what this means to you" (Northcutt & McCoy, 2004:100). Throughout the process, the participants had the opportunity to reflect on each theme and its associated cards, providing their own interpretation and point of view.

The above paragraphs provide an in-depth discussion regarding the adapted IQA data collection that was implemented in this research study. However, in the following paragraphs, the researcher describes how she went about collecting the actual data from Focus Group One and Two, respectively.

3.6 Group One: Adapted IQA data collection process

3.6.1 Participant selection

The researcher purposefully selected six Grade One teachers from public primary school A who participated as Group One in the first focus group interview (see Table 3.3). The reason for conducting the first focus group interview with all six Grade One teachers from one primary school was the COVID-19 pandemic's influence on schools' unwillingness to participate in any research at the time. Thus, as the willingness of primary schools was limited, the researcher decided to commence with Primary School A's six Grade One teachers as Group One. Table 3.6 below illustrates the six participants who participated in Group One.

Table 3.6: Selection of participants for Group One

CRITERIA FOR INCLUSION	Unstructured open-ended focus group interviews	Field observations of Grade One mathematics lessons	Semi-structured individual interviews
Grade One teachers from <u>Public Primary School A</u>	Participant 1 Participant 2 Participant 3 Participant 4 Participant 5 Participant 6	Participant 1 Participant 3 Participant 5	Participant 1 Participant 3 Participant 5

3.6.2 Preparations and ethical considerations

During the IQA data collection process, the researchers' role was centred around four parts, namely, administrator, facilitator, guide, and non-participant observer. According to McMillan and Schumacher (2014:375), the researcher's social relationship with the participants is very important. Thus, studies must determine the researcher's role and position within the group. The role of the researcher in the perpetrations and ethical considerations of this study are discussed further below.

The researcher's first role required the preparations for data collection; thus, there were some administrative duties that had to be taken care of. According to Cohen et al. (2018:134), at an early stage of the research study, informed consent becomes obvious, and researchers cannot expect access to be granted as a matter of right. Researchers therefore need to prepare for data collection by getting access to the specific field where the research will be conducted and acceptance from those whose consent is required before beginning the investigation. In preparation for this research study, the researcher first applied for ethical approval from the Cape Peninsula University of Technology (CPUT) and the education authorities (Western Cape Education Department [WCED]) to conduct the research study (see Appendices D and E).

Thereafter, the researcher's duties demanded creating informed consent forms, arranging for participating members to sign these forms, arranging for the venue and seating, and making sure that the necessary stationery and audio recording equipment were accessible. In this regard, the researcher had to follow the ethics of creating informed consent forms to conduct the unstructured open-ended focus group interviews. She contacted the schools where the research was carried out to invite the participants to take part in the study. Thus, prior to the commencement of the IQA data collection process, each participant received an invitation letter (see Appendix A) in which the researcher explained to the participants what their roles and responsibilities were before they signed the informed consent forms (see Appendix B). It was also necessary for the researcher to obtain consent from the parents of the learners who would be present in the classrooms where the observations were conducted (see Appendix C). These consent forms were provided to each school to distribute to the parents of these learners.

Moreover, as the six participating teachers from Group One all taught at the same school (i.e., Primary School A), the principal of Primary School A offered a quiet but spacious venue for the researcher to conduct Group One's focus group interview. At the venue, the researcher used two tables with three chairs spread out around them so that all the participants could see the researcher standing in front of the two tables. The researcher made sure that each participant had 40 white index cards (to write their thoughts on), 15 A4 yellow pieces of paper (for naming the themes), 15 A1 sheets (for the descriptive paragraphs), a black felt tip marker, two strips of Prestik for each participant, one condenser mic, an audio interface, a laptop for recording, a backup hand recorder, and two hand sanitisers (one per table).

The second part of the researcher's role entailed that of a facilitator in both the unstructured, open-ended focus group interviews and the semi-structured individual interviews. In this regard, the researcher's role as facilitator commenced when she explained the IQA process to the participants.

The third role occurred concurrently with the second, although in this case, the researcher assisted the participants in constructing an interview framework. She directed the participants to organise their thoughts into a number of themes (groups of written references with an underlying common meaning or theme, such as factors or subjects) with which they could work (Northcutt & McCoy, 2004:16–17; Bargate, 2014:12).

When the researcher embarked on the observations of the mathematics lessons and making field notes, her role changed to that of a non-participant observer – standing apart from the group activities being studied (Cohen et al., 2018:386). According to Cohen et al. (2018:551), the goal here was to observe the participants in their natural environments, ordinary social settings, and their everyday behaviour in these settings. Furthermore, part of being a non-participant observer is blending into the background as if you are not there (McMillan & Schumacher, 2014:376). In this regard, the researcher's body language was posed in such a way that the learners treated her as if she was not there. This influenced the learners to take part spontaneously and unaffectedly in their maths lesson while the researcher wrote down what she observed.

3.6.3 Data collection via an unstructured, open-ended focus group interview with Group One

Before commencing with Group One's unstructured, open-ended focus group interview, which was conducted on 8 September 2021, the researcher first welcomed each participant and expressed her gratitude for their presence and willingness to participate in the study. The researcher made it clear that the participants were allowed to leave the room at any point if the processes or content of the focus group interview made them uncomfortable in any way. The researcher made it clear that all inputs would be kept confidential. She requested permission from the participants to audiotape the session, explaining to them that only she and her research supervisor would have access to the recording. If transcripts are made, the participants will remain anonymous and will only be identified by their number, such as participant number 1. The audio recording will be stored in a secure safe for at least five years as a reference in the event that any questions about it arise. The researcher explained to the participants that the recording served two purposes, namely: 1) to serve as both a true and accurate replica of what was said and done during the interview, and 2) to help the researcher set up an interview framework for the semi-structured individual interviews. This type of data collection agrees with Bargate's (2014:11) notion that qualitative research aims to capture what individuals say and do, that is, the outcomes of how individuals interpret the world around them. The figure below depicts the IQA unstructured, open-ended focus group interview that was conducted as part of this study.

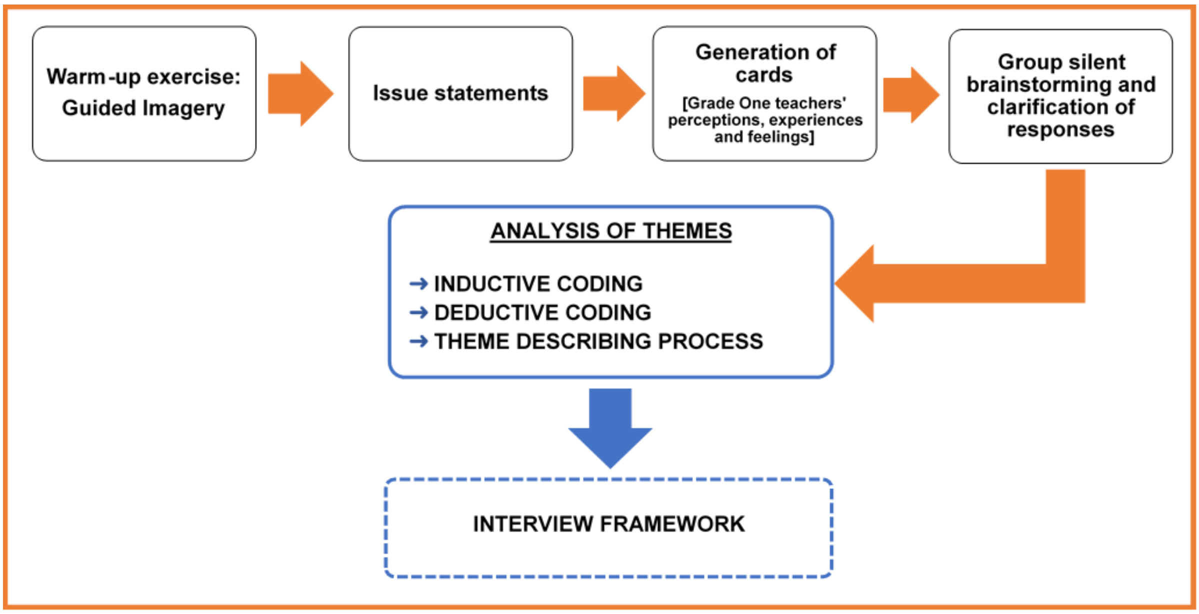

Figure 3.11: IQA unstructured open-ended focus group interview (adapted from Barnard, 2011:201)

The researcher commenced with the data collection by handing each participant a black felt tip marker and a pack of white index cards. The researcher informed the participants that the goal of the focus group interview had two outcomes. The first outcome entailed participants' thoughts and experiences about how they utilised teaching and learning strategies to help isiXhosa-speaking learners better understand mathematics in English

Grade One classrooms. Secondly, their ideas assisted the researcher in shaping the interview framework, which helped guide data collection during the lesson observations and semi-structured individual interviews.

The researcher, as facilitator, guided the group through a warm-up exercise in guided imagery. The goal of the warm-up exercise was to ease the participants into the data collection process that followed, clearing their minds of any other thoughts except the issue that was at hand (Northcutt & McCoy, 2004:88). The participants were asked to close their eyes and relax by inhaling deeply and putting aside their day-to-day thoughts. The facilitator prompted them to silently reflect and recall their perceptions, experiences, and feelings about the use of teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics. The facilitator guided the participants by instructing them to recall the words, phrases, mental images, or other memories associated with their experiences. The facilitator used neutral language to assist the participants in recalling their experiences completely and avoid biasing their responses (Northcutt & McCoy, 2004:93).

Following the warm-up exercise, the facilitator invited the focus group participants to participate in the IQA study's first data collection technique, a nominal group technique session. The nominal group technique (NGT) session is a structured process for group brainstorming that aims to establish a structured procedure for generating qualitative data from all the participants of the target group most strongly linked with the phenomenon under investigation. The NGT allows participants of a group to write down their thoughts on issues related to the research problem and, at the end, collaboratively establish which thoughts they believe are the most suitable (Olsen, 2019:2). The first issue statement, based on the research question and SRQs, was posed to the participants (Bargate, 2014:13), namely, *"Tell me what you think or feel or call to mind when I use the term 'mathematical language'".* Individuals silently brainstormed using the NGT by writing their individual thoughts and reflections on index cards. Northcutt and McCoy (2004:197) refer to these individual inputs as "personal meanings". The participants were also allowed to record their thoughts on the issue statement in single words, short phrases, or even drawings. To avoid any influence from peers in the focus group or the facilitator, the process was silent and private. According to Northcutt and McCoy (2004:47), it is critical that the process be carried out in silence so that individual responses are not influenced by discussion. This ensured that no one in the focus group exercised any power or influence over the other participants in the group, and therefore, all the participants responded honestly and individually to the issue statement. Additionally, the participants were encouraged to write as many thoughts as they could.

Once the generalisation of thoughts was saturated, the researcher asked the participants to silently stick their written cards in a column on the wall with Prestik where they could all see them. Again, this activity was done in complete silence. The researcher then posed the next statement*: "Tell me about your understanding of teaching and learning strategies to enhance mathematical understanding".* Again, the same process was followed regarding the generation of as many thoughts as possible on cards about the second issue statement. When the brainstorming was saturated, the participants were again asked to place their cards on the wall in silence. The researcher then posed the third statement: *"Tell me about your experiences of teaching and learning strategies to enhance mathematical understanding".* Again, the participants were encouraged to brainstorm silently and generate their inputs on index cards. When the researcher noticed that no more inputs were written on cards, she asked the participants to place their cards on the wall in silence. The researcher finally presented the fourth statement: *"Tell me how you are using teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics in your classroom".* Once again, the brainstorming activity continued in silence, and the participants wrote down their thoughts on index cards. When the input became saturated, as described above, the participants were asked to place the cards on the wall in silence.

The researcher then proceeded to read all the cards aloud to the group in order to establish a socially constructed shared meaning for each response, and to eliminate any vagueness or ambiguity in the meaning of the words or phrases on the cards (Northcutt & McCoy, 2004:81–94). Following the clarification conversation, the participants had the opportunity to supplement the original body of index cards with additional reflections and thoughts. The facilitator encouraged additional responses.

Next, the researcher continued by inviting the participants to "silently organise the cards into groups of meaning (similar themes), an activity referred to as "inductive coding" (Northcutt & McCoy, 2004:47). The silent action in this step was important as it prohibited participants from justifying why they placed a card within a specific group of cards. It is important to remember that at this stage of the process, the cards did not belong to a specific participant. The generated thoughts on the cards were grouped. If a participant believed that a card belonged in one cluster as opposed to another, she moved the card (Northcutt & McCoy, 2004:98). Participants not only sorted the cards into groups but also made sure that any cards that may have been miscategorised were placed into a group, even if it meant that the miscategorised card formed its own group or cluster (Northcutt & McCoy, 2004:81). Silent consensus was reached when there was no more movement of cards and everyone was in agreement with the groups (Northcutt & McCoy, 2004:199). Thus, data analysis, and specifically inductive coding, occurred concurrently with the data collection, through the silent brainstorming activity (writing thoughts on cards) and then reviewing the cards on the wall and sorting them into groups with similar themes (Northcutt & McCoy, 2004:98).

Deductive coding took place when the facilitator handed out to the participants A4 yellow paper and then requested the group to label each cluster of responses with a theme name or heading (Northcutt & McCoy, 2004:47). As a result, the six participants of Focus Group One sorted and clustered their inputs into thematic groupings with a theme heading. The participants further refined and reorganised the said themes or thematic groupings into sub-themes, where possible, through group discussion until a consensus was reached. Figure 3.12 below illustrates Group One's individual cards, eight themes, and one sub-theme.

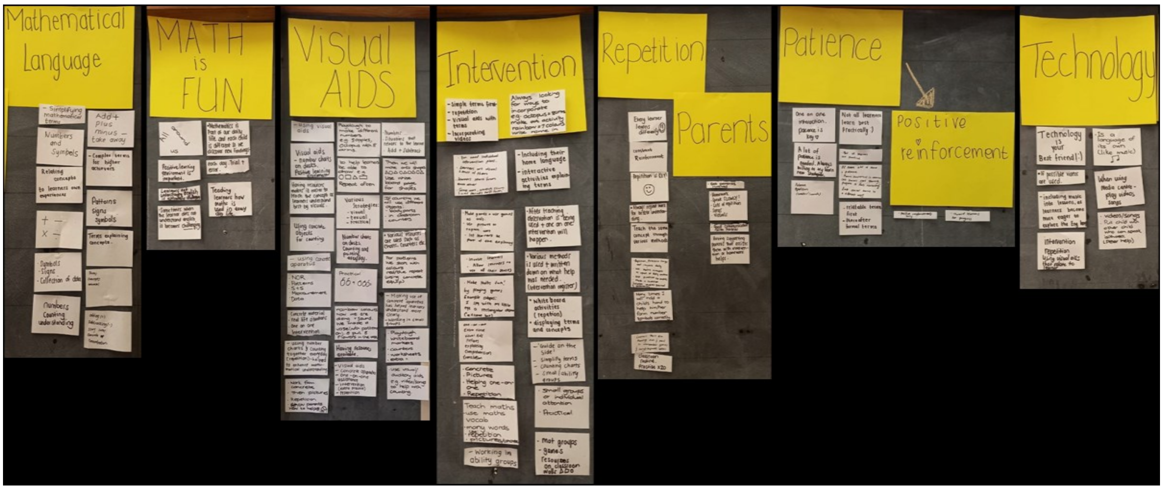

Figure 3.12: Individual cards, themes and sub-themes generated by Group One's open-ended focus group interview

The deductive coding process was concluded when the group discussed all the cards under the theme heading and proceeded to compile a descriptive paragraph and/or definition of each theme, using all the information on the cards (Northcutt & McCoy, 2004:99–100). Figure 3.13 below shows Group One's in-depth descriptive paragraphs of each theme and sub-theme.

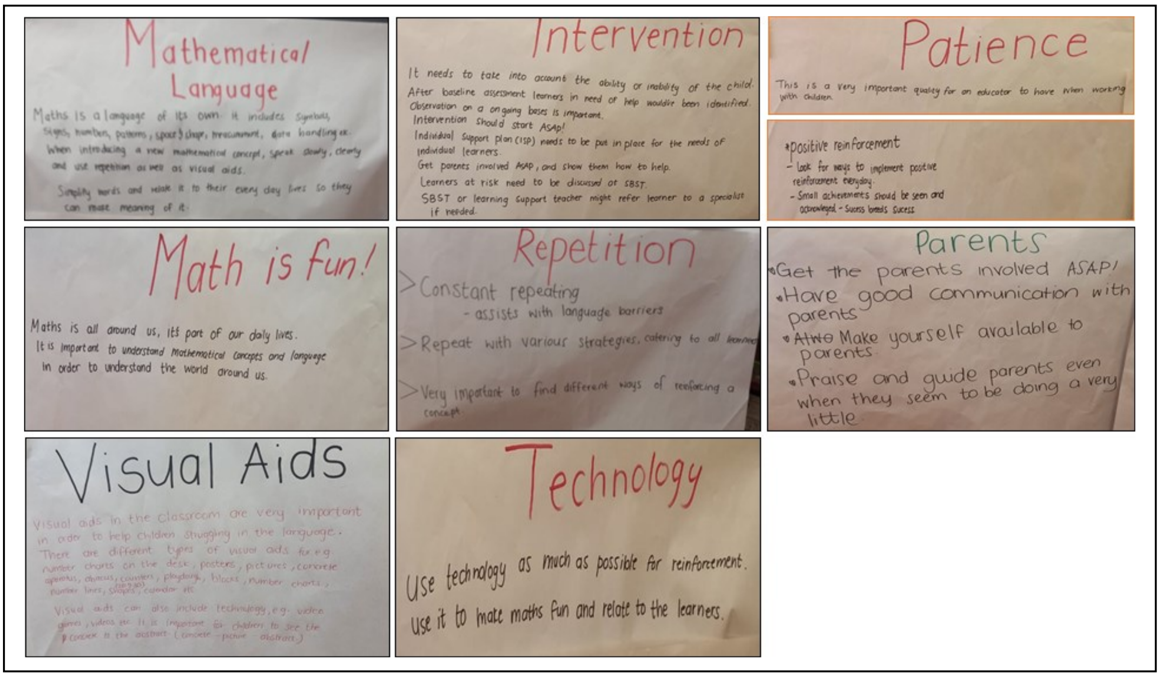

Figure 3.13: Group One's in-depth descriptive paragraphs of each theme and sub-theme

Then, the researcher read each theme one by one and its descriptive paragraph to the group to ensure that the meaning of the theme was agreed upon by all the participants. Finally, the researcher thanked every member that participated in the unstructured open-ended focus group interview. The duration of the focus group interview was approximately 2 hours and 30 minutes.

At the conclusion of the unstructured open-ended focus group interview, the researcher invited each participant to draw a peg from a bag to determine who would participate in the lesson observations and semi-structured individual interview sessions. The three individuals who drew the green pegs were the same individuals with whom the researcher conducted both the mathematics lesson observation and a semi-structured individual interview. The researcher finalised a date for conducting both the mathematics lesson observation as well as the individual interviews with each of the randomly selected participants. The dates for these lesson observations and semi-structured individual interviews were both conducted on the same day and took place on 14 September, 15 September, and 17 September 2021.

At home, the researcher transcribed the themes with their cards, together with the descriptive paragraphs. This transcription was then used as a guide for the field notes during the mathematics lesson observations and as an interview framework during the semi-structured individual interviews. According to Northcutt and McCoy (2004:48, 99), an IQA interview framework was created to achieve specific goals, each of which was related to the research question(s). The table below illustrates Group One's interview framework.

Table 3.7: Interview framework generated from Group One's transcription of data collected during the unstructured, open-ended focus group interview

THEME	CARDS CONSISTING OF THE BRAINSTORMING ACTIVITY OF TEACHERS' PERCEPTIONS, EXPERIENCES AND FEELINGS	DESCRIPTIVE PARAGRAPH
1. MATHEMATICAL LANGUAGE	• Simplifying mathematical terms (2x) • Numbers and symbols (4x) • Story sums • Concentration • Numbers, patterns and relationships, patterns, Space and shape, measurement, data (2x) • Is a language of its own (like music) (2x) • Relatable terms first thereafter formal terms (2x) • Relating concepts to learners' own experiences • Speak slowly	*"Maths is a language of its own. It includes symbols, signs, numbers, patterns, space and shape, measurement, data handling etcetera. When introducing a new mathematical concept, speak slowly, clearly and use repetition as well as visual aids. Simplify words and relate it to their everyday lives so they can make meaning of it".*
2. MATHS IS FUN	• Teaching learners how Maths is used in everyday life (2x) • Positive learning environment is important • Complex terms for higher achievers • Learners learn via having fun and tend to remember games and songs or rhymes better (2x) • Once learners start showing progress it feels rewarding	*"Maths is all around us, it's part of our daily lives. It is important to understand mathematical concepts and language in order to understand the world around us".*

3. VISUAL AIDS	• Having resources makes it easier to teach the concept as learners understand best by visuals. (3x) • Using concrete objects for counting (2x) • Number charts on desk • Real life situations • Playdough to make different numbers • Use whiteboard page for shapes • Worksheets • Work from concrete then pictures • Various strategies: visual, textual, practical, auditory	*"Visual aids in the classroom are very important in order to help children struggling in the language. There are different types of visual aids for e.g., number charts on the desk, posters, pictures, concrete apparatus, abacus, counters, playdough, blocks, number lines, 2D and 3D shapes, calendar etc. Visual aids can also include technology, e.g., video games, videos etc. It is important for children to see the concrete to the abstract (concrete – picture – abstract)".*
4. INTERVENTION	• Repetition • Visual aids with terms (4x) • Allow learners to use all of their senses (2x) • Make games and use games as aids • One-on-one (2x) • Learners learn from each other (3x) • Small groups • Extra time • Including their home language (3x) • Concrete • Practical examples • Use Maths vocabulary • Always looking for ways to incorporate, e.g. octopus = 8 arms make art activity rainbow = 7 colours write name in • Interactive activities (2x) • Whiteboard activities • Displaying terms and concepts (3x) • Simplify terms (2x) • You need individual intervention plans (3x) • Homework	*"It needs to take into account the ability or inability of the child. After baseline assessment, learners in need of help would've been identified. Observation on an ongoing basis is important. Intervention should start as soon as possible. Individual support plan (ISP) needs to be put in place for the needs of individual learners. Get parents involved as soon as possible and show them how to help. Learners at risk need to be discussed as school based support team (SBST). SBST or learning support teacher might refer learner to a specialist if needed".*

5. REPITITION	• Constant reinforcement (4x) • Teach the same concept through various methods	*"Constant repeating – assists with language barriers. Repeat with various strategies catering to all learners. Very important to find different ways of reinforcing a concept".*
6. TECHNOLOGY	• Technology is your best friend • Including music into lessons, as learners become more eager to explore the English language (2x)	*"Use technology as much as possible for reinforcement. Use it to make Maths fun and relate to the learners".*
7. PATIENCE	• Patience is key • Repetition (2x) • Each learner learns in a different way (2x) • Learners not understanding English is extremely challenging • Each day – trial & error • Always willing to try learn new strategies	*"This is a very important quality for an educator to have when working with children".*
7.1 POSITIVE REINFORCEMENT [SUB-THEME]	• Positive reinforcement only • Reward learners for progress	*"Look for ways to implement positive reinforcement every day. Small achievements should be seen and acknowledged – success breeds success".*
8. PARENTS	• Get parents involved (3x) • Good communication with parents (2x)	*"Get the parents involved as soon as possible! Have good communication with parents. Make yourself available to parents. Praise and guide parents even when they seem to be doing a very little to support".*

3.6.4 Data collection through Group One's observations of mathematics lessons of Participants 1, 3 and 5

The lesson observations of Group One's participants followed the unstructured, open-ended focus group interview. Before the researcher commenced with each lesson observation of Participants 1, 3, and 5, the participants first welcomed her into their classrooms. The researcher expressed her gratitude and asked the participating teacher and learners to continue with their activities as usual, as if she was not there. In this regard, during the observations of the mathematics lessons, the researcher acted as a non-participant observer, sitting at the back of the classroom (Cohen et al., 2018:386). On the day of the observations, the researcher made sure to have a notebook and a pen with her.

It was important for the researcher to pay attention to the themes that were pointed out in the unstructured, open-ended focus group interview while taking field notes of the mathematics lessons. The reason for this was to see if the data that were collected during the observations of the mathematics lessons was consistent with the IQA data collected during the unstructured open-ended focus group interviews and semi-structured individual interviews (§3.5.2.2). During the observations, data were collected by observing the scene as it occurred in the participants' reality. The field notes were dated, and the contexts were identified. The field notes included verbal and non-verbal body language and/or facial expressions to help explain what was observed. Moreover, the advantage of the field observations in this research study was that they presented an opportunity to gain insight into how things were done in the participants' natural context (McMillan & Schumacher, 2014:376). The duration of each observation was between 30 and 60 minutes.

The researcher transcribed the field notes at home after the lesson observation, providing a chronological description of the activities, including when they occurred, who was present, and what exchanges between the teacher and the learner(s) occurred throughout the mathematics lesson. The researcher also described the setting in which the activity occurred. These transcripts were compared with the semi-structured individual interviews that commenced on the same day as the observations. In this regard, the researcher wanted to determine if the teachers' practices and their use of teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding matched what they claimed in their interviews. The researcher recorded contradictions and inconsistencies.

Following the lesson observations, semi-structured individual interviews were carried out.

3.6.5 Data collection via semi-structured individual interviews with Group One's Participants 1, 3 and 5

Due to the COVID-19 pandemic, any unnecessary face-to-face interaction had to be avoided (§3.11). Consequently, following the lesson observations, semi-structured individual interviews were conducted online via Microsoft (MS) Teams. Ananth and Maistry (2020:4) state that the goal of semi-structured individual interviews is to verify what individuals believe as well as what they have to say about their beliefs through an interview framed and led by an interviewer (i.e., the researcher as facilitator). The data is then used to write a report of the findings.

In line with Northcutt and McCoy's (2004:48,197) method of collecting data, they recommend that the focus or content of the semi-structured individual interview needs to be determined by the focus group's themes. Hence, the data from the unstructured open-ended focus group interview was used to develop an interview framework comprised of eight themes, one sub-theme, and their accompanying descriptive paragraphs (see Table 3.7). Subsequently, this interview framework guided the semi-structured individual interviews. Thomas (2017:206) adds that the interview framework serves as a "framework for potential questions, follow-up questions, and probes".

The researcher compiled a list of possible interview questions based on the interview framework to serve as the interview's structure (see Appendix F). The researcher utilised the interview framework and a list of related questions to probe the themes, their cards (i.e., written inputs), and the explanatory paragraphs in depth. However, the participant was not limited to the information on the interview framework but was invited to add any information she may have thought would contribute to the research study.

During the semi-structured individual interviews, the researcher ensured that she treated each participant with respect, sensitivity, and friendliness, and that she formed a cooperative relationship with each participant. The researcher began each interview by thanking the participant for her time. The researcher then explained the research study's objectives (§3.1) as well as the critical role that the individual interview participants play in the data collection process (§3.6.3). The researcher emphasised that each teacher's participation in this research process was completely voluntary, and no one was forced to take part in this study. Each participant was informed by the researcher that if she was uncomfortable or did not want to keep taking part in the study, she could stop and leave the online interview platform.

The researcher tested the audio equipment before the interview began. Each participant was asked to give their permission for the interview to be recorded. They were also informed that the recording would be transcribed and that it would only be available to the researcher and her supervisor. The confidentiality of the responses of the participants was explained (Northcutt & McCoy, 2004:207). It was further clarified that there would be no personal references to her or her school in the data collection analysis, and that she would be referred to as Participant 1, 2, 3, or 4. This was in accordance with McMillian and Schumacher (2014:134) who state that if you want to keep something anonymous, you can use aliases or numbers instead of real names.

Due to the semi-structured individual interviews conducted online, the researcher provided a hard copy of the interview framework containing descriptions of each theme and sub-themes to the participant on the morning of her lesson observation (Northcutt & McCoy, 2004:202). The first set of questions focused on eliciting demographic data in order to acclimate the participant and establish a rapport between the researcher and the participant (Northcutt & McCoy, 2004:204). By using the phrase *"Tell me more about your experience with...",* the researcher prompted the participant to reflect on her personal encounters and beliefs concerning the theme (Northcutt & McCoy, 2004:203). Follow-up questions and probes fostered an atmosphere of respect and trust, allowing the participant to share her perceptions, experiences, and feelings about the themes and their descriptive paragraphs. According to Thomas (2017:206), probes in the form of a nod, a head tilt, or the phrase "Go on..." encourage people to talk more about their answers.

The researcher and the participant discussed each of the themes and their descriptive paragraphs together. The participant was encouraged to agree or disagree with the different themes and their descriptive paragraphs. The participant was also invited to add themes to the current themes of the interview framework. After discussion of such newly added themes and no further information being forthcoming from the participant, the researcher briefly summarised the participant's contributions. The duration of each semi-structured individual interview was between 40 and 90 minutes. At home, the researcher transcribed the audio recording of the interview. The researcher used time stamps to easily and accurately refer back to a specific quote from an interview transcript (Northcutt & McCoy, 2004:211).

3.7 Group Two: Adapted IQA data collection process

3.7.1 Participant selection

As previously explained, the COVID-19 pandemic's restrictions on social distancing forced the researcher to collect her data from two smaller groups separately (§3.5). Hence, the same data collection process was conducted with the second group (i.e., Group Two). Moreover, due to most schools' unwillingness to participate in any research at the time of the pandemic, the researcher's samples (i.e., schools) were limited. Thus, as Group One consisted of six teacher participants, all from one school (i.e., Public Primary School A), the remaining three schools (Public Primary School B and C, and Independent Primary School D) made up for Group Two's other five participants (§ 3.5). In this regard, the researcher purposefully selected two Grade One teachers from Public Primary School B, and two

Grade One teachers from Public Primary School C. Because one of the two participants from Independent Primary School D abruptly withdrew her participation at the last minute due to an urgent parent meeting, Independent Primary School D had only one participant in Group Two (§3.11). The table below illustrates the five teachers who participated in Group Two.

Table 3.8: Selection of participants for Group Two

CRITERIA FOR INCLUSION	Unstructured open-ended focus group interviews	Field observations of Grade One mathematics lessons	Semi-structured individual interviews
Grade One teachers from Public Primary School B	Participant 7 Participant 8	Participant 7	Participant 7
Grade One teachers from Public Primary School C	Participant 9 Participant 10	Participant 9	Participant 9
Grade One teachers from Independent Primary School D	Participant 11	Participant 11	Participant 11

3.7.2 Preparations and ethical considerations

Preparations and ethical considerations were previously described in the context of Group One's unstructured open-ended focus group interview, lesson observations, and semi-structured individual interviews. The same procedures were followed for setting up the venue and stationery, obtaining permission to participate in the research project, and discussing the ethical implications of recording the interviews for Group Two (§3.6.2).

3.7.3 Data collection via an unstructured open-ended focus group interview with Group Two

The data collection process for Group Two's unstructured open-ended focus group interview (§3.6.3), which was conducted on 21 September 2021, was the same as that of Group One (§3.6.3). Prior to beginning data collection, the researcher briefed the participants on the purpose of the focus group interview. Then the researcher guided the participants through an imagery warm-up exercise. Following the latter ice-breaker activity, the researcher commenced by posing the same research statement (i.e., *"Tell me what you think or feel or call to mind when I use the term mathematical language"*). The participants were requested to silently brainstorm and write their beliefs, experiences, knowledge, and feelings on cards. Once the generalisation of thoughts was saturated, the researcher asked the participants to silently place their written cards in a column on the wall where all could see them. Again, this activity was done in the same way as with Group One, in complete silence with all four of the research statements. The researcher proceeded to read all the cards aloud to the group in order to establish a socially constructed, shared meaning for each response and to eliminate any vagueness or ambiguity in the meaning of the words or phrases on the cards. Following the clarification conversation, the facilitator encouraged additional responses. Thereafter, a silent group brainstorming session was held. By silently grouping the cards into groups of similar meanings, the participants engaged in an inductive coding process that resulted in a theme analysis. After silent consensus was reached when there was no more movement of cards and everyone agreed with the groups, deductive coding took place when the participants refined these groups into themes and assigned each group a theme heading. Figure 3.14 below illustrates Group Two's individual cards, four themes, and one sub-theme.

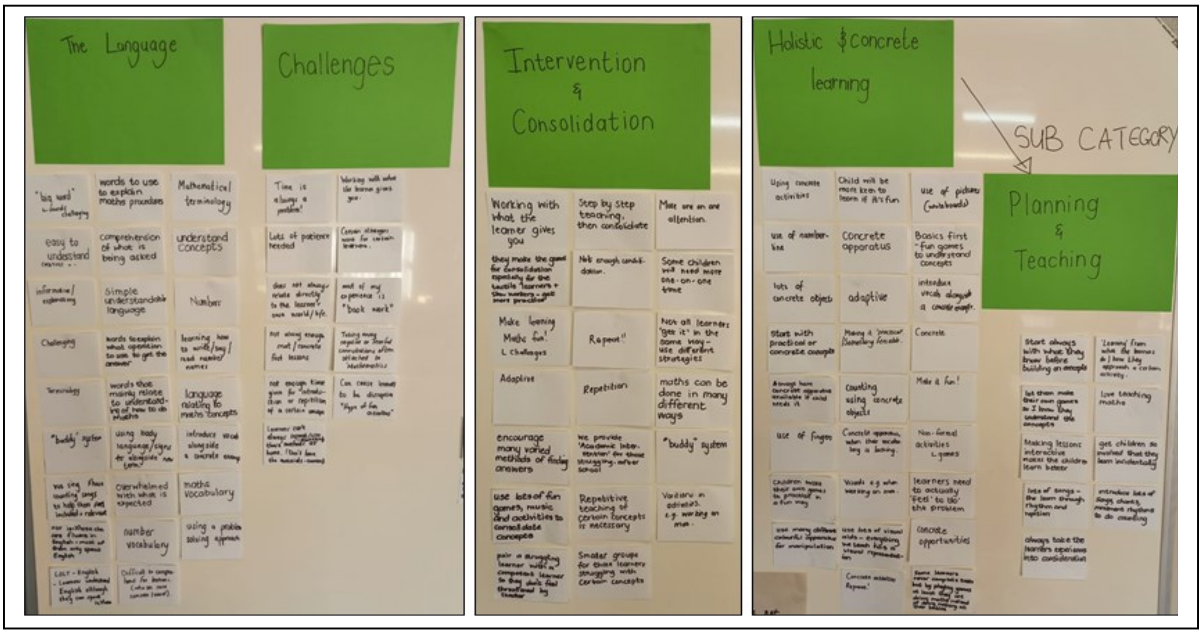

Figure 3.14: Individual cards, themes and sub-themes generated by Group Two's open-ended focus group interview

Finally, the deductive coding process was concluded when the participants began the process of theme description by writing a descriptive paragraph for each theme and sub-theme. Figure 3.15 below shows Group Two’s in-depth descriptive paragraphs of each theme.

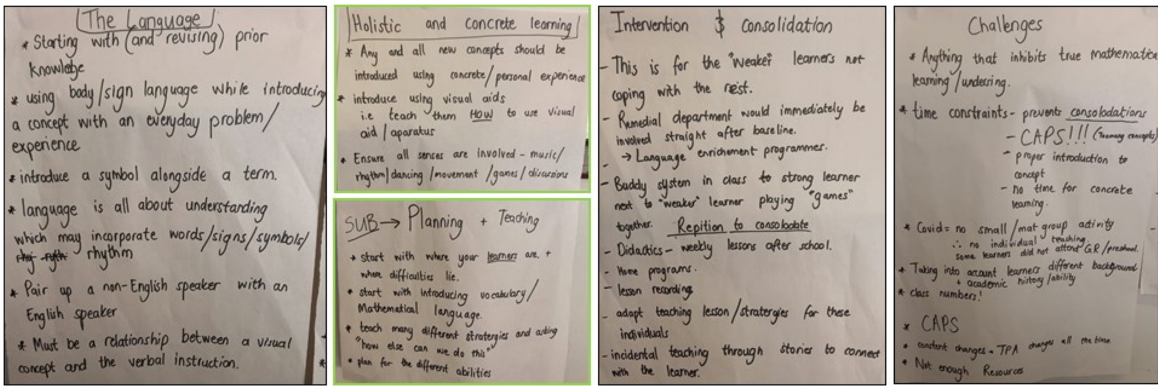

Figure 3.15: Group Two’s in-depth descriptive paragraphs of each theme and sub-theme

The researcher expressed her gratitude to everyone for their participation once they had given their final approval and no further additions were made. The duration of the focus group interview was approximately 2 hours and 30 minutes. Finally, the researcher followed the same random selection process as with Group One (§3.6.3). The researcher arranged tentative dates with the three participants for the lesson observations and follow-up semi-structured individual interviews. The dates for these lesson observations and semi-structured individual interviews were both conducted on the same day and took place on 28 September, 29 September, and 14 October 2021.

After transcribing Group Two's unstructured, open-ended focus group interview, she compiled an interview framework based on the themes that emerged. The interview framework was used as a guide for the field notes during the mathematics lesson observations and as an interview framework during the semi-structured individual interviews. The table below outlines Group Two’s interview framework.

Table 3.9: Interview framework generated from Group Two's transcription of data collected during the unstructured, open-ended focus group interview

THEME	CARDS CONSISTING OF THE BRAINSTORMING ACTIVITY OF TEACHERS' PERCEPTIONS, EXPERIENCES AND FEELINGS	DESCRIPTIVE PARAGRAPH
1. THE LANGUAGE	• "Buddy" system • We sing Xhosa counting songs to help them feel included + relevant • LOLT is English: Learners understand English although they can speak isiXhosa • Comprehension of what is being asked and understanding concepts (3x) • Simple understandable language • Words that mainly relate to understanding of how to do Maths (2x) • Using body language/signs alongside new term • Overwhelmed with what is expected (2x) • Difficult to comprehend for learners (who are more concrete/visual) • Mathematical terminology (3x) • Numbers • Learning how to write/ say/ read number names • Introduce vocabulary alongside a concrete example • Using a problem solving approach	*"The language is all about understanding which may incorporate words/ signs/ symbols and rhythm. Start with (and revise) prior knowledge. Make use of body or sign language while introducing a concept with an everyday problem or experience. Introduce a symbol alongside a term. There must be a relationship between a visual concept and the verbal instruction. Pair up a non-English speaker with an English speaker".*

2. HOLISTIC AND CONCRETE LEARNING	• Using concrete activities and objects/apparatus (Learners need to actually 'feel' to 'do' the problem) (6x) • Use of number line • Use many different colourful apparatus for manipulation • Child will be more keen to learn if it's fun (2x) • Adaptive approach • Use lots of visual aids – everything we teach has a visual representation (2x) • Basics first – Fun games to understand concepts (3x) • Introduce vocabulary alongside a concrete example	*"Any and all new concepts should be introduced using concrete or personal experience. Introduce concepts using visual aids, i.e., teach them HOW to use visual aids or apparatus. Ensure that all senses are involved, e.g., music, rhythm, dancing, movement, games and discussions".*
2.1 PLANNING AND TEACHING [SUB-THEME]	• Always start with what they know before building on concepts • Let them make their own games – so I know they understand the concepts • Making lessons interactive makes children learn better • Lots of songs – they learn through rhythm and repetition (2x) • Always take the learners experiences into consideration (2x) • Love teaching Maths • Get children so involved that they learn incidentally	*"Start where your learners are and where their difficulties lie. Start with introducing vocabulary or Mathematical language. Teach many different strategies and asking "how else can we do this?" Plan for the different abilities".*

3. INTERVENTION AND CONSOLIDATION	• Adaptive approach (5x) • Encourage many varied methods of finding answers • Use lots of fun games, music and activities to consolidate concepts, especially for the tactile learners and slow workers to get more practice. (2x) • Pair a struggling learner with a competent learner so they don't feel threatened by the teacher, e.g., "Buddy system" • Step by step teaching, then consolidate • We provide 'Academic Intervention' for those struggling, after school • Repetitive teaching of certain concepts is necessary • Smaller groups for those learners struggling with certain concepts • More one on one attention	*"Intervention and consolidation is for the "weaker" learners not coping with the rest. The remedial department would immediately be involved straight after Baseline for language enrichment programmes. A "buddy system" in class works, where a strong learner is put next to a "weaker" learner, playing "games" together. Furthermore, repetition to consolidate is important. For example: Weekly didactics lessons after school, home programmes, lesson recordings, adapting teaching lessons or strategies for these individuals and incidental teaching through stories to connect with the learner".*

4. CHALLENGES	• Time is always a problem (3x) • Lots of patience needed • Not always enough lessons on the mat or lessons starting with the concrete first • Learners can't always repeat or use their methods at home (Don't have the materials or counters) • Certain strategies work for certain learners (3x) • Most of my experience is "book work" • Taking away negative or fearful connotations often attached to 'Mathematics' • Can cause learners to be disruptive – "Hype of fun activities"	*"Challenges are anything that inhibits true mathematical learning or understanding. Time constraints prevents consolidation. CAPS has too many concepts. There is not enough time for a proper introduction to concepts and no time for concrete learning. Due to COVID no small or mat group activities take place, in other words no individual teaching. Also, some learners did not attend Grade R or preschool. It is a challenge to take into account learners' different background and academic history or ability. The class numbers are also challenging. Again, CAPS! There are constant changes. ATP changes all the time and there are not enough resources".*

3.7.4 Data collection via observations of Group Two's mathematics lessons with Participants 7, 9 and 11

Again, the same process of observation was followed with Group Two as it was with Group One. First, the participants welcomed the researcher to their classrooms. The researcher expressed her gratitude and asked the teacher and learners to continue with their activities as usual, as if she was not there. In this way, the researcher sat in the back of the classroom with a notebook and pen and watched without taking part.

The researcher used the interview framework indicating the themes generated by Group Two's focus group interview (see Table 3.9) as a guide to see if the data from the lesson observations confirmed the findings of the unstructured open-ended focus group interviews and semi-structured individual interviews. The researcher collected the data by observing the scene as it occurred in the participants' reality. The field notes were dated, and the contexts were identified. The field notes included verbal and non-verbal language to help explain what was observed. The duration of each observation was 60 minutes.

After the lesson observation, the researcher transcribed the field notes at home, providing a chronological description of the activities, including when they occurred, who was present, and what exchanges between the teacher and learners occurred throughout the mathematics lesson. She also described the setting in which the activity occurred. These transcripts were compared with the semi-structured individual interviews that commenced on the same day as the observations. The researcher recorded contradictions and inconsistencies.

Following the lesson observations, semi-structured individual interviews were conducted.

3.7.5 Data collection with Group Two's semi-structured individual interviews with Participants 7, 9 and 11

Semi-structured individual interviews were conducted online with Participants 7, 9, and 11 after the lesson observations. The researcher followed the same logistical and ethical procedures as with Group One (§3.6.2). The researcher initiated a conversation with the participants, asking them to describe their personal background and the context in which they were teaching, as well as inviting them to share their perceptions, experiences, and feelings about the themes and accompanying descriptive paragraphs covered in the interview framework (see Appendix G). The participants were encouraged to agree or disagree with the different themes and their descriptive paragraphs. They were also invited to add themes to the current themes of the interview framework. After discussing the newly added themes and no further information being forthcoming from the participants, the researcher briefly summarised the participants' contributions. The duration of each semi-structured individual interview was between 50 and 100 minutes.

At home, the researcher transcribed the audio recordings of the interviews. The researcher used timestamps, which made it easy for her to go back to any quote from any interview transcript.

3.8 Method of data analysis

Cohen et al. (2018:315) elucidate that qualitative data analysis entails organising, reporting, and describing data; in other words, interpreting data in terms of the participants' perceptions of the phenomenon under study, recognising themes, categories, patterns, and consistencies (or inconsistencies). In this qualitative research study, the researcher wanted to explore, describe, and understand how Grade One teachers were using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. Thus, the researcher chose to work within an adapted IQA Systems Method framework, advocated by Northcutt and McCoy (2004), which brought a form of order, structure, and meaning to the quantity of data that was collected specifically for this research study. Hence, this study's data analysis followed an adapted IQA data analysis procedure, supplemented by John Stuart Mill's Analytic Comparison technique (§3.2.5). This analytical comparison technique employs the "method of agreement" and the "method of difference" that were used to identify patterns among the themes while analysing the data (Neuman, 2014:492). Moreover, these themes and patterns were compared with literature (Cohen et al., 2018:315). The steps of the data analysis process will be elaborated on in Chapter Four.

3.9 Method of data verification

In qualitative research, the researcher is the instrument of construction. As a result, reliability in qualitative research depends on the ability and effort of the researcher to make the study trustworthy, dependable, credible, confirmable, and transferable (Cohen et al., 2018; Maree, 2016:373). Furthermore, in qualitative research, data verification is concerned with the trustworthiness of a research study's findings and the analysis. It is also dependent on the consistency of the research methodologies used and whether they accurately depict the population under study (Thomas & Magivy, 2011:151). In this research study, the researcher applied Maxwell's (2016:243-246) five categories of reliability in qualitative research and Auerbach and Silverstein's (2003) category of transparency as described by Thomson (2011:77-82). The table below describes the execution of distinct strategies in each category.

Table 3.10: Data verification

Method of data verification	Strategy that was followed	Implementation
Descriptive reliability	Data accuracy: Maxwell (2016:243–246) and Thomson (2011:78) recommend that the information gathered must accurately show the truth of the data. Crystallisation: According to Maree (2016:38–81), this strategy is the practice of "validating" results by combining multiple data collection and analysis methods to compare the findings with. This allows the researcher to shift from viewing anything as a fixed, rigid, and two-dimensional object to viewing everything as a crystal, which allows the changing reality to be defined and analysed.	Transcripts of verbatim responses were used by the researcher to accurately explain the data. To guarantee descriptive reliability, no information was left out or modified. As a result, the data accurately reflected the realities. The researcher's efforts to meet the standard for descriptive reliability were helped by asking each participant (i.e., member check) whether she agreed with the themes, categories, and descriptive definitions of the interview framework as generated during the unstructured open-ended focus group interview as a means to ensure that the researcher's bias did not influence how participants' perspectives were portrayed (Bloomberg & Volpe, 2016:176).

Interpretive validity	This strategy refers to the researcher's ability to accurately reflect the participants' definitions and interpretations of events, objects, and/or behaviours (Maxwell, 2016:243-246; Thomson, 2011:79).	The interview framework that was created directly from the focus group participants' perceptions, experiences, and feelings about the themes prohibited the researcher from tampering with or altering the participants' understanding of the phenomenon. The researcher utilised Northcutt and McCoy's IQA Systems Method framework to make sure that the participants in the focus group interview did not have any influence on each other when they generated their individual inputs and themes for the interview framework. In this framework, the participants not only provided data but also analysed the data. When participants in semi-structured individual interviews were asked to add, amend, agree, or disagree with the interview framework's content, the validity of each component of the interview framework was further strengthened (Northcutt & McCoy, 2004:208). Furthermore, when the researcher compared the transcripts of the individual interviews and the transcripts of the mathematics lesson observations, she tried not to make interpretations based on her own ideas. Instead, she relied on the transcripts, which included both the participants' verbal and non-verbal exchanges.

Theoretical validity	This strategy aims to determine the validity of the researcher's concepts as well as the theorised relationships between them in relation to the phenomena (Maxwell, 2016:243–246; Thomson, 2011:79).	The inductive and deductive data analysis, which occurred concurrently with data collection, revealed the themes and sub-themes generated by the participants themselves. Thereafter, the researcher conducted a literature check by using the verbatim quotes and current and relevant literature as a backdrop to articulate and formulate the findings (of the themes and sub-themes).
Generalisability	It refers to the research study's transferability (Thomson, 2011:79).	The non-probability and purposeful sampling of this case study limited the external validity of this research. This research study is embedded in the interpretive paradigm, which is related to naturalistic reality. Therefore, this research study is not designed to provide generalisable findings to the wider Grade One teacher population.
Evaluative validity	The researcher's evaluation of the data takes precedence above the data itself (Thomson, 2011:77-80).	The evaluative validity was shown to be true by drawing conclusions from the data analysis, the literature review, and the theoretical framework.

Furthermore, credibility and confirmability can be obtained in this research design by means of triangulation (McMillan & Schumacher, 2014:407). Multi-method strategies permit triangulation of data across inquiry techniques. In its broad sense, triangulation is defined as the use of more than one data collection method (White, 2005:89; Creswell, 2018; Chetty, 2013:41). This entails using the same methodological data collection methods for interviews (for both focus group and individual interviews), field notes of observations of mathematics lessons together with the literature review, thereby resulting in its strength (Shenton, 2004:65). The research study also employed multiple theoretical perspectives, that is, sociocultural theory of language and mathematics; constructivism; cognitive theory; and data sources in order to broaden the researcher's understanding of the method and phenomenon of interest.

This research was grounded in ethical research principles, which is described next.

3.10 Ethical considerations

The purpose of the adoption of ethical practice in this research study is to ensure that standardised procedures of conduct are consistent with the protection of the participants' rights (Gravetter & Forzano, 2010:60). As noted by Strydom (2011:126), Babbie (2007:65), and Kumar (2014:212), ethical considerations, including participant anonymity, confidentiality, privacy of information, and informed consent, were taken into account. Appendices A (i.e., invitation to participate), B and C (i.e., informed consent form) demonstrate how the researcher addressed the ethical considerations listed in the table below.

Table 3.11: Ethical considerations

Method of ethical consideration	Strategy that was followed	Implementation
Do no harm	The researcher must take care in qualitative research studies to limit any potential harm to the participants. To accomplish this, participants must be interviewed at a convenient time for them within a private setting. Moreover, the participants must be informed about the potential risks and benefits of participating. Babbie (2007:27) states that if participants become upset while collecting data, the researcher must refer them to a professional for counselling. In addition, when collecting data amid a global pandemic (i.e., COVID-19), when conducting interviews in groups, participants must be spread out carefully in a large enough room with good natural ventilation (Nicolaides, 2020).	The researcher avoided harming the participants by conducting interviews in a private setting and at a time that was convenient for them. During the focus group interview, the participants were evenly dispersed in a big, well-ventilated room. In addition, the risks and advantages of participation were communicated to the participants. Participants had access to professional counselling if the interview had upset them in any way (i.e., a school principal or social worker).

Informed consent	According to Babbie (2007:64), participants in a research study need to do so willingly and with knowledge of the nature and potential risks of the study. Prior to collecting data, the researcher must ensure that participants are not subjected to undue pressure and have provided informed written consent (Kumar, 2014:212).	Participation was fully voluntary in this study. The participants were informed of the type of information the researcher sought from them; the reason the researcher sought the information; the purpose for which the information was sought; how they were expected to participate in the research study; and the direct and indirect effects of their participation. In addition, individuals were not coerced into completing and signing the written informed consent form. In addition, they were informed that they were free to withdraw at any time without repercussions.
Anonymity	The term "anonymity" means that no one can identify participants included in the research study (Babbie, 2007:64). Thus, the data of participants should not be identified in the research study (Bless, Higson-Smith & Kagee, 2006:143).	The participants' participation in this study was not revealed. Furthermore, because the responses were presented collectively, the participants' contributions were not acknowledged in the study.
Confidentiality	According to Bless et al. (2006:143), the principle of anonymity is intertwined with the concept of confidentiality. According to McMillian and Schumacher (2014:133), confidentiality means that only the researcher can recognise the participant's contribution but that the researcher has agreed not to reveal the participant's identity to the public.	The participants were informed that the transcripts would be accessible only to the researcher and her supervisors, and that their participation and identities would be kept confidential.

Privacy	According to Strydom (2011:119), confidentiality is an extension of privacy that refers to agreements between participants and researchers to keep private information confidential.	The agreement made between the participants and the researcher prohibited access to private information by the general public. All transcripts and supporting paperwork were stored in a secure location that was accessible only to the researcher.
Management of information	According to Strydom (2011:126), qualitative data must be processed so that the research findings can be conveyed in writing. It should be easy to read and include all the required information for the reader to comprehend the findings of the research. The author emphasises the researcher's ethical responsibility to guarantee that information is presented clearly, that plagiarism is avoided at all times, and that anonymity and confidentiality are maintained. The researcher's ethical commitment to information management should be interpreted in terms of anonymity and privacy.	In this research document, the research findings are presented in written form. There was no plagiarism, and the information was clearly written. Furthermore, the participants' anonymity and confidentiality were maintained.

The execution of the research methodology, as well as the study's findings, should be viewed in the context of the limitations encountered during the research process. This will be covered in the paragraph that follows.

3.11 Limitations regarding the study

Several factors influenced the data collection process. The primary influencing factor was the educational institutions. Due to the global COVID-19 pandemic, many schools were unwilling to take part in the research as the educators already had too much on their plates. Another factor which had an influence was the data collection methods. In this regard, again due to the COVID-19 pandemic, the face-to-face focus group interviews and classroom observations were not welcomed by some of the school principals and educators, as they were uncomfortable with the social distancing aspect of face-to-face interaction (Moises & Torrentira, 2020:79). Unfortunately, the nature of the IQA Systems Method of Northcutt and McCoy (§3.2.4) would not have worked with focus group interviews and classroom observations taking place online. As a result, the only change that the researcher could make in this regard was to conduct individual interviews online rather than face-to-face. The researcher was also required to limit her lesson observations to one per teacher participant.

Furthermore, Group Two's unstructured open-ended focus group interview only had five participants, not six, because one participant abruptly cancelled her focus group interview appointment due to an urgent parent meeting. The participant was willing to join the focus group an hour later, but doing so would have disrupted the entire process. Unfortunately, the researcher was not able to replace the participant at such short notice and decided to proceed with the focus group interview.

It is also important to note that this study focused solely on Grade One teachers in the Western Cape of South Africa and Grade One isiXhosa-speaking learners who receive mathematics instruction in English-LOLT classrooms.

3.12 Conclusion

This chapter presented an overview of the research methods employed as well as an explanation of the procedures used to collect, analyse, and verify the data acquired from the participants. Ethics and limitations during the research were also discussed. The next chapter will furnish the reader with the adapted IQA data analysis method, a description of the participants' personal profiles, and the research findings supported by a literature review.

CHAPTER FOUR
DATA ANALYSIS AND FINDINGS

4.1 Introduction

The previous chapter provided a detailed description of the research process (see Figure 3.8). The focus of the different data collection methods (see Figure 3.9) was to collect data about the participants' personal perceptions, experiences, and feelings regarding the research phenomena. In this chapter, the data analysis and subsequent findings attempt to provide clear and thorough answers to the main research question and SRQs as stated below:

4.1.1 Research question:

- "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?"

4.1.2 Sub-research questions:

- SRQ 1: "What are Grade One teachers' understandings of mathematical language?";
- SRQ 2: "What are Grade One teachers' understandings of teaching and learning strategies to enhance mathematical understanding?";
- SRQ 3: "What are Grade One teachers' experiences of teaching and learning strategies to enhance mathematical understanding?" and
- SRQ 4: "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?"

Before the researcher could conduct data analysis, she needed to effectively manage the data that she had gathered. As a result, the researcher used the three steps listed below (see Figure 4.1), namely: 1) data management, 2) data analysis, and 3) findings and conclusions.

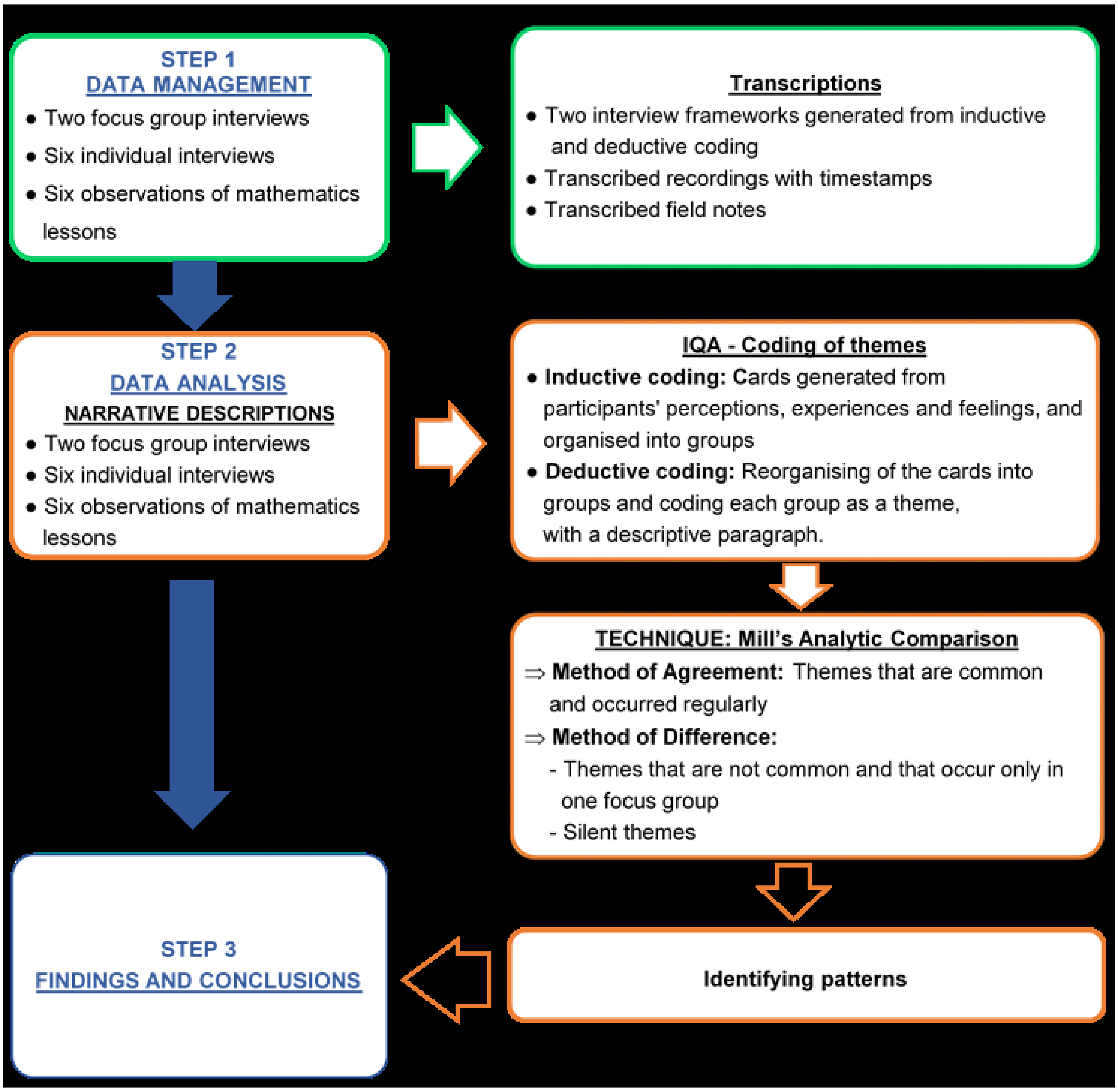

Figure 4.1: Qualitative data analysis process

4.2 Data management

Step one, data management, refers to the process of controlling the information obtained during the unstructured open-ended focus group interviews, semi-structured individual interviews, and field observations of mathematics lessons by means of transcripts (Creswell, 2014:193–194). During the unstructured, open-ended focus group interviews, data management took place when the researcher compiled the interview framework, consisting of the cards, themes with their descriptive paragraphs, as well as the categories under which some themes were grouped together (see Tables 3.6 & 3.8). After the compilation of the final interview framework, each participant received a copy to check if they agreed with the framework as it was compiled by the focus group (Cohen et al., 2018). The interview audio recording was transcribed in MS Word format by the researcher, who used timestamps in minutes and seconds. The timestamp on the transcripts displays where in the audio the text can be found. Final data management occurred when the researcher transcribed her observations in MS Word format.

As the researcher used an interpretative research style, she tried to "make sense of the data in terms of the participants' interpretations of the phenomenon, identifying patterns, themes, categories, and regularities" in the data (McMillan & Schumacher, 2014:397). After all the data had been transcribed and saved in electronic folders, the researcher moved on to the next step of the qualitative data analysis process, namely, data analysis. According to McMillan and Schumacher (2014:398), "Researchers use data to create narrative descriptions of people, incidents, and processes". Thus, the researcher used "narrative descriptions" to portray how teaching and learning strategies were utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding and their perceptions, experiences, and beliefs in this regard.

4.3 Data analysis and findings

In *Step two*, the researcher employed two data analysis techniques throughout the data analysis process. Both techniques aimed to pinpoint themes (thus, the coding of themes) as well as ascertain patterns.

4.3.1 Stage one: Data analysis of the two unstructured open-ended focus group interviews

The first data analysis technique entailed Northcutt and McCoy's IQA Systems Method (2004), which was utilised when the two unstructured open-ended focus group interviews [Group One and Group Two] were analysed. Thus, the participants of the focus group interviews were actively engaged in generating thoughts on cards of their personal perceptions, experiences, and feelings, before they silently clustered these thoughts into similar groups of meaning (inductive coding) (§3.5.2.1). Then, the participants (as a group) commenced with a data analysis activity when they were requested to name each group of cards depicting a theme, as well as rearrange any cards that might have been wrongly clustered into the appropriate group (deductive coding). The coded themes with their cards and descriptive paragraphs then served as the basis for an interview framework (Northcutt & McCoy, 2004). The two interview frameworks were used to guide the six individual interviews and observations of the mathematics lessons. The fourteen themes, the cards, and descriptive paragraphs identified by participants in both focus group interviews are summarised in two separate tables below (Table 4.1 & Table 4.2).

Table 4.1: Themes generated by Group One's open-ended focus group interview

GROUP ONE – Open-ended focus group interview		
CARDS CONSISTING OF A BRAINSTORMING ACTIVITY OF TEACHERS' PERCEPTIONS, EXPERIENCES AND FEELINGS	**THEMES**	**DESCRIPTIVE PARAGRAPHS**
• Simplifying mathematical terms (2x) • Numbers and symbols (4x) • Story sums • Concentration • Numbers, patterns and relationships, patterns, Space and shape, measurement, data (2x) • Is a language of its own (like music) (2x) • Relatable terms first thereafter formal terms (2x) • Relating concepts to learners' own experiences • Speak slowly	**MATHEMATICAL LANGUAGE**	*"Maths is a language of its own. It includes symbols, signs, numbers, patterns, space and shape, measurement, data handling etcetera. When introducing a new mathematical concept, speak slowly, clearly and use repetition as well as visual aids. Simplify words and relate it to their everyday lives so they can make meaning of it".*
• Teaching learners how Maths is used in everyday life (2x) • Positive learning environment is important • Complex terms for higher achievers • Learners learn via having fun and tend to remember games and songs or rhymes better (2x) • Once learners start showing progress it feels rewarding	**MATHS IS FUN**	*"Maths is all around us, it's part of our daily lives. It is important to understand mathematical concepts and language in order to understand the world around us".*

• Having resources makes it easier to teach the concept as learners understand best by visuals (3x) • Using concrete objects for counting (2x) • Number charts on desk • Real life situations • Playdough to make different numbers • Use whiteboard page for shapes • Worksheets • Work from concrete then pictures • Various strategies: visual, textual, practical, auditory	**VISUAL AIDS**	*"Visual aids in the classroom are very important in order to help children struggling in the language. There are different types of visual aids for e.g., number charts on the desk, posters, pictures, concrete apparatus, abacus, counters, playdough, blocks, number lines, 2D and 3D shapes, calendar etc. Visual aids can also include technology, e.g., video games, videos etc. It is important for children to see the concrete to the abstract (concrete – picture – abstract)".*

• Repetition • Visual aids with terms (4x) • Allow learners to use all of their senses (2x) • Make games and use games as aids • One-on-one (2x) • Learners learn from each other (3x) • Small groups • Extra time • Including their HL (3x) • Concrete • Practical examples • Use Maths vocabulary • Always looking for ways to incorporate, e.g. octopus = 8 arms, make art activity; rainbow = 7 colours, write name in • Interactive activities (2x) • Whiteboard activities • Displaying terms and concepts (3x) • Simplify terms (2x) • You need individual intervention plans (3x) • Homework	**INTERVENTION**	*"It needs to take into account the ability or inability of the child. After baseline assessment, learners in need of help would've been identified. Observation on an ongoing basis is important. Intervention should start as soon as possible. Individual support plan (ISP) needs to be put in place for the needs of individual learners. Get parents involved as soon as possible and show them how to help. Learners at risk need to be discussed as school based support team (SBST). SBST or learning support teacher might refer learner to a specialist if needed."*
• Constant reinforcement (4x) • Teach the same concept through various methods	**REPETITION**	*"Constant repeating – assists with language barriers. Repeat with various strategies catering to all learners. Very important to find different ways of reinforcing a concept".*

• Technology is your best friend • Including music into lessons, as learners become more eager to explore the English language (2x)	**TECHNOLOGY**	*"Use technology as much as possible for reinforcement. Use it to make Maths fun and relate to the learners".*
• Patience is key • Repetition (2x) • Each learner learns in a different way (2x) • Learners not understanding English is extremely challenging • Each day – trial & error • Always willing to try learn new strategies	**PATIENCE**	*"This is a very important quality for an educator to have when working with children".*
• Positive reinforcement only • Reward learners for progress	**POSITIVE REINFORCEMENT**	*"Look for ways to implement positive reinforcement every day. Small achievements should be seen and acknowledged – success breeds success".*
• Get parents involved (3x) • Good communication with parents (2x)	**PARENTS**	*"Get the parents involved as soon as possible! Have good communication with parents. Make yourself available to parents. Praise and guide parents even when they seem to be doing a very little to support".*

Table 4.2: Themes generated by Group Two's open-ended focus group interview

GROUP TWO - Open-ended focus group interview		
SEGMENTS [CARDS] CONSISTING OF A BRAINSTORMING ACTIVITY OF TEACHERS' PERCEPTIONS, EXPERIENCES AND FEELINGS	**THEMES**	**DESCRIPTIVE PARAGRAPH**
• "Buddy" system • We sing Xhosa counting songs to help them feel included + relevant • LOLT is English: Learners understand English although they can speak isiXhosa • Comprehension of what is being asked and understanding concepts (3x) • Simple understandable language • Words that mainly relate to understanding of how to do Maths (2x) • Using body language/signs alongside new term • Overwhelmed with what is expected (2x) • Difficult to comprehend for learners (who are more concrete/visual) • Mathematical terminology (3x) • Numbers • Learning how to write/ say/ read number names • Introduce vocabulary alongside a concrete example • Using a problem solving approach	**THE LANGUAGE**	*"The language is all about understanding which may incorporate words/ signs/ symbols and rhythm. Start with (and revise) prior knowledge. Make use of body or sign language while introducing a concept with an everyday problem or experience. Introduce a symbol alongside a term. There must be a relationship between a visual concept and the verbal instruction. Pair up a non-English speaker with an English speaker".*

• Using concrete activities and objects/apparatus (Learners need to actually 'feel' to 'do' the problem) (6x) • Use of number line • Use many different colourful apparatus for manipulation • Child will be more keen to learn if it's fun (2x) • Adaptive approach • Use lots of visual aids – everything we teach has a visual representation (2x) • Basics first – Fun games to understand concepts (3x) • Introduce vocabulary alongside a concrete example	**HOLISTIC AND CONCRETE LEARNING**	*"Any and all new concepts should be introduced using concrete or personal experience. Introduce concepts using visual aids, i.e., teach them HOW to use visual aids or apparatus. Ensure that all senses are involved, e.g., music, rhythm, dancing, movement, games and discussions".*
• Always start with what they know before building on concepts • Let them make their own games – so I know they understand the concepts • Making lessons interactive makes children learn better • Lots of songs – they learn through rhythm and repetition (2x) • Always take the learners experiences into consideration (2x) • Love teaching Maths • Get children so involved that they learn incidentally	**PLANNING AND TEACHING**	*"Start where your learners are and where their difficulties lie. Start with introducing vocabulary or Mathematical language. Teach many different strategies and asking 'how else can we do this?' Plan for the different abilities".*

• Adaptive approach (5x) • Encourage many varied methods of finding answers • Use lots of fun games, music and activities to consolidate concepts, especially for the tactile learners and slow workers to get more practice. (2x) • Pair a struggling learner with a competent learner so they don't feel threatened by the teacher, e.g., "Buddy system" • Step by step teaching, then consolidate • We provide 'Academic Intervention' for those struggling, after school • Repetitive teaching of certain concepts is necessary • Smaller groups for those learners struggling with certain concepts • More one on one attention	**INTERVENTION AND CONSOLIDATION**	*"Intervention and consolidation is for the 'weaker' learners not coping with the rest. The remedial department would immediately be involved straight after Baseline for language enrichment programmes. A 'buddy system' in class works, where a strong learner is put next to a 'weaker' learner, playing 'games' together. Furthermore, repetition to consolidate is important. For example: Weekly didactics lessons after school, home programmes, lesson recordings, adapting teaching lessons or strategies for these individuals and incidental teaching through stories to connect with the learner ".*

• Time is always a problem (3x) • Lots of patience needed • Not always enough lessons on the mat or lessons starting with the concrete first • Learners can't always repeat or use their methods at home (Don't have the materials or counters) • Certain strategies work for certain learners (3x) • Most of my experience is "book work" • Taking away negative or fearful connotations often attached to 'Mathematics' • Can cause learners to be disruptive – "Hype of fun activities"	**CHALLENGES**	*"Challenges are anything that inhibits true mathematical learning or understanding. Time constraints prevents consolidation. CAPS has too many concepts. There is not enough time for a proper introduction to concepts and no time for concrete learning. Due to COVID no small or mat group activities take place, in other words no individual teaching. Also, some learners did not attend Grade R or preschool. It is a challenge to take into account learners' different background and academic history or ability. The class numbers are also challenging. Again, CAPS! There are constant changes. ATP* [Annual Teaching Plans] *changes all the time and there are not enough resources".*

The second data analysis technique deviated from Northcutt and McCoy's original theoretical coding process of the IQA Systems Method (§3.2.2 & 3.2.5). The original data analysis of the theoretical coding process of the IQA Systems Method focused on establishing systems and relationships between the themes. However, this research study is embedded in a naturalistic, interpretive, qualitative research design, where the focus is rather on understanding, describing, explaining, and inferring the knowledge, perspectives, and experiences of the participants regarding the phenomenon. Hence, the researcher's decision to opt to employ John Stuart Mill's Analytic Comparison technique to identify patterns among the themes while analysing the data (Neuman, 2014:492). McMillan and Schumacher (2014:395) explain that a pattern is "a relationship [connection and/or links] among categories". Neuman (2014:492) explains that Mill's Analytic Comparison employs the "method of agreement" and the "method of difference" to recognise such patterns within a phenomenon. By firstly applying the "method of agreement" of Mill's Analytic Comparison (Neuman, 2014:429), the researcher looked at which themes were common and occurred regularly across the two focus group interviews. Secondly, she then proceeded to employ the "method of difference" (in which the researcher looked at which themes were not common but occurred in a specific focus group interview) (Neuman, 2014:493). By comparing the patterns of both the focus group interviews (which are the same and which are different amongst the themes), the researcher compiled a comprehensive list depicting the categories of themes (see Table 4.3 – The various colours represent the diverse categories and their related themes).

Table 4.3: Four categories of themes from the two open-ended focus group interviews

Open-ended focus group interviews	
Focus Group One	**Focus Group Two**
Themes	**Themes**
1. Mathematical Language	10. The language
2. Maths is fun	11. Holistic and concrete learning
3. Visual aids	12. Planning and teaching
4. Intervention	13. Intervention and consolidation
5. Repetition	14. Challenges [FOCUS GROUP TWO]
6. Technology	
7. Patience	
8. Positive reinforcement	
9. Parents	

CATEGORIES

1. MATHEMATICAL LANGUAGE

[THEMES: Mathematical Language/ The language (of mathematics)]

2. HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES

[THEMES: Holistic and concrete learning/ Planning and teaching/ Visual aids/ Technology/ Maths is fun/ Positive reinforcement/ Parents]

3. INTERVENTION AND CONSOLIDATION STRATEGIES

[THEMES: Intervention and consolidation/ Intervention/ Repetition and Patience]

4. CHALLENGES

[FOCUS GROUP TWO]

The analysis of the two focus groups' fourteen themes revealed the *first pattern* where the researcher found that some of the themes had similar content and/or flash cards, but they had different names. Thus, the researcher decided to group together the themes that had similar or complementary content (method of agreement) into three categories:

1. Mathematical language
2. Holistic and concrete teaching and learning strategies
3. Intervention and consolidation strategies

Using the "method of difference" the researcher substantiated the theme, Challenges, that was identified by the participants of Focus Group Two. As a result, a second pattern emerged in which Focus Group Two identified a unique theme, namely:

4. Challenges [Focus Group Two]

Thus, four categories of themes developed from the open-ended focus group interviews (see Table 4.3 above).

After the researcher finished analysing the data from the focus group interviews, she continued analysing the data from the individual interviews based on the themes that formed the interview frameworks.

4.3.2 Stage two: Data analysis of the semi-structured individual interviews

The purpose of analysing the semi-structured individual interviews was to find patterns. The researcher analysed the transcripts of each participant's individual interview to ascertain the following:

- if the participant agreed with the interview framework's themes (method of agreement);
- if the participant happened to disagree with the interview framework's themes (method of difference); and
- if the participant identified, expanded, or adapted the interview framework's themes (method of difference).

It was documented that in transcribing the six semi-structured individual interviews from the six selected Grade One participant teachers, the researcher first invited the participants to participate in an ice-breaker activity. However, the data from this ice-breaker activity documented background information about the participants' qualifications and experience as a Grade One teacher teaching mathematics in an English LOLT classroom. Zumwalt and Craig (2005:111-113) claim that individual demographic characteristics are important in the sense that they may have an impact on research outcomes. Demographic characteristics are significantly related to specific perceptions, attitudes, or work outcomes. By documenting the background information of the six participants of the individual interviews in a table format (see Table 3.5 – Demographic description of the participants), which was introduced in section 3.5.1 of the participant selection for this study, the researcher was able to draw insightful conclusions from this data set by asking what is the same and what differs (Neuman, 2014:494).

The data analysis of the demographic description of the individual interview participants (see Table 3.5) revealed that all six participants implement their school's LOLT, namely English. It further brings to light the discrepancy that second and third language learners (i.e., isiXhosa HL learners) experience when they are receiving mathematical instructions and education with first language learners whose HL corresponds with the LOLT of the specific school. Graven and Venkat (2017:15) point out that, regardless of the much research done acknowledging the importance of mother tongue education in South Africa, English remains the dominant language for teaching and learning. Hence, the majority of teachers appeared to be teaching in their HL (i.e., English), while isiXhosa HL speaking learners are educated in a LOLT other than their mother tongue.

Furthermore, the above table demonstrates that participants ranged in experience from newly qualified teachers to much more experienced teachers (method of agreement). While the participants' ages vary and they all possess the necessary qualifications to teach, it appeared as though they shared similar demographic characteristics and variables in this regard (method of agreement). According to the findings, all participants identified similar outcomes, such as implementing a variety of teaching and learning strategies that enhance the isiXhosa HL learners' understanding of mathematics (method of agreement). In this regard, the literature in Chapter One states that teachers in multilingual classrooms need to implement sufficient teaching and learning strategies to support ELLs (in this case, isiXhosa) in the understanding of mathematics (Robertson & Graven, 2020:82; Graven et al., 2016). Then again, another similar outcome indicated the lack of pre- and in-service training with regard to the teaching of mathematics in an African language (i.e., isiXhosa) (method of agreement). This outcome is supported by Robertson and Graven (2019:604) who affirm that there is a scarcity of teachers who have adequate skills and pedagogical knowledge to manage both the teaching of mathematics and the teaching of a second language simultaneously. This argument is further strengthened by Alex and Roberts (2019:71), who claim that much remains to be done for the improvement of mathematics learning in ITE programmes for primary school teachers in South Africa. Another viewpoint by Robertson (2017:342) asserts that little has been done by district offices to support teachers regarding strategies for handling the challenge of teaching mathematics in and through a second language.

As a result, it can be concluded that the age and qualifications of Grade One teachers, in the context of African language instructions, have no or minimal effect on their experiences of implementing teaching and learning strategies to enhance mathematical understanding. Conversely, teachers across the South African education system struggle with effectively utilising African language learners' (i.e., isiXhosa) linguistic knowledge for effective mathematics learning in early grade mathematics, especially given that the mathematics register in indigenous languages is still not fully developed (Essien, 2018:55).

The following sections will discuss the data analysis of the individual interviews, focusing on the selected Grade One teacher participant's perceptions, experiences, and feelings about teaching and learning strategies for mathematical understanding in her classroom. The researcher uses italics and timestamps to quote specific participants. After carefully examining the categories using the "method of agreement" and "method of difference" (Neuman, 2014:493), the following was discovered:

4.3.2.1 Category One: Mathematical language

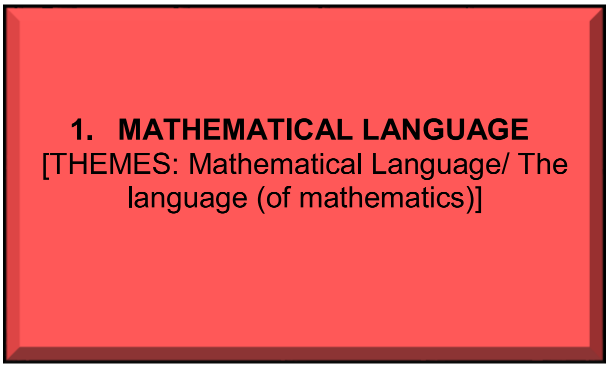

Figure 4.2: Category one – Mathematical language

The category "Mathematical language" was created by clustering the themes "Mathematical language" and "The language". For this research study, the researcher wanted to have an insight concerning Grade One teachers' understanding of mathematical language. Thus, using the method of agreement and the method of difference as described in John Stuart Mill's Analytic Comparison (Neuman, 2014:493-494), the researcher attempted to analyse the transcripts of six individual interview participants relating to the category, "Mathematical language" and its underlying themes.

Theme 1.1 The language [of mathematics]

When the researcher reflected on the category "Mathematical language", the six individual participants, from their own perceptions and experiences, shared a variety of viewpoints about the language of mathematics. The participants responded as follow:

> *"It is a language of its own" (PARTICIPANT 1, 3:32).*

> *"... it's a language of its own; I mean, we're teaching the children maths and then they see it as numbers" (PARTICIPANT 5, 04:28).*

> *"… but as far as mathematical language is concerned, we basically have to start right at the beginning. So, no matter what language they're speaking or just say predominant language, even the English children are learning it* [mathematics] *for the first time" (PARTICIPANT 9, 0:05:16).*

> *"So, language is … when we teach maths in the Grade One classroom and not only for those learners that don't speak English as their first language, but children don't speak maths. Maths language is something you teach them whether they are English speakers or not first language English speakers, and that is how you build any maths concept for a child, and from there you build onto those concepts" (PARTICIPANT 11, 0:05:16).*

Le Cordeur and Tshuma (2019:107) argue that mathematical language is viewed as a distinct "register" within an ordinary language (i.e., English), and learning mathematics automatically includes the acquisition of the mathematics register itself (Setati, 2005; Sibanda & Graven, 2018:3). Consequently, the isiXhosa-speaking learner needs to grasp both the LOLT, which is English, and the language of mathematics simultaneously (Sibanda & Graven, 2018:3).

Two participants shared their views that the language of mathematics consists of specific terminology (which corresponds with the participants' statements above), but they stressed that the mathematics terminology is, however, challenging:

> *"… when I think of the language with regard to mathematical, or mathematics, the mathematical language, … then the first that … come to mind… is the mathematical terminology, … and the specific terminology we use when teaching a new concept … division of maths … part of mathematics* [content area], *that falls under mathematics. For example, addition, subtraction or objects, 3D objects, those kinds of terminologies. …these terms are a big word that might sound challenging for learners, … that can sometimes hinder them because they just think of this big word and what it means, overwhelms them" (PARTICIPANT 7, 03:31).*

> *"… I also think that it's* [mathematical language] *about simplifying the terms because sometimes they get so overwhelmed. … you got to plus this and minus this, or if you even bring up the word divide, they're like looking at you like, what does that mean?" (PARTICIPANT 3, 03:45)*

Jourdain and Sharma (2016:44–45) as well as Le Cordeur and Tshuma (2019:107) are of the opinion that the special vocabulary used in mathematics is one feature of the mathematics register. This special vocabulary is unique in describing and/or explaining a particular type of mathematical situation. Pertaining to the terminology that overwhelms learners, Ní Ríordáin et al. (2015:12–13) state that learners from diverse cultural or linguistic backgrounds will often encounter difficulties in understanding mathematical problems due to being unfamiliar with these terms.

Adding to the quotations by the participants thus far, they also acknowledged the important role that language plays in the understanding of mathematics. Mulaudzi (2016:165) maintains that the LOLT through which mathematics is learnt lays the foundation for mathematical teaching and learning to develop in that language. Hence, learners must not only be familiar with and knowledgeable in the everyday English register (LOLT), but they also need to be fluent in multiple mathematical registers to be successful in mathematics (Moschkovich, 2005:121-144; Schleppegrell, 2011:73-112; Essien, 2018:50). Three participants endorsed the importance of understanding the LOLT when mathematical concepts are introduced.

> *"And with mathematics you need to understand the language that it's being taught in* [i.e. English LOLT]. *So once you understand the language mathematics is taught in – concepts and all of those things that is part of mathematics become easier to understand" (PARTICIPANT 1, 3:32).*

> *"… the learners do not necessarily understand the language itself* [Language of Mathematics] *and/or if it is learners that perhaps struggle with English as it might not be their home-language, ...they then struggle to understand the* [mathematical] *concepts" (PARTICIPANT 7, 05:38).*

> *"The language* [LOLT] *and the concept goes hand in hand. If they don't get the language, they're not going to get the* [mathematical] *concept; and if they don't hear them often enough, then they may not be able to use it and remember it" (PARTICIPANT 11, 0:09:12).*

The above highlights the reality that language (both the LOLT and language of mathematics) is involved in promoting mathematical understanding (Bruner, 1975; Vygotsky, 1962; Moschkovich, 2012a:95; Sfard, 2008; Barwell et al., 2016; Presmeg et al., 2016:11-15; Robertson & Graven, 2020; Das, 2020:106-107).

Furthermore, one participant's response confirmed Le Cordeur and Tshuma's (2019:107) opinion that the language of mathematics requires the same didactic strategies that are similar to those utilised in acquiring any other language. Participant 9 asserted the following:

> *"… if I teach say Afrikaans, I would always put a visual with a word and we do a lot of repetition, so for mathematical language we would do the same. We would introduce a concept, we would give the concept a name, and then we would work around that concept and all the children are learning the same mathematical language" (PARTICIPANT 9, 0:05:16).*

Participant 9's opinion is further strengthened by Robertson and Graven's (2019:20) argument that in order to increase inclusion in mathematics classrooms, mathematics teachers must find ways to incorporate second language teaching and learning strategies into their pedagogical repertoires.

4.3.2.1.1 Conclusion and interpretation of category one: Mathematical language [semi-structured individual interviews]

After reflecting on the data analysis of all six transcriptions pertaining to the category "mathematical language", the method of agreement and method of difference reflected the following:

Table 4.4: Conclusion of category one: Mathematical language [semi-structured individual interviews]

CATEGORY ONE: MATHEMATICAL LANGUAGE		
Theme	**PATTERNS**	**PATTERNS**
	Method of agreement	**Method of difference**
Theme 1.1: The language [of mathematics]	• Mathematics is a language of its own with special vocabulary (mathematical terminology). • Language plays an important role and needs to be simplified for mathematical understanding.	• Participant 9 acknowledged that the language of mathematics is the same as any other language and can be acquired using the same didactic strategies as any other additional language.

In summary, the method of agreement points out that all the individual interview participants agreed that mathematics is a language of its own with a special vocabulary (i.e., mathematical terminology). In addition, they have concurred that language does not only play an important role but needs to be simplified for mathematical understanding. On the other hand, the method of difference indicated that only one participant acknowledged that mathematical language can be acquired like any other additional language.

4.3.2.2 Category Two: Holistic and concrete teaching and learning strategies

2. HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES
[THEMES: Holistic and concrete learning/ Planning and teaching/ Visual aids/ Technology/ Maths is fun/ Positive reinforcement/ Parents]

Figure 4.3: Category two – Holistic and concrete teaching and learning strategies

The category of "Holistic and concrete teaching and learning strategies” was created when the themes "Holistic and concrete learning”; “Planning and teaching”; “Visual aids”; “Technology”; “Maths is fun”; “Positive reinforcement”; and "Parents” were clustered together (Focus Group Interviews One and Two), as shown in Table 4.3.

The aim of this study was to explore, describe, and understand how teaching and learning strategies were utilised by Grade One teachers to enhance isiXhosa-speaking learners’ mathematical understanding in English Grade One classrooms. This category is directly related to this study's aim. In this regard, Kusumawati and Nayazik (2018:111) refer to the important role and function of teachers in terms of implementing appropriate teaching and learning strategies to enhance mathematical understanding for ELLs (i.e., isiXhosa-speaking learners).

Using the method of agreement and the method of difference, the researcher analysed the transcripts of the six individual interview participants pertaining to the category, “holistic and concrete teaching and learning strategies”, with its underlying themes.

Theme 2.1 Planning and teaching

In analysing the transcripts of the six individual interviews, the researcher discovered that the participating teachers employed several planning and teaching strategies embedded in a holistic approach. Mahmoudi, Jafari, Nasrabadi, and Liaghatdar (2012:179) describe holistic education as being concerned with the total development of the individual. Naudé and Meier (2019:1-2) emphasise that the teachers’ mathematics instruction needs to be linked to the learner's experience and/or everyday life. Some of the participants shared their responses:

> *"So, if the learner does not grasp the language mathematics is being spoken in or the concept that's being taught, if you link it to the everyday life they will get a better understanding of what is being taught" (PARTICIPANT 1, 7:09).*

> *"I am making it practical, making it something on their level, something in their …; that they would experience in their everyday lives, to help them better understand the concepts" (PARTICIPANT 7, 26:02).*

> *"Um, the language* [of mathematics] *has to relate to their daily, um, experiences, so I will often start with stories as well …" (PARTICIPANT 11, 0:05:16).*

Jourdain and Sharma (2016:51) advise that connecting mathematics to English language learners' (ELLs') everyday experiences and cultures not only demonstrates that they are valued, but it can also help bridge some language gaps.

The participants further acknowledged the importance of learners' different learning styles (i.e., visual, auditory, and kinaesthetic) and asserted that isiXhosa-speaking learners gained a better understanding of mathematical content when teachers planned to accommodate their different learning styles. In this regard, Chou (2021) is of the opinion that this is a strategy that combines a variety of methods and techniques that improve ELLs' mathematical understanding while allowing for relative adaptability to changing classroom situations. Participant 11 stressed the importance of knowing every individual learner to plan and to provide for his/her various learning styles.

> *"Planning makes the biggest difference to how you would reach these kids, because you would have to give a lot of individual thought to these individual kids and how would this child learn?" (PARTICIPANT 11, 0:45:17).*

Participants 1, 5 and 9 highlighted the importance of adapting teaching methods as well as using various teaching strategies, including step-by-step methods for solving mathematical problems.

> *"I need to adjust my teaching method because not every learner can understand when I read, when I speak … So, when I'm maybe teaching a topic or a new*

concept, I would need to show them many ways to get to an answer … So, we will do many ways in teaching that concept. Through visuals, through auditory, through role play, through sensory" (PARTICIPANT 1, 9:02).

"I think it [mathematics] *needs to be more like interactive and uses* [using] *every kind of learning like different learning strategies and how they learn differently… (08:44).* [Example] ... *when it's sharing, I like doing it in the class, you just choose how many kids sometimes two or five, just so they can show the class and they can actually 'feel'* [sensory] *okay, I've got two, they've got two … (22:36). I mean songs and rhymes are great … that's how they know, um, the months of the year and days of the week, otherwise they definitely wouldn't just know it by just saying if they didn't know the song" (PARTICIPANT 5, 53:40).*

"I think I would say the majority of anything that I do I would, um, draw it and the learner draws it, this give me an idea whether they understand it or not. I find drawing, I suppose I'm a visual learner and I think that's what I relate to, so whatever I can't get through to any learner really, is we'll draw it … (58:50). What I also do is; I use their body [kinaesthetic] *as body language, so using it, like making them into a human number line, I will say to them; … come and stand where you think number three belongs; you go and stand where number ten belongs … (0:24:54). I find clapping out and doing movement to their number counting important … I do a lot of counting with music, um... I will play any music and they've got to jump, um, so many times, and then spin around and then sit or ... so we use, um, a lot of rhythm" (PARTICIPANT 9, 0:27:17).*

Another aspect that the participants pointed out was the need to adapt the curriculum and/or their teaching approaches to fit the needs of the isiXhosa learners and to build on what they know (South Africa. DBE, 2011a:5). According to Ayieko (2017:31), adapting the curriculum or teaching approaches for mathematics learning may lead to effective classroom instruction. Participants 1, 9 and 11 share their experiences.

"So, it's very important that we also understand where they are at and build on that knowledge" (PARTICIPANT 1, 12:18).

"Most of our planning is done according to where the kids are at and what they need … more than anything else (58:22). …When I look at the curriculum … often there are things in the curriculum that is even in our planning for the week, and I

will adapt it. … I'm going to move it to the end of the term when I think they might be a little bit more ready for it and I would rather take something else and swap it around. So that's how I would adapt the curriculum really, to suit where my kids are at" (PARTICIPANT 9, 49:49).

"… you have to plan realistically and realise... what ability groups [there] *are before … teaching … a child with a language barrier. … you would have to really think about that child and … what they … know at the moment and what they relate to before you can actually teach them and build up with them. It is all planning, … and executing your plan* [that] *is really important… (0:45:17). Adapting teaching lessons or strategies for these individuals" (PARTICIPANT 11, 1:01:32).*

In analysing the transcriptions of the individual interviews, it comes to the fore that all the participants adapted their planning, curriculum, and teaching approaches by incorporating various teaching and learning styles and strategies (i.e., multi-semiotic systems) to interact holistically with the learner through visual, auditory, kinaesthetic, and sensory experiences. Strategies focusing on role-playing, drawing, and using songs and rhymes also assisted participants in relaying mathematics concepts to isiXhosa learners for understanding.

Additionally, one participant noted that she incorporates mathematics into other subjects.

"... so you bring Maths into language, *you bring Maths into everything, it belongs to everything in the holistic approach. …when we're watching say, for instance, we've got a video clip of a plant and all these arts, we will add maths to it... how many flowers are there? and if each one has got petals, how many petals altogether? So everything is correlated and I don't often teach just maths and just English and just Afrikaans, we mingle it all (0:35:04). Most of the time I don't see maths as maths and English as English and life skills as life skills, um, I interact it all the time" (PARTICIPANT 9, 1:00:14).*

Ariba (2017:25-26) emphasises that for effective learning to occur, the curriculum must be integrated, and learners must participate in active experiences. Thus, different experiences are required for isiXhosa-speaking learners to progress to different levels of understanding. As a result, incorporating mathematics into other subjects may promote learning and comprehension (Schüler-Meyer, Prediger, Kuzu, Wessel & Redder, 2019:324).

In line with the above adaptations, Bosman and Schulze (2018:2) add that mathematics lessons need to be "scaffolded" in order to build on learners' prior knowledge. Thus, when isiXhosa-speaking learners are introduced to new information that cannot be explained by their current constructs, they must connect the information to their own personal experiences to gain a better understanding of mathematical content (Banse, Palacios, Merritt, & Rimm-Kaufman, 2016:101).

Theme 2.2 Visual aids

Banse et al. (2016:102) argue that in mathematics education, visual manipulatives are used, either concrete objects or visual representations, to help learners make connections to what they already know as a means of scaffolding and communicating their own thinking. This viewpoint complements Arzarello et al.'s (2009) notion of the semiotic bundle, which are different semiotic resources (or different signs), such as printed text, pictures, gestures, physical objects, etc., that are produced by teachers (or learners) to make sense of mathematics activities. According to Chikiwa and Schäfer (2019:127), learners who don't have the language skills equal to their mathematical ability will benefit from visual support strategies. The following responses indicate how participants used visual representations, supplemented, in some instances, by the bodies and or dramatisations of the learners.

> *"I literally draw the pictures on the board. … Say they say, they're talking about Sally and Ann or whatever sharing Apples. I literally draw Sally and I'll draw Ann and all the apples. And I'll be like, we're taking this apple. And I'll draw the apple underneath her* [Sally] *and… underneath her* [Ann]. *And now we count them together before sharing. Or how many she has and how many they have altogether. So I use lots of drawings... And I make them* [the learners] *do the drawings as well" (PARTICIPANT 3, 09:14).*

> *"... I have a lot of visual apparatus that helps the learners* [isiXhosa learners] *because they do not need to read or to understand something in English to be able to do those activities. For example, the cookie jars; it's the numbers and the cookies with the chocolate chips on there; that is just visual, and they can understand and know what to do without necessarily being well-versed in English" (PARTICIPANT 7, 47:43).*

> *"... posters … I've actually got… counting in twos to thirty on my wall, and fives to fifty, and threes too. … When we first started counting, they would actually look at the wall* [mathematics word-wall]" *(PARTICIPANT 5, 19:31).*

"They are looking for the resources [visual representations]. *I mean one of my really weak… child*[ren], … *also Xhosa, he was looking on the wall… 'okay I can look* [on the word-wall] *and' … 'think about it', when before he was just writing whatever he wanted. ...that's why visual aids are important, for them to see things around the classroom and use it to help them with the maths" (PARTICIPANT 5, 20:34).*

"… it's important in order to teach a topic that you do have visual aids for learners to make sense (15:41). Those are the main things that I use, is my visual aids and whatever apparatus that I have that links to what I'm doing, what I'm teaching so that learners can physically see things that they can physically touch, pack out and understand. … But I also do incorporate either something where I need to act out like, um, they need to maybe, for example, I need to create a scenario. Like maybe reading a word problem, I would also act out something, but that's about it" (PARTICIPANT 1, 43:19).

"[When] *…I'm introducing addition for the first time, I would do a whole story effort and act it out and we'll talk a lot about 'more' and I'm very greedy because I just want 'more' ... like we'll tell a story about Mrs. Polly, her arms are always just grabbing from both sides so when she stands with her arms open she would be looking like a plus sign, because she's got her arms out wide and she just keeps grabbing everything that's in her way, from one arm to the next, she will put them all into a big plate and that's how we work out the equals at the end. ... So you would do a lot of dramatis[ation] and get them to understand the concept; and so then every time after that, you almost give them a crutch to work on* [scaffolding], *because you give the name Polly Plus, and what does Mrs. Polly do, she's greedy…" (PARTICIPANT 9, 0:05:16).*

"When we are doing … more and less, before we even do plussing, I will still put the plus sign on the board, so they know … we're going more, we're going to, … move it onto the right side of our number line. So those [plus and minus signs] *will, um, be ever-present whenever I am speaking more and less … and I will constantly point to it. When I am counting, I will use my fingers, but I will also point at the number line so they can connect the number line to the number itself, so they can see what the numbers are" (PARTICIPANT 11, 0:22:45).*

"For example, if we do symmetry, I would use my body as an example. If I cut myself in the width, is it symmetrical? Do both sides look the same? Or if I cut myself down in lengthwise, is it then symmetrical? So that is an example of how I would use my body" (PARTICIPANT 7, 09:50).

The participants also shared their experiences of engaging learners to physically manipulate concrete objects and resources during their mathematics lessons. Chikiwa and Schäfer (2019:128) underline the importance of providing learners with the necessary opportunities to manipulate concrete objects and how it aids in their understanding of mathematical concepts and vocabulary. Participant 1 reflects on the importance of using counters.

"… if I had to look at patterns … it's important for learners to actually pack out, to touch these things. And then once they see it, they draw it, or they see a picture of it and then you can move them to the abstract where you speak about these things, and they don't need that extra support in order to understand the concept. So visual aids [i.e., concrete objects] *is* [are] *really important, especially for learners that struggle to grasp* [mathematical] *concepts" (PARTICIPANT 1, 15:41).*

Participants 7 and 11 enhance the manipulation of concrete apparatus by introducing mathematical games and play-money.

"… when you break down the language into something that is visual or concrete, um, they are then able to actually understand what it means…, and connect a visual image or concrete theme to the language (03:31). ... I enjoy using things like that with the rolling of the dice, and they each get a chance to roll their own dice. It makes it more fun for them and it almost feels like a game, and I think they are then more receptive to learning a new concept. I also have, which I think is quite cute, for before and after, it is the body of an owl that has a number in the middle and then you add the wings of the owl, for the number that is before or after that (16:39). … And with that you can also then change, for example, later on we do make two more, one-two legs where they can then also go and add the wings on the owl, which is also a more fun and concrete visual way to teach the new concept of what is 'before and after'" (PARTICIPANT 7, 17:09).

"… I would definitely use concrete objects to start introducing a topic, … measurements and money. I love doing those because the kids get to handle the paper money and they get to handle the different disks for weight measuring and the non-standard measuring units for measuring, so those kinds of things really make maths fun, and I wish we could teach all concepts using a concrete activity with it. Because that would be the best way to reach non-English speakers, that is just going to make maths more sense to them" (PARTICIPANT 11, 0:27:13).

Theme 2.3 Technology

According to Morgan et al. (2014:12) and Rajadell and Garriga-Garzón (2017), educational videos are both a teaching methodology and a useful semiotic tool in the classroom to enrich learners' learning experiences. In analysing the interview framework of Focus Group One and the transcribed individual interviews of Participants 1, 3, and 5, the method of difference indicated a discrepancy. Although the three individual interview participants were part of the focus group interview (Focus Group One), and agreed with the rest of the focus group participants on identifying the theme "Technology" and compiling the descriptive paragraph (see Table 4.1), the analysis of their individual interviews indicated that these participants (Participants 1, 3, and 5 of Focus Group One) did not make use of technology as indicated in the interview framework, as a means for reinforcement, making maths fun, and using technology to relate mathematics to learners (see Table 4.1). The method of agreement confirmed that three individual interview participants are hesitant to engage with technology during their mathematics lessons.

"… unfortunately, um, I haven't had that opportunity to involve technology in my class when teaching something [mathematics]" *(PARTICIPANT 1, 19:23).*

"I have not yet used technology for mathematics" (PARTICIPANT 3, 13:52).

Participant 5 further rationalised her lack of interacting with technology during her mathematics lessons due to the limited time available.

"… I don't do a lot of maths when it comes to technology (25:38). … I could be using technology … so much more if I had the time…" (PARTICIPANT 5, 31:35).

The method of difference further revealed that during the Focus Group Interview Two, technology as a theme was not identified by the participants. However, Participants 7 and 9 (who were also participating in the Focus Group Interview Two) raised technology as a theme during their individual interviews when they explained their understanding and experiences of holistic and concrete teaching and learning strategies. Thus, an emergent theme arose. Williams (2008:248-249) explains that an emergent theme can originate "from the words or documented experiences of research participants". Therefore, the researcher considers the contributions of Participants 7 and 9 regarding "Technology" as new and insightful, shedding light on a possible strategy to enhance mathematical understanding under the category of holistic and concrete teaching and learning strategies.

In analysing the transcription of Participant 7, the method of difference indicated that, despite believing in the advantages of technology, there is a lack of access to such apparatus:

> *"Um, I think um, it would help to have a screen in class in terms of a whiteboard or a screen television screen, because then I can better use visual images, um, or videos to help them learn … to help explain to the learners, or to help get them … help them understand the concepts, um, as it can then be very visual, very auditory. I do keep up with what I have available, but I feel if I had something like that (whiteboard or television screen,) it would be more effective, and it could be done more regularly" (PARTICIPANT 7, 48:18).*

The analysed transcriptions of the individual interview of Participant 9 echoed similar beliefs to those of Participant 7 about what the benefits are of utilising various technologies in a Grade One classroom. The method of difference mirrored that Participant 9 implements what she believes. She explained that she utilised the online YouTube platform to obtain educational videos about mathematical concepts:

> *"Fortunately, there's a lot on the Internet. The one of Jack Hartmann. … He's a real quirky old man and he does a lot of bonds... He does days of the week; he does months of the year; he does counting; he does in fives and twos; he's got an old grandma that counts in twos... Um, and it's all music related and then there's another Scratch Garden, that was the one you're counting in fives, counting in fives that they did..." (PARTICIPANT 9, 44:53).*

Insorio and Macandog (2022:2) contend that digital interventions influence learners' acquisition of mathematical competencies positively. In this regard, Participant 9 further elaborated that she used videos that she and the learners could interact with.

> *"… so there's a lot available, free media. So if you've got the right resources in your class, you can access them. There're also a lot* [of] *visual aids that …you can use, … where you can manipulate the stuff and go* [and] *put it in* [the wrong] *order. They … all shout no, no, no, … you must do it this way" (PARTICIPANT 9, 45:33).*

Theme 2.4 Maths is fun

Arthur et al. (2017:21) declare that mathematics needs to be experienced as fun and in a "game-ish" manner. Hence, it is important to introduce developmentally appropriate and mathematically challenging activities into the classroom. Playing games assists young learners to master mathematical concepts at an early age. As a result, mathematics is learned incidentally and is better understood by learners with language barriers (Jourdain & Sharma, 2016:50; Bakar & Samsudin, 2021:279). Additionally, Bakar and Samsudin (2021) believe that when learners are taught mathematics in a fun way, information and knowledge are retained better. In this regard, the method of agreement shows that all six participants shared the significance of making mathematics enjoyable. Some participants shared the following:

> *"… it's important for us when we are teaching mathematics to make it fun and relatable to learners so that they understand the concepts being taught" (PARTICIPANT 1, 7:09).*

> *"… it's important to make it fun so that they can … grasp it better because children … learn well through play. So if you make a game out of it or something like that, that gets them exited and also, it gets them to actually learn without them know that they're learning" (PARTICIPANT 3, 05:42).*

> *"The visual aids* [are] *mostly … games that they've played* [and] … *manipulate*[d] *themselves. … When they're playing, they're obviously having fun, they're learning incidentally" (PARTICIPANT 9, 40:18).*

> *"So one of the games that I will use* [is for] *… example … playing shop. So there* [are] *little basket*[s] *with the coins in* [and] *with some paper money… then they would play shop with their friend… and again* [it is] *… fun and interactive* [as it] *is just a chance for them to use the vocabulary with their friend. An informal kind of setting where they don't feel like their friend is judging them" (PARTICIPANT 11, 0:53:09).*

Theme 2.5 Positive reinforcement

According to a recent study by Ayuwanti (2021:665), it was found that awarding learners with "positive talk" and/or "real awards" (i.e., stickers) has a significant effect on mathematics learning, on learner motivation, and on learners' mathematical progress. As a result, it is argued that positive reinforcement can help learners improve their mathematical understanding (Khanal, 2015:294-295; Ayuwanti, 2021:665).

The analysis of the interview framework of both the Focus Group Interviews One and Two clearly shows that only one focus group (namely, One) deemed this theme as significant. In the analysis of the transcribed individual interview of Participant 1, it is apparent that acknowledging a learner's efforts and showing the learner that the teacher believes in him or her motivates the learner to improve his or her mathematical abilities:

> *"I think like the small gestures, like a smile to a learner to let them know that you are proud, makes them feel good. Seeing, for example, just putting a star in their book makes them feel good. Once the learner knows he's happy, the learner sees that you as an educator is happy with their progress, they will want to do more because their effort is being acknowledged. They want to do more; they are more interested in their work. So, I think it's really important that we need to implement positive reinforcement all the time" (PARTICIPANT 1, 52:53).*

The analysis of the individual interview of Participant 3 agrees with Participant 1's focus on acknowledgement. However, Participant 3 emphasises a strategy of rewards:

> *"I think it's a good thing to use* [positive reinforcement]. *That they feel good about themselves. If they get something right, then it's like good, okay good. They get excited. And, um, what I usually do is at the end of the day if somebody did really well and I'll tell him what they did well in and then I'll give them a sticker. So it's like okay, Learner A really did his counting well today, he gets a sticker. Or Learner B figured out her word sum, so she gets a sticker. So I think that's something that's really good to… (38:21). So, um, what I do especially with Learner C and Learner D* [both isiXhosa learners] *is, when they do get something right, I let the whole class celebrate them. So we give them a clap or, um, they get, like I said, the stickers. And I will also, in their books actually put the stickers and a smiley. And I'll tell them like good, well done that was great. So I think praising them is one of the… one of the ways, ja" (PARTICIPANT 3, 39:06).*

The method of agreement illustrates a combination of the aforementioned emphasis on acknowledgement and belief, on the one hand, and the above-mentioned reward systems, on the other hand, in the analysis of the individual interview of Participant 5:

> *"Well, all the kids love to be rewarded, they feel like they've done more you know. If you're a child struggling… I mean I told him the other day how proud I am of him and then … I rewarded him for improving so much, and you could see the difference in his work when he is rewarded. And that you tell the whole class how proud you are, and you know he wants that all the time, and all the kids, you know, want that. So I do think it is important to encourage as much as possible... (01:22:16). …little things like, he, even if he gets 'one plus one' right like, it's a big thing for him to actually know what it means now…" (PARTICIPANT 5, 01:22:54).*

Theme 2.6 Parents

In analysing the data from the Focus Group One interview, the participants identified "parents" as a theme. The method of difference indicated that the Focus Group Two participants did not specifically identify such a theme, but the analysis of their individual interviews revealed that the individual participants acknowledged the pivotal role parents and regular communication between teachers and parents play in their children's holistic development. The method of agreement affirmed that the three individual participants of Focus Group One were focused on establishing and maintaining good teacher-parent relationships. They further agreed that a digital platform, such as WhatsApp groups, is a useful tool to interact and communicate between parents and teachers. The following comments by Participants 1, 3, and 5 testify to the importance of healthy teacher-parent relationships and regular communication to assist both the learner and his/her parents with mathematics challenges when the learner struggles with homework:

> *"It's very important to … interact with parents at a very, very early stage. Have meetings with parents, introduce yourself so that you have that … communication with the parents from the very start. … So, if anything does happen in the early stages that we identify* [it and] *we can immediately sort it out (56:00). … And now, due to COVID, we created WhatsApp groups. … we can have direct contact with the parent (32:21). … And I think that is so important. … to have that … open communication with parents (33:41). … What I do, I kind of break it down for my parents. So that is what I do with my parents over my WhatsApp group, … I always tell parents … You* [parents] *also need to sit with your children…* [and]*… go through that flip file, see whatever they are struggling with… (59:12). So for each*

learner, giving them the resources for homework, nobody can say they don't have a homework file, or they didn't have this; they have all of the resources with them" (PARTICIPANT 1, 1:01:11).

"… So they [the parents] *have a group, a parent's group* [on WhatsApp]. *And then they obviously have weekly homework. And I always ask the parents, please make sure you sit with them when they do their homework. … So I think that the contact with the parents via WhatsApp is the main thing. And helping them … also telling them specifically what to focus on, I think that's also … that helps a little bit" (PARTICIPANT 3, 23:30).*

"There's some children that are doing homework every day, that was failing but now they are passing because, um, parents are helping, and it is good to have a relationship because some of them say 'thank you so much'… (01:26:19). …We explain how to do homework and what they can do… that actually encourages them. …I actually write out the homework in the first term and send it to them, and they like that communication, so I have a group [WhatsApp], *I send what I can, how I can help" (PARTICIPANT 5, 01:26:19).*

In accordance with the statements above, Dabell (2021) states that it is critical that teachers keep parents informed and facilitate two-way communication. In this regard, teachers can use parents and/or guardians as resources to help learners learn mathematics.

Furthermore, teachers must keep in mind that parents have very different maths experiences, which will affect their confidence and, potentially, their child's confidence (Dabell, 2021). Hence, it is very important that teachers guide and assist parents with their mathematics homework to make connections that are more meaningful and inclusive, which benefits mathematics learning (Jourdain & Sharma, 2016:53; Dabell, 2021).

The method of agreement further demonstrated that the individual interview participants of Focus Group Two were also in agreement that parental involvement and communication between the teacher and parents to render assistance regarding the understanding of mathematical concepts are critical in the holistic development of learners. Participants 7, 9 and 11 built on the above-mentioned discussions on how they guided the parents via WhatsApp groups to help with their child's mathematics homework:

"… to make it as simple as possible … so that when they do it at home, the parents are able to understand what we are trying… what we want them to do. We also made apparatus like flash cards, for the parents on like a word document and they could then, if they had the means, either print it out and make it into flash cards to use at home, or then if they're not able to do that, then write it down and make flash cards by writing and cutting it. So, we really tried to make it very visual and very simple. Um, being very instructive with what we want them to do at home, so that it can actually be done successfully" (PARTICIPANT 7, 44:40).

"We also [assist] *our parents … with the homework, …the homework file ... (1:05:23). … And we give the parents, um, instruction on how to do what we've asked them to do in the homework, so they get a lot of practice that they don't necessarily get in class because a lot of them don't finish their work in class, but when they're working one-on-one with the parent at home, um, they – the parent – can see where they're struggling, and … they've got our guidelines as on how to help them" (PARTICIPANT 9, 1:08:00).*

"Lesson recordings … is one of our biggest wins … since COVID has happened because… [if]… *you miss this lesson… you just go* [and] *watch the recording… (0:58:35). … the recordings… last forever so the parents can go back to … a recording from the beginning of the year if they need to" (PARTICIPANT 11, 1:01:18).*

4.3.2.2.1 Conclusion of category two: Holistic and concrete teaching and learning strategies [semi-structured individual interviews]

Reflecting on the category of "Holistic and concrete teaching and learning strategies", the method of agreement and method of difference elicited the following guidelines from the six participants in the semi-structured individual interviews:

Table 4.5: Conclusion of category two: Holistic and concrete teaching and learning strategies [semi-structured individual interviews]

CATEGORY TWO: HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES		
Theme	PATTERNS	PATTERNS
	Method of agreement	Method of difference
Theme 2.1: Planning and teaching	• Planning and teaching need to incorporate isiXhosa-speaking learners' everyday experiences and cultures to enhance mathematical understanding. • Plan and teach according to learners' different learning styles. • Adapt the curriculum or teaching approaches by building on what learners already know (prior knowledge). • Use scaffolding strategies (multiple semiotics) to enhance isiXhosa-speaking learners' mathematical understanding.	• One participant (Participant 9) asserted the importance of integrating mathematics with other subjects.
Theme 2.2: Visual aids	• Visual aids (visual representations and concrete objects) are the most suitable strategy Grade One teachers utilise to help isiXhosa speaking learners with the understanding of mathematics.	
Theme 2.3: Technology	• Hesitancy to implement technology during mathematic lessons (Three participants).	• One participant utilised technology (i.e., educational videos) successfully in her mathematics lessons. • One participant did not express any comments, beliefs, or perceptions about the use of technology in mathematics lessons. • One participant experienced a lack of access to technology.
Theme 2.4: Maths is fun	• Fun mathematics activities presented in a "game-ish" way leads to incidental learning and a better understanding of mathematical concepts.	

Theme 2.5: Positive reinforcement	• Three participants (Participants 1, 3 and 5) elaborated on the importance of positive reinforcements for encouraging mathematical learning, motivation, and achievement.	• Three participants did not express any views on this theme.
Theme 2.6: Parents	• Teacher-parent relationships and parental involvement in mathematics homework is important. • WhatsApp groups are a more convenient and effective platform for direct communication with parents. • Six participants regarded providing guidelines to parents in assisting their children with mathematics homework important.	

Concerning the theme, "Planning and teaching", the method of agreement indicated that participants employed a multiple semiotic approach by connecting their planning and teaching of mathematics to isiXhosa-speaking learners' everyday experiences and cultures, and they all incorporated learners' different learning styles. The participants also adapted the curriculum or their teaching approaches by building on what learners already know (prior knowledge) and using scaffolding strategies to enhance isiXhosa-speaking learners' mathematical understanding. However, it is important to note that the method of difference revealed that only one participant (Participant 9) regarded the integration of mathematics with other subjects as important.

All the participants shared the view that "visual aids" are one of the most effective strategies (or semiotic resources) that can clarify and make mathematical concepts simpler for understanding by isiXhosa-speaking learners in an English Grade One classroom. The participants elaborated on various visual aids to be used, such as drawings, posters, whole-story efforts, number lines, and counters. The visual aids overlapped with the discussion of the first theme, "Planning and teaching", whereby scaffolding strategies also included semiotic tools and techniques relating to the holistic development of the young learner. The absence of different views regarding what visual aids entail and how to implement them is justified by Participant 1 mentioning that visual aids are the main apparatus that assists the isiXhosa-speaking learner with the understanding of mathematics.

> "*… the main things that I use is my visual aids … so that [isiXhosa] learners can physically see … things … touch, pack out and understand. … I don't really use anything else besides that [visual aids] …" (PARTICIPANT 1, 43:19).*

The third theme, "Technology", exposed a discrepancy whereby the transcripts of Focus Group One highlighted the importance of using technology as a semiotic tool to enhance mathematical understandings and experiences in Grade One classrooms, whereas the transcripts of the individual interview participants, in contrast, shared feelings of being anxious and hesitant to apply technology. The method of difference rendered an additional perspective to this theme by indicating that one other participant, in line with the nonidentification of this theme by Focus Group Two, did not even consider infusing mathematic lessons with technologies. In contrast with the above reluctance to interact with technologies, two participants, however, had different experiences. Participant 7 believes in the benefits of technology but has no access to such equipment in her classroom, while Participant 9 embraces any opportunity to enhance her mathematics lessons with technology.

The analysis of "Maths is fun" as a theme did not reveal any opposing perceptions or experiences. Indeed, all six individual interview participants shared the belief that Grade One learners need to experience mathematical activities in an interactive, joyful, and playful manner, which leads to incidental learning and a better understanding of mathematical concepts.

The fifth theme, "Positive reinforcement", is a significant theme. On the one hand, only three individual interview participants of Focus Group One shed light on their understanding and perspectives of this theme. The analysis of the individual interviews of Participants 1, 3, and 5 makes it clear that all three individual interview participants placed a high value on acknowledging and believing in their Grade One learners' abilities to master mathematical concepts. These young learners are motivated by encouragement and learn constructively when reward strategies are introduced.

The last theme under Category Two: Holistic and concrete teaching and learning strategies, namely "Parents", has as its foci: parental involvement, teacher-parent relationships, communication, and guidance and support with homework. However, the COVID-19 pandemic limitations forced teachers to re-examine their own strategies in communicating with parents. The method of agreement highlighted a crucial strategy that strengthened and enriched teacher-parent relationships: parental involvement in supporting their children's mathematical abilities, guided by the teacher; as well as regular two-way communication. During the COVID-19 pandemic, limitations were enforced on the face-to-face interactions between the teacher and learners, as well as between their parents and the teacher. As a result, the teacher could not rely on her previous methods of communication with parents, such as individual meetings or the use of a message book sent home, during this time. The method of agreement emphasised that all six individual interview participants utilised a digital platform, namely, WhatsApp, to communicate and support Grade One learners and their parents. Although WhatsApp is not a new digital platform, the new focus of teachers is to communicate in this manner, leading to the establishment of an effective support network.

The next category will elaborate how Grade One teachers employed “Intervention and consolidation strategies” to support isiXhosa HL learners with mathematical understanding.

4.3.2.3 Category Three: Intervention and consolidation strategies

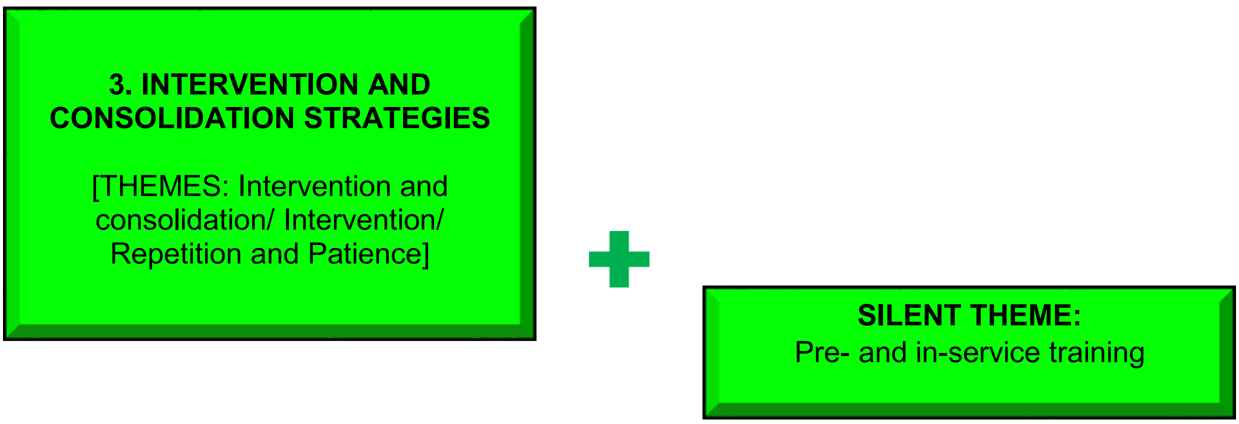

Figure 4.4: Category three – Intervention and consolidation strategies

The category "Intervention and consolidation strategies" was formed when the themes "Intervention and consolidation", "Intervention", and "Repetition" and "Patience" were clustered together. However, during the analysis of this category, the researcher identified a silent theme, "pre- and in-service training", which was not mentioned during the focus group interviews but came to the forefront when the researcher analysed the transcriptions of the individual interviews. Neuman (2014:435) views silent themes as being undesirable, but the researcher deems them as a significant indicator of the areas in which teachers need additional training and the skills they lack.

In the following data analysis, a more in-depth discussion of the data pertaining to the themes of Category Three – Intervention and Consolidation Strategies – takes place.

Theme 3.1 Intervention

Before the researcher engages with the data analysis of this theme, a brief literature review is conducted to explain the context in which the theme, “Intervention”, is analysed. Hazell, Spencer-Smith, and Roberts (2019:50) emphasise the important role that intervention plays in enabling learners to master mathematics learning outcomes. The Education White Paper 6 (South Africa. DoE, 2001:21) states that the framework for developing an inclusive education and training system must prioritise meeting the diverse needs of all learners who face educational barriers. The School Improvement and Support Policy (SIAS) defines intervention support as "all activities that improve a school's capacity to respond to diversity" (Magoge, 2018:1). Magoge (2018:1) further explains that the term "diversity" refers to the numerous needs of learners, as well as the extensiveness of the efforts made by the school to meet these diverse needs. One participant described her experiences of intervention as follows:

> *“Okay, um, in our school we … are forced basically to do intervention, um, because we have to keep a record of what we did to help any – any learner who is struggling; there has to be a paper trail” (PARTICIPANT 9, 1:04:23).*

In line with the above quotation, the transcripts revealed that all the participants in this study mainly implemented intervention at the classroom level, namely: 1) peer support, and 2) didactic classes (i.e., extra classes in smaller groups). With regard to peer support, or the so-called "buddy system", the researcher identified that a "buddy system" strategy was utilised by five participants. Five participants shared their experiences as follows:

> *“I would pair them up with a buddy … because they would need that consolidation (0:57:50).* [Example] *…for rote counting and discussion I would have them buddy up or pair up and they can, um, also do a word problem together and say to their friend, ‘oh, okay, teacher told us we need to share these eight things, how are we*

going to do this?' and they can, you know, talk about it together, and discuss how they would do it first, obviously with the concrete objects" (PARTICIPANT 11, 0:39:15).

"So, what we do is we do the buddy system, where I will pair... and I only really do it when we play games, because I let a weaker learner play a game with a stronger learner because they teach them the skills incidentally" [laughs]... (PARTICIPANT 9, 1:04:23).

"A buddy-system is also, I feel, a nice way for learners who are a bit weaker as they might feel more comfortable, or more inclined to ask their buddy, or the person next to them, as asking maybe out loud to the teacher. … I think, um, it is … needed for consolidation for the Xhosa speaking learners if they struggle with certain concepts to then help them in that sense" (PARTICIPANT 7, 29:16).

"I use another student to explain things sometimes because it is difficult for him [isiXhosa learner] *to understand me … So the buddy system is great because they also learn from looking at the others because he never used to know how to write like, let's say, at the top; he'd always just write in the middle. But now I have a boy that actually sits and tells him like, if he's doing something you know, wrong, or if he can't do this …" (PARTICIPANT 5, 10:53).*

"And then, I've also tried the buddy system. The little boy with the language barrier [isiXhosa speaking]. *He, um ... When I'm helping another child … there's a boy in that class that finishes work quite quickly, he will sit with him. I asked him to sit with him and explain to him and break things down" (PARTICIPANT 3, 17:03).*

Haynes (2020) recognises the importance of peer support, arguing that allowing learners to talk to one another makes them feel more at ease trying out new vocabulary without fear of embarrassing themselves in front of the entire class. Furthermore, non-English speakers will gain a better understanding of material if they explain it to another learner in either English or their HL. In contrast, with the other five participants, where the peer support was rendered in the LOLT of the school, namely English, the method of difference (Neuman, 2014:493) portrayed that only one participant (Participant 1) utilised a strategy of peer support by having another isiXhosa-speaking Grade One learner assist other isiXhosa-speaking Grade One learners in their own HL:

"So, they'll have the buddy system where you have a strong learner and maybe a learner in the group that's struggling. So, you'd pair them up or you pair them up maybe if a child is full on, speaks Xhosa and is struggling to understand English. So then you'll put the learner that speaks both languages in the group that can assist the child (24:43). … So, they assist each other, when a concept is being taught I obviously, as an educator, I would do many different methods to get my message across to him" (PARTICIPANT 1, 35:20).

In contrast to the intervention that takes place during the mathematical lessons, the method of agreement revealed that specific interventions (i.e., didactic classes) took place after school hours. According to Ji Yeong (2011:22) and Haynes (2020), interventions in smaller group settings are used to enable ELLs to participate without the added stress of public speaking and to develop both their English and mathematical understanding through interaction with their teacher and peers. Two participants shared their experiences below in this regard.

"It makes the biggest difference. The reason why I love teaching didactics classes is because I can take the time to use those concrete things and if within that hour we are doing one concept … not just for five minutes, but for the whole lesson, and making it a lot less about book work and more about understanding the concept. You can actually see them having fun and enjoying it and they want to carry on doing it" (PARTICIPANT 11, 1:11:45).

"... we do extra classes in the afternoon after school for forty-five minutes, which I think is really important as it is then a bit smaller groups and it gives you a chance to give more one-on-one attention to the learners that are struggling, to then help them consolidate the work that has been done during the day" (PARTICIPANT 7, 29:16).

The White Paper 6 on Inclusive Education (South Africa. DoE, 2001:21) conceptualised that education support services may take place on two levels, namely, at the school level and at the district level. At the school level, SBSTs are formed primarily from volunteer staff, while multidisciplinary district-based support teams (DBSTs) are formed by provincial departments of education (i.e., psychologists, therapists, remedial/learning support educators, and special needs specialists) (Hay, 2018:4-5). Three participants elaborated on the inclusion of other valuable professionals into the SBST, such as 1) a learning support teacher, 2) a remedial teacher, and 3) an intern (i.e., teaching assistant).

> *"… if it's a case where* [the learner] *… need extra help. ...we have this thing called SBST where we would discuss the learner and then we would figure out as a group how can we help this learner" (PARTICIPANT 1, 56:51).*

> *"… the first thing I would do is obviously after base line if I had found the child that seems to not know more than ten words of English, I would immediately send them to our SBST, our school-based support team and they* [learning support teacher] *would get put on the list for a language support system" (PARTICIPANT 11, 0:57:50).*

> *"Where else they get their one-on-one is we have a system in our school where the remedial teacher is available to each one of the Grade One classes four periods a week. So we can use her any way we want to use. So say, for instance, there's a child who's really struggling with distinguishing between a plus and a minus sign, then you will ask that when she arrives she will take that child out of the classroom and go and sit in the library or in her little remedial room or anywhere else, where she can work just one-on-one with the child remedially" (PARTICIPANT 9, 1:05:23).*

> *"Each grade has got an intern, and we have also about four periods a week with her. So I will say, for instance, there's a new concept; I will let her go and sit with each child in a particular group and see what their understanding is, and she would report back to me so I know whether I must re-teach or whether I can go on" (PARTICIPANT 9, 1:05:23).*

In support of the statements above, van Niekerk and Pienaar (2018:9-11) claim that learning support professionals are important in inclusive mathematics classrooms because they have special knowledge that is used to help learners with special needs.

Theme 3.2 Repetition

"Repetition" for consolidation is necessary to ensure that ELLs understand mathematics content while also developing their overall English language abilities (Freeman, 2012:53). The responses of the participants to questions about repetition were analysed, and it was found that all six participants believed that repetition is critical for consolidation in mathematics education, especially for isiXhosa-speaking learners. Participant 1's quotation represents the shared beliefs of the other participants:

"... lots of repetition because if it's taught in a language that learners are not understanding very well, we need to use different methods [to consolidate] *in order to get the concept across to other learners" (PARTICIPANT 1, 47:06).*

All six participants regarded homework as a strategy to consolidate maths concepts learners have learned during the mathematic lessons:

"Making sure that the learners get enough consolidation with all the concepts… with the resources what they have at home to do the homework and to also consolidate certain concepts at home" (PARTICIPANT 7, 42:06).

Graven (2016:37) highlights the importance of regular homework for the consolidation of maths concepts, whereby the latter is important when mathematical difficulties are experienced by the learner.

Theme 3.3 Patience

The method of agreement showed that some participants believed that teachers do not only need to be patient, but they also need to understand that the learner is struggling with mathematical concepts:

"Learners not understanding English is extremely challenging, which is my honest opinion. It's very difficult and it's become very challenging to teach something. If it's time to teach them a concept, it's very difficult for them to actually grasp the concept if they don't have the language. … So yes, patience is your best then, you would need to just pull through, you need to do lots of repetition hey, to get that concept across so that eventually the learner will grasp it. With trial and error, each day is a different day. If something doesn't work now, we'll have to change it up (47:06). I think that's why they say Grade One teachers are the most patient of all because your whole outlook, your whole being just screams repeat, so you've got to repeat it in every possible way so that everybody can understand it" (PARTICIPANT 9, 1:15:12).

"Well … you need to have patience as a teacher, … there's a lot of … times I want to lose it and you just got to … breath and… to understand what they're feeling …" (PARTICIPANT 5, 01:07:06).

The literature review on the third theme, "patience," points out that persistence can positively influence mathematical achievement (Ertac & Alan, 2018:2). In addition, Ertac and Alan (2018:2) explain that patience involves the attitude of the teacher when she needs to persevere in repeating the same mathematical concepts over and over without responding in frustration and/or giving up on the learners.

Silent theme 3.4 Pre- and in-service training

To gather more detailed data, the researcher took a cue from one participant's answer and debated further by asking the participant if she used the isiXhosa learners' HL to help them better understand mathematics. The participant responded as follows:

> *"No, we do not use their home language, um, as we stick to our LOLT… I only have limited knowledge of Xhosa. We did it a bit at university, but I would not say it is enough to have a conversation with somebody, um, but I think it will help the learners…" (PARTICIPANT 7, 11:31).*

As a result of the above statement, the researcher identified a silent theme, "Pre- and in-service training". Before this silent theme is analysed further, the context in which teachers teach needs to be acknowledged. On the one hand, the LiEP (South Africa. DoE, 1997:1) encourages teachers to recognise their learners' HLs, whilst on the other hand, mathematics is a language with its own register (Le Cordeur & Tshuma, 2019:107). As a result, teachers need to employ second language learning strategies, such as code-switching, to enhance learners' mathematical understanding (Mahofa, 2014:30). Chikiwa and Schäfer (2019:134) emphasise the importance of using isiXhosa words from learners' everyday lives through code switching to aid their understanding of mathematical content. However, Jourdain and Sharma (2016:47) argue that it is not that simple as code switching occurs between both languages and registers. Consequently, ELLs employ a variety of registers in both English and their HL (i.e., isiXhosa). Furthermore, Machaba (2018:46) is of the opinion that the English LOLT cannot be code-switched due to the absence of certain terminology in African languages. As the researcher embarked on the analysis regarding the silent theme, *pre- and in-service training*, the method of difference revealed that only one participant referred to the strategy "code-switching", but that she never employed it as she had training on supporting learners with language barriers in general, which did not focus on learning mathematics.

> *"I have never actually code-switched in a maths lesson before (25:44). … So we learned about language barriers, um… it was mostly on language* [in

general]. *It was just barriers to learning as like as a whole. [35:40] …Um, they didn't focus on barriers to learning mathematics* [specifically]*...” (PARTICIPANT 3, 34:45).*

Corresponding with the above quotation, it is important to note that in 2018, the DBE introduced the Mathematics Teaching and Learning Framework for South Africa as a guideline for the South African education sector on how to teach mathematics for understanding (South Africa. DBE, 2018:3). This framework model, which came into effect in 2019 and will be ongoing till 2030, is based on four of the five strands of Kilpatrick’s model of mathematics proficiency (South Africa. DBE, 2018:11-13). This framework asserts that both pre- and in-service teacher training are necessary for its success. The objective is to establish intensive and systematic programmes designed to increase teachers' confidence in their ability to teach mathematics in a way that learners can understand (South Africa. DBE, 2018:10). Furthermore, this framework also acknowledges the multilingual context in which South African teachers are teaching and recommends that teachers need to use bilingual materials (i.e., isiXhosa and English), especially in Grades R–Four, as well as practice code-switching and translanguaging (South Africa. DBE, 2018:10, 79). However, in contrast, Alex et al. (2020:12) claim that little attention has been paid to the extent to which South Africa's universities' ITE programmes equip teachers with the necessary training and discourse needed to teach mathematics in African languages. Moreover, the participants agree with this dilemma and shed light on their experiences of pre-service training.

> *“I studied through … so … there wasn’t much support that … has given in order for us to do these workshops* [to support isiXhosa HL learners with mathematics in English LOLT classrooms] *(50:42). I would like to be trained in how to teach the different methods on getting the points across to the learners, what of resources do I need to implement within my class in order to get just the mathematical concepts across to learners. That for me is very interesting. If there’s a topic, how do I teach the topic to the best of my ability” (PARTICIPANT 1, 51:31)?*

> *“… we did a course or two on Xhosa* [at university] *but* [it] *didn’t really teach me … how to … interact and teach them mathematics in Xhosa… I think actual experience being in the classroom taught me that” (PARTICIPANT 5, 01:16:29).*

"In our mathematic module in university, we didn't do anything that would, um, teach us, or equip us with helping learners with regard to mathematics who speak a different home language" (PARTICIPANT 7, 50:52).

"Okay, when I studied forty years ago there was no such thing … we didn't get any training at all, um, and we've not yet got any training, okay, even now... (1:35:44). …There's a huge need, I mean, as I say, we try our best and, and in the grade we have one teacher who did do Xhosa at college [everyday isiXhosa language], *um, so we, we sort of go to her quite often and say, 'how do you say this word, or you know, whatever?' Um, and I think when we start Xhosa, a lot of it is just language, but we do start a lot with counting and, um, the number names and the, the colour names and that kind of stuff, which falls under maths. But we don't even know how to say the words, so we do need training, definitely" (PARTICIPANT 9, 1:36:27).*

Van Niekerk and Pienaar (2018:11) are of the opinion that in-service training belongs to the domain of the DBST. They further argued that the DBST, in collaboration with other community specialists, needs to train and equip teachers with pedagogical knowledge and skills for them to meet the diverse needs of all learners (Van Niekerk & Pienaar, 2018:11). Additionally, the DBE's Mathematics Teaching and Learning Framework initiative advocated supporting in-service teacher development by appointing highly trained individuals from the South African Mathematics Foundation (SAMF), comprised of the professional mathematics organisations The Association for Mathematics Education of South Africa (AMESA) (Mathematics Educationists) and the South African Mathematical Society (SAMS) (Mathematicians). The Method of Agreement, however, revealed that participants had not received sufficient in-service training on maths assistance for isiXhosa-speaking learners:

"Not yet [have I received training for implementing teaching and learning strategies to enhance Xhosa home language learners understanding of mathematics]. *No. I hope they do because it's very – it's needed. But not yet" (PARTICIPANT 3, 36:20).*

"[During my years of in-service], *no one's ever told me how to teach them* [isiXhosa speaking learners]" *(PARTICIPANT 5, 01:17:37).*

In support of the statements above, Alex and Roberts (2019:71) argue that much remains to be done in research and the improvement of mathematics learning in ITE programmes for primary school teachers. With regard to in-service training, Graven (2020:86) further stipulates that the important role of language in education is overlooked in curriculum and teacher-training courses, which leads to poor language awareness and results in inadequate teaching strategies that lead to language difficulties in all curriculum areas.

4.3.2.3.1 Conclusion of category three: Intervention and consolidation strategies [semi-structured individual interviews]

When considering the category "Intervention and consolidation strategies", the following was foregrounded:

Table 4.6: Conclusion of category three: Intervention and consolidation strategies [semi-structured individual interviews]

CATEGORY THREE: INTERVENTION AND CONSOLIDATION STRATEGIES		
Theme	PATTERNS Method of agreement	PATTERNS Method of difference
Theme 3.1: Intervention	• All six participants employed classroom level support in the form of "buddy systems" and/or didactics classes (intervention in smaller groups).	• Participant 1 utilised the HL strategy (i.e., isiXhosa) by using other isiXhosa-speaking learners to explain difficult concepts.
	• Three participants (Participants 3, 5 and 9) utilised additional learning support professionals in the form of a learning support teacher, a remedial teacher, and an intern to assist with mathematical support.	
Theme 3.2: Repetition	• All participants asserted that repetition and homework are strategies that help learners with the consolidation of mathematical concepts and the understanding thereof.	
Theme 3.3: Patience	• Three participants (3, 5 and 9) felt that patience is an important factor when teaching mathematics to ELLs.	

Silent Theme 3.4: Pre- and in-service training	• All the participants acknowledged that they have not been professionally trained in how to support isiXhosa-speaking learners with mathematics education in an English LOLT classroom.	

The first theme, "Intervention", asserted that all six participants employed classroom-level support for mathematics in the form of "buddy systems" and/or didactics classes. However, the method of difference exposed additional perceptions and experiences regarding the theme, "Intervention". In this regard, four participants, in addition to the buddy-system and/or didactic classes, also utilised other intervention strategies such as the isiXhosa learner's HL to explain difficult concepts (Participant 1) and employing other additional learning support professionals (i.e., a learning support teacher, a remedial teacher, and an intern) (Participants 3, 5 and 9).

In analysing the second theme, "Repetition", all six participants experienced and perceived repetition as a strategy that helps isiXhosa learners consolidate and comprehend mathematical concepts.

The third theme, "Patience", is an important theme as it specifically applies to the teacher's attitude in supporting Grade One isiXhosa learners during their mathematics lessons. The method of agreement portrayed the belief of three individual interview participants that patience by the teacher needs to be exercised if a specific mathematical concept is to be understood and internalised by learners. The participants elaborated further on the concept of "patience", as they pointed out that teachers need to be empathetic to learners and what they experience when they struggle to master mathematical concepts in a language that is different to their HL.

The silent theme, which came about from the analysis of the transcripts of the six individual interviews, namely "Pre- and In-service training", gives a picture of dire need. The method of agreement confirmed that none of the six participants had been specifically trained in how to support isiXhosa-speaking learners with mathematics education in an English LOLT classroom, whether during pre- or in-service training.

The next discussion of the data analysis, Category four: “Challenges”, will shed light on the various challenges Grade One teachers experience when teaching mathematics to isiXhosa HL learners.

4.3.2.4 Category Four: Challenges [Focus Group One & Two]

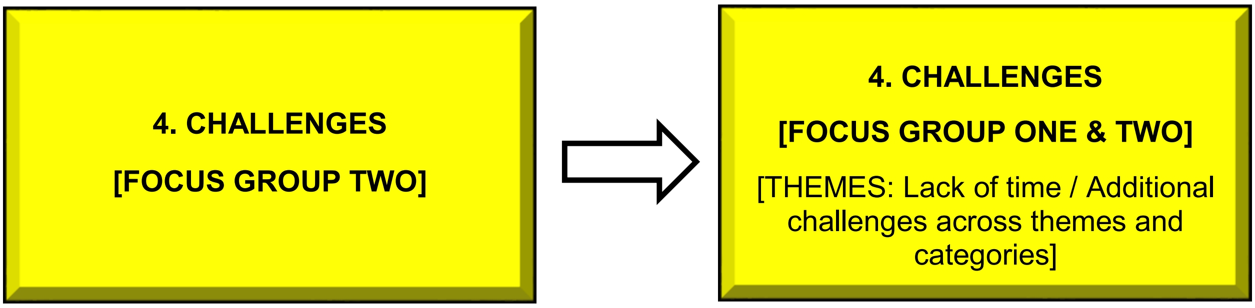

Figure 4.5: Category four – Challenges [Focus Group One & Two]

Although the participants of Focus Group Two identified the theme "Challenges", the method of difference revealed that during Focus Group One’s interview, no participant identified the theme "Challenges". But during the analysis of their individual transcripts, however, Focus Group One’s participants made reference to encountering various challenges. Consequently, the researcher grouped this theme under Category Four: “Challenges”, as both the inputs of the individual interview participants in Focus Group Two and Focus Group One were insightful.

When the researcher examined the cards and descriptive paragraph of the theme “Challenges” in the interview framework of Focus Group Two (refer to Table 4.2), she discovered that the cards (individual inputs) relating to time (e.g., time is always a problem (x3); not always enough lessons on the mat, or lessons starting with the concrete first) can be grouped under the theme "Lack of time".

Theme 4.1 Lack of time

The revised curriculum of the DBE (2011a:37) provides guidelines for the time allocation of the mathematics content areas for Grade One. To be more specific, 24 minutes per day are allocated to Number Operations and Relationships; 16 minutes for Patterns, Functions and Algebra; 16 minutes for Space and Shape (Geometry); 16 minutes for Measurement; and 12 minutes for Data Handling. During each mathematics lesson, teachers should also provide support to learners experiencing barriers to learning mathematics (South Africa.

DBE, 2011a:12). In this regard, one of the key strategies when teaching ELLs is frequent repetition and consolidation of all mathematical concepts to enhance their mathematical understanding (Dicker, 2015:67). In contrast to this statement, the DBE (2011a:36) recommends that teachers allow a week at the start of each term and a week at the end of each term for concept consolidation. The method of agreement indicated that all three individual participants of Focus Group Two shared similar views about the limited time available:

> *"I would definitely say time is a challenge, um, especially now with COVID that we are working on an alternative day basis; um, there's less contact time with the learners, as it would have been, um, if we were full days, so um, I feel that that is a challenge to make sure that the group that comes twice this week, um, does not miss out with, um, regard to the group that comes three times that week. So, balancing, or working it out in the planning and making sure that the learners get enough teaching time and enough consolidation time with all the concepts. … And also* [in general] *the time that CAPS gives and the amount of work that we have to teach in that time, um, is a challenge. I feel that there is not always enough time for consolidation, because you have to move on to the next concept or if it is the next number in the number range. So, um, that is also a difficult balancing act" (PARTICIPANT 7, 42:06).*

> *"My consolidation is one of our challenges and that's why I do the games, is because even when, um, they're not getting enough practice because they don't finish their work, they are still getting a chance to play every day and so they are ... I can see through the consolidation there, whether they understand the concepts or not, so they get the practice there more than anything else. We also give a lot of games for them to take home to practice ... to play at home with an adult, so basically, we've got to find ways on how to consolidate because there isn't time. There are too many concepts in a week for the number of days there are in a week, um, there's just too much for them to do …" (PARTICIPANT 9, 1:08:00).*

> *"One of our main problems is time for repetition, and we don't always get the necessary time to repeat these concepts so they can really, uh, take it in and take it home and make it a part of their learning. … that would be … what I found challenging, just for the child to really, um, have enough time to grasp those* [concepts]. *The language and the concept goes hand in hand; if they*

> *don’t get the language, they not going to get the concept, and if they don’t hear them often enough, then they may not be able to use it and remember it” (PARTICIPANT 11, 0:09:12).*

In support of the statements above, Jourdain and Sharma (2016:45) argue that ELLs (in this case, isiXhosa-speaking learners) may require more processing time than English HL speakers to understand mathematics in an English-medium classroom.

The data analysis by means of the method of agreement confirmed that the three individual participants from Focus Group Two experienced the time allocation of mathematics in Grade One as problematic. On the one hand, a lack of time limits the time available to introduce, explain, clarify, and give opportunities to experience mathematical concepts concretely and hands-on by Grade One learners. On the other hand, the lack of time further complicates matters since the participants need to convey mathematical concepts in a language (LOLT) that some isiXhosa learners are not proficient in, and which is thus very time-consuming.

Theme 4.2 Challenges across themes and categories

As mentioned earlier, the method of difference revealed that during Focus Group One’s interview, no participant identified the theme "Challenges" in itself. However, during the transcripts of the individual interviews of Focus Group One, references were made to various challenges some participants encounter on a daily basis when they teach mathematics to Grade One learners who are not fluent in the LOLT (English). Furthermore, it was also found in the data analysis of the individual interviews of Focus Group Two (Participants 7, 9 and 11) that they pointed out additional challenges that also overlapped with other themes and categories (see Table 4.7 below). Hence, in analysing the individual interview transcripts of both focus groups, the method of agreement pointed out that participants experienced challenges regarding seven factors across various categories and *themes, namely: lack of time, CAPS, inconsistent ATPs, teacher-learner ratio, the impact of the COVID-19 pandemic, Grade R as a foundation*, and *insufficient resources*. Table 4.7 illustrates the additional challenges experienced by both focus groups across themes and categories.

Table 4.7: Additional challenges across themes and categories

ADDITIONAL CHALLENGES EXPERIENCED BY BOTH FOCUS GROUPS ACROSS THEMES AND CATEGORIES	THEMES WHERE THE CHALLENGES OVERLAPPED	CATEGORIES WHERE THE CHALLENGES OVERLAPPED
Lack of time	**Repetition**	**Category 3: Intervention and consolidation strategies**
CAPS	**Planning and teaching**	**Category 2: Holistic and concrete teaching and learning strategies**
Continuous changing ATPs	**Planning and teaching**	**Category 2: Holistic and concrete teaching and learning strategies**
Teacher-learner ratio.	**Intervention**	**Category 3: Intervention and consolidation strategies**
Influence of the COVID-19 pandemic	**Intervention**	**Category 3: Intervention and consolidation strategies**
Grade R as a foundation	**Planning and teaching**	**Category 2: Holistic and concrete teaching and learning strategies**
Insufficient resources	**Pre- and In-service training**	**Category 3: Intervention and consolidation strategies**

In reflecting on the table above, the method of agreement identified that the three individual participants from Focus Group One (Participants 1, 3 and 5) also experienced similar challenges to Focus Group Two regarding the theme "lack of time". The participants believed that the time allocated for mathematics in Grade One is not enough. In this regard, they perceive that some isiXhosa-speaking learners take longer to grasp mathematical concepts and that there is not enough time to consolidate these concepts.

> *"…not knowing English … He* [isiXhosa-speaking learner] *doesn't understand, but the one's that do kind of have some understanding, they are improving; it's just some of them* [isiXhosa-speaking learners] *take a lot longer … than others (23:33). … It's all about time …" (PARTICIPANT 5, 24:10).*

Subsequently, the method of agreement further confirmed that three individual participants experienced the work allocation as stipulated by the CAPS for Mathematics Grades R–Three as problematic. Participant 9 summed it up as follows:

> *"I would think the biggest challenge would be that dreaded CAPS document … What they expect of the Grade One child is way too much, um, there are too many different concepts that you've got to do in one week…* [It] *is definitely* [a] *… major challenge … to try and fit that CAPS document into a year for grade one when they should be playing a lot more... So if they would half the CAPS document, I think you would get a far better result at the end of the day" (PARTICIPANT 9, 1:19:51).*

In support of the preceding argument, Goetze (2016) contends that forcing an excessive amount of content into a curriculum leaves teachers and learners with inadequate time to develop a firm basis for the concepts taught. In this regard, a content-heavy curriculum subject (for example, mathematics) may cause learners to achieve only a superficial understanding of the learning content, preventing the development of a solid foundation of mathematical understanding.

Furthermore, the method of agreement asserted that three participants elaborated on their frustration with the continuously changing ATPs, especially due to the COVID-19 pandemic. It should be noted that it is difficult for teachers to adapt to curriculum changes if they are rushed and they are not provided with the proper training and resources (Govender, 2018:5). The DBE (2021) itself confirmed that COVID-19 has caused unprecedented disruptions in education systems across the globe. In this regard, it was reported that since learners have lost more than half (57%) of the year's school days, curriculum modifications were implemented (van der Berg, Zuze & Bridgman, 2020:3). These included the reduction of core content and skills to emphasise the fundamentals for each subject and grade (Shepherd & Mohohlwane, 2021:23). Despite the claim made by Gustafsson and Nuga Deliwe (2020) that the South African educational system is incapable of catching up to pre-pandemic trends, the DBE adopted a 3-year curriculum recovery strategy to mitigate the effects of COVID-19 on learning and instruction. In this regard, teachers are constantly receiving these short-term modifications and/or changes from the original curriculum (i.e., ATPs) and a temporary arrangement until the policy amendment processes are finalised (South Africa. DBE, 2021).

"Then when they say the ATPs change, sometimes they change within a term. So you've already done the planning and, oh my goodness, now we've got to suddenly change it and fit this in and take that, and you've done it already, and so there's a lot of messing around with teachers in that respect" (PARTICIPANT 9, 1:19:51).

With regard to the latter statements, it is also important to note that additional effects of "forgetting" or stagnation may slow current learning to the extent that the number of learners who do not meet the minimum required standards and the average distance from these standards are likely to increase. Consequently, as learners progress through school, they may lose more and more knowledge, particularly if the material from the previous year is taught as if it has already been mastered, let alone learned (Shepherd & Mohohlwane, 2021:23).

Moreover, other challenges that were experienced by both focus groups across themes and categories include the teacher-learner ratio being too large, the impact of the COVID-19 pandemic regulations, and the reality that some learners did not attend any Grade R. The method of agreement showed that some participants experienced difficulties with the large number of learners in their classroom.

"… for me, my biggest challenge is the amount of learners (1:18:02). ... the amount of kids that I had in the class [during COVID-19] *would have been ideal. At one stage I think I had like eighteen kids in the classroom, it was amazing because I got … to really connect with … those few kids" (PARTICIPANT 11, 0:49:32).*

Panthi and Belbase (2017:14) argue that an insufficient class size when teaching and learning mathematics may have a negative impact on the performance of the learners as they cannot all participate equally in classroom activities. Hence, it is anticipated that children in a smaller class will receive more teacher attention, leading to better mathematical learning and understanding (Canbeldek & Isikoğlu Erdogan, 2017:259).

According to the individual transcripts of Focus Group One and Two's participants, the COVID-19 pandemic regulations concerning social distancing compelled them to make adaptations in their classroom arrangements and specifically how to render support and intervention to Grade One learners struggling to grasp mathematical concepts. The researcher deduced that they were not allowed to teach in smaller groups and/or in pairs. Thus, the participants shared the following challenges they faced:

> *"… a buddy-system is also, I feel, a nice way for learners who are a bit weaker as they might feel more comfortable, or more inclined to ask their buddy … That is, however, now difficult during COVID to have a buddy system with social distancing…" (PARTICIPANT 7, 29:16).*

> *"Uh, back then* [before the COVID-19 regulations] *… we would, um, be interacting … with each other … either in pairs or as a group on the mat, because we have got four different ability groups that could come to the mat" (PARTICIPANT 11, 0:53:09).*

> *"I have a child that … knows everything, so she can also help a learner while I'm helping another learner* [i.e., "buddy system"] *but … with COVID it's like quite difficult … we're not supposed to be touching,* [and] *they do need that … extra guidance, um, especially with forming numbers" (PARTICIPANT 5, 29:09).*

> *"… one-on-one is the only way that … I've tried to … make things a little better [for mathematical understanding]. And [employing intervention and consolidation] is a little bit harder seeing them so little because they come in groups" (PARTICIPANT 3, 22:34).*

Concerning the reality that group work was limited and/or could not take place in classrooms worldwide during the COVID-19 pandemic, it is important to note that the school environment is well known to influence achievement through peer influence. Being in a classroom and thus having the opportunity to interact with peers can have significant positive effects. For example, by teaching mathematics in smaller groups and/or in pairs, learners can teach and learn from one another. Additionally, learners may develop an interest in mathematics because of their peers (Di Pietro, Biagi, Costa, Karpiński & Mazza, 2020:9).

Moreover, aside from the challenge of not being able to work in groups and/or pairs for intervention purposes, participants also acknowledged the further influence that the COVID-19 pandemic had on learners' progress as they were attending school on a rotational basis. Participant 5 summarised this aspect as follows:

> *"Oh yeah* [COVID-19] *definitely* [had an influence on learner's progress] *because if they were coming every day … I could be doing so much more … if I had the time* [but] *we* [are] *just trying to, um, cover the whole syllabus and … make* [help] *them understand what they're supposed to know … to move on to Grade Two, so we just trying to cover everything that the department says we need to cover…" (PARTICIPANT 5, 31:35).*

The latter quotes from the participants once again reflect what was stated in Shepherd and Mohohlwane's (2021:5) report, who claim that the COVID-19 pandemic's challenges have contributed to the reality that learners have fallen behind due to missed opportunities for curriculum engagement. Consequently, it was estimated that most primary school learners have lost between 70% and an entire academic year's worth of knowledge (Shepherd & Mohohlwane, 2021:23).

Between 2019 and 2020, the number of children enrolled in Grade R and other early education programmes dropped from 36,8% to 24,2%, while the number of children remaining at home increased from 57,8% to 67,2% (StatsSA, 2021:1). Nevertheless, whether it be pre-COVID-19 or due to the COVID-19 pandemic's influence, these statistics still indicate that education prior to Grade One is a significant concern (Shepherd & Mohohlwane, 2021:23). In this respect, the method of agreement pointed out that three of the participants (Participants 1, 5 and 11) believed that not having Grade R as a foundation prior to entering Grade One had a negative influence on learners' mathematical performance as they lacked the necessary mathematical skills for Grade One. According to Hazell et al. (2019:49), learners who attend Grade R acquire the necessary conceptual understanding and mathematical skills to enjoy mathematics and succeed in the FP (starting from Grade One).

> *"… Baseline …* [Example:] *it's a big puzzle. They must just cut it out one by one and stick it and a lot of the children* [will stick] *the face … at the bottom … and that's how they see the puzzle, going back*[wards] *… most of* [these] *children are the ones that are struggling and then half the class will do that puzzle perfectly… I really pick up from there … (35:41). … it's just basic stuff* [learners struggle with] *…* [and] *… they haven't been to Grade R (37:02). … I had I think five children* [who] *passed the Baseline for Maths this year. They're isiXhosa learners but I think … two of them … out of the five, went to Grade R, so it is a big impact as well" (PARTICIPANT 5, 37:41).*

> *"So we do a diagnostic test in order to see what level the learners are at. … you get* [some] *learners straight from day care. They come into your class, … within Grade One, … but we … don't know who is strong [or] who is the average learners… So we don't really know these learners until we do these type of assessments. And the assessment is very basic. It's very, very basic, but* [sometimes] *they can't* [even] *count" (PARTICIPANT 1, 27:08).*

> *"… we have to, um, place more emphasis on … going back to, um, you know, re-teaching of some Grade R stuff and all of that, … because of COVID last year. …* [It has] *been, um, challenging on our time constraints" (PARTICIPANT 11, 0:52:21).*

Berg (2013:8) states that exposure to experiencing Grade R mathematical concepts concretely and thus laying the foundation of a basic understanding of mathematics, prior to the Grade One year, is very important as it produces immense value for mathematics learning. However, even though the government agreed in 2013 to a CAPS that would make the reception year (Grade R) compulsory by 2030, this remains a concern if the Basic Education Laws Amendment (BELA) Bill is not passed by 2022 (Gitonga, 2021).

Upon reflecting on the challenge regarding insufficient resources, it should be noted that a learner's HL is also a resource to be utilised and is most likely to improve the conceptual and epistemological access of a learner to master core basic mathematics proficiencies (Robertson & Graven, 2020:2). Hence, the method of agreement revealed that some participants, although they had the necessary visual and/or physical resources, were unable to use the isiXhosa-speaking learners' HL as an intellectual resource to support their mathematical understanding.

> *"… How can I say. Because I think it would've been nice if I had more resources. Because like, if I myself also knew the language better, I think I could also help them* [isiXhosa learners] *..." (PARTICIPANT 3, 06:32).*

The method of difference disclosed that two participants (Participants 1 and 11) asserted that they do not have enough resources. However, although Participant 1 claimed that she does not have all the resources, she believed that there are alternative ways to find and/or make your own resources.

"... there isn't enough resources, [because of] *… the amount of learners in a classroom" (PARTICIPANT 11, 1:18:14).*

"I don't have all the resources, but I do have quite a few resources. And fortunately, I have a printer. So, I'm always looking at different resources online. There's never a weekend that goes past where I don't print something for myself or to help me teach. So, I am fortunate that I do have counters. But it's not only things that can be bought, we need to use things within our home. That is, things like bottle caps, or you know those sucker sticks. Because there's many ways that learners can learn, use buttons. So, I try and give my learners the opportunity to use the different things [resources] *for mathematics" (PARTICIPANT 1, 10:58).*

In support of the latter quote from Participant 1 and in line with the Mathematics Teaching and Learning Framework for South Africa, it encourages teachers to be innovative and to minimise their dependence on commercially available manipulatives (South Africa. DBE, 2018:78). Furthermore, Dicker (2015:72) asserts that physical resources may assist isiXhosa learners in comprehending word problems and other complex mathematical concepts. Hence, visual aids and manipulatives are vital as they may aid in contextualising mathematics.

4.3.2.4.1 Conclusion of category four: Challenges [Focus Group One & Two] [semi-structured individual interviews]

In Table 4.8, Conclusion of Category Four: Challenges [FOCUS GROUP ONE & TWO] [semi-structured individual interviews] below, the participants were confronted with the following challenges when teaching mathematics:

Table 4.8: Conclusion of category four: Challenges [Focus Group One & Two] [semi-structured individual interviews]

CATEGORY FOUR: CHALLENGES [FOCUS GROUP 1 & 2]		
Theme	**PATTERNS**	**PATTERNS**
	Method of agreement	**Method of difference**
Theme 4.1: Lack of time	• Three participants from Focus Group Two indicated that there is not enough time for the consolidation of mathematical concepts for isiXhosa-speaking learners.	Three participants of Focus Group One did not refer to any challenges until the individual transcripts revealed an overlap of challenges across themes and categories from both focus groups.
Theme 4.2 Additional challenges across themes and categories	• Three participants from Focus Group One also revealed that there is not enough time for the consolidation of mathematical concepts for isiXhosa-speaking learners.	
	• Three participants perceived the work allocation as stipulated by the Mathematics CAPS Grades R–Three document as problematic and content-heavy.	• Three participants did not express any challenges with regard to the work allocation as stipulated by the Mathematics CAPS Grades R–Three document.
	• Three participants experienced the continuous changing ATPs as frustrating.	• Three participants did not share any frustration in this regard.
	• Three participants felt that a too large class hindered them from successfully reaching those learners who struggled to grasp mathematics.	• Three participants did not point out challenges regarding large class sizes.
	• Due to the COVID-19 pandemic's regulations concerning social distancing, all six participants were restricted to using certain intervention strategies, which they believe had an influence on the learners' understanding of mathematics.	
	• Five participants experienced that learners who did not attend Grade R prior to Grade One lacked the necessary mathematical skills for Grade One.	• One participant did not make mention of experiencing Grade One learners who did not attend Grade R prior to Grade One.

	• All the participants revealed that they do not possess the necessary language resources as a means to assist the isiXhosa learners with mathematical understanding.	• Two participants claimed to have insufficient resources in general.

With regard to time being a challenge, the method of agreement disclosed that all six participants perceived the time allocation, as stipulated by the CAPS Mathematics Grades R–Three document, as challenging. All the participants were adamant that some isiXhosa-speaking learners need more time to understand, apply, and consolidate mathematical concepts.

In summary, Theme 4.2 – "Additional challenges across themes and categories" – refers to six factors that participants identified as additional challenges across various categories and themes, namely: *CAPS, inconsistent ATPs, teacher-learner ratio, the impact of the COVID-19 pandemic, Grade R as a foundation*, and *insufficient resources*.

The curriculum expectations of the CAPS document for Mathematics Grades R–Three is overwhelming as too much content needs to be covered for mathematics in a short time span. Frustrations were experienced with the additional work demands relating to ATPs and the subsequently continuous adaptations to lesson plans. Despite the latter frustrations, the participants indicated that they have access to mathematical resources but are in dire need of bilingual (English-isiXhosa) mathematics resources. The feelings of being overwhelmed are further aggravated by the impact of the COVID-19 pandemic, whereby limitations were placed on the number of learners allowed in the Grade One classroom. All the participants asserted that the COVID-19 pandemic regulations concerning social distancing had a negative influence on the implementation of specific intervention strategies such as group work and/or working in pairs. However, although the teachers believed that some learners' progress was marginally influenced in this regard, a smaller intake of learners enabled the participants to work more individually with isiXhosa learners who needed support and guidance. The importance of a compulsory Grade R-year to lay the foundations for further learning in mathematics and language, was seen as a possible intervention strategy to enhance the mathematics understanding of learners who did not attend such a developmental year.

4.3.3 Stage three: Data analysis of the field notes of the mathematics lesson observations

As described in section 3.3.5, the researcher incorporated six observations of Grade One mathematics lessons to supplement the other data collection methods and gain a more complete picture of how Grade One teachers taught mathematics in their classrooms (Cohen et al., 2018:470). The researcher used John Stuart Mill's Analytical Comparison technique, described in section 4.3.1, to compare the individual interview data transcriptions to the transcriptions of the six participants' mathematics lesson observations (Neuman, 2014:428). The researcher wanted to ascertain whether the transcriptions:

- Indicate the presence of the interview framework's themes when mathematics was taught (method of agreement);
- Indicate the absence of the interview framework's themes when mathematics was taught (method of difference);
- Alternatively, whether a participant identified, added, or modified the interview framework's themes (method of difference).

The researcher uses **bullet points** to give examples of activities she observed from specific participants. When the researcher compared the categories of the individual interview data transcriptions to the data transcriptions of the maths lessons, she found the following.

4.3.3.1 Category One: Mathematical language

Theme 1.1 The language [of mathematics]

As one of the aims of this research study was to determine what Grade One teachers' understanding of mathematical language is, the category concerning "the language [of mathematics]" was not something that the researcher could fully capture by just observing Grade One teachers' mathematics lessons. However, to some extent, the method of agreement revealed the participants' understanding that mathematics has its own register in the sense that all the participants had a mathematics wall with all the necessary mathematics terminology displayed. All these terms had visual representations attached to them so that learners who speak isiXhosa could make sense of the maths vocabulary.

Furthermore, the researcher also discovered that Participants 1, 7, and 9 simplified the mathematical terms by exposing learners to different vocabulary with the same meaning for better understanding, whereas Participants 5 and 11 simplified the language when they were introducing word sums, for example, through using everyday English that is simple and connected to learners' everyday lives.

- When the teacher introduced the activity of "bonds" to the learners, she talked about tens and units, but also mentioned to the learners that units are also referred to as ones (PARTICIPANT 1).
- Before the teacher embarked on an addition activity, she first asked the learners what addition is. The learners answered that you plus. The teacher acknowledged their answer and told the learners that addition also means you add or make something more (PARTICIPANT 7).

- The teacher reads the word sum to the learners: "If I have 8 sweets and eat 2 of them, and I eat another 3, how much do I have left?" Before the learners are left to solve the problem, she first asks them what kind of sum it is. Then she asks them why they say it is a minus sum. She asks the learners to think about the sum and picture it in their heads. If I eat 2 sweets, what happens? It gets less. If I eat three more sweets, it gets less (PARTICIPANT 9).

- When the teacher teaches story sums, she uses learners' names in the classroom and relates the story to their everyday experiences – as the teacher said, for example, when she does a sharing story sum, she would use real objects (i.e., real lollipops) to share amongst the learners, as everyone likes sweets (PARTICIPANT 5).

- Instead of just asking learners which number is greater than five, the teacher simplifies the language and relates it to their everyday life by asking: "If she has five sweets and they have three sweets, who has more?" (PARTICIPANT 11).

Participant 3 makes the language easier to understand by giving learners the chance to revise terminology as a group before they do an individual activity about the same thing.

- The teacher asked learners a few before and after questions [i.e., "What comes before twelve?"; "What comes after twelve?"] As soon as the teacher saw that everyone was on par with the terms before and after, she gave them an individual activity to complete in this regard (PARTICIPANT 3).

Only Participant 9 claimed that mathematics can be taught and learned like any other additional language. In this case, the method of difference revealed that all the participants were employing different language strategies (i.e., semiotics systems), which are also used in the acquisition of a second and/or third language. For example, all the teachers used visual representations to make mathematical vocabulary and concepts easier to understand.

4.3.3.1.1 Conclusion of category one: Mathematical language [comparison between the semi-structured individual interviews and observations of mathematics lessons]

Reflecting on the category, "mathematical language", the method of agreement and method of difference reflected the following (the discrepancies are indicated in colour):

Table 4.9: Conclusion of category one: Mathematical language [Comparison between the semi-structured individual interviews and observations of mathematics lessons]

CATEGORY ONE: MATHEMATICAL LANGUAGE				
Theme	SEMI-STRUCTURED INDIVIDUAL INTERVIEWS		OBSERVATIONS OF MATHEMATICS LESSONS	
	PATTERNS		PATTERNS	
	Method of agreement	Method of difference	Method of agreement	Method of difference
Theme 1.1: The language [of mathematics]	Six participants agreed that mathematics is a language of its own with special vocabulary (mathematical terminology).		Six participants demonstrated an understanding that mathematics is a language of its own with special vocabulary (mathematical terminology).	
	Six participants showed an under-standing that language plays an important role and needs to be simplified for mathematical under-standing.		Six participants demonstrated an understanding that language plays an important role, hence, teachers simplified the language for better understanding.	

		One participant (Participant 9) acknowledged that the language of mathematics is the same as any other language and can be acquired using the same didactic strategies as any other additional language.	All six participants applied second language learning didactic strategies to simplify the language of mathematics for better understanding.	

In analysing the transcripts of the classroom observations of the category "Mathematical Language" and comparing them with the transcripts of the individual interviews, the method of agreement confirmed that all six participants share the view that mathematics consists of different terminology. They further agreed that language plays a critical role in the understanding of mathematics, thus the reason for the participants' simplifying mathematical terms. During the analysis of the individual interview transcripts, the method of difference reflected that only Participant 9 pointed out that second language didactic strategies could be employed for mathematical understanding. In line with the above perception of Participant 9, it was observed that all the other individual interview participants did, however, employ second language didactic strategies in their mathematics lessons without their realising it.

4.3.3.2 Category Two: Holistic and concrete teaching and learning strategies

Theme 2.1 Planning and teaching

As determined by the method of agreement, all the participants applied their planning and teaching to the learners' everyday experiences and cultural backgrounds. During the classroom observations, the participants demonstrated this in a variety of semiotic approaches. For example, Participants 5, 9, and 11 kept learners' everyday experiences in consideration when they employed word sums by using learners' names in the classroom. They also used short and simplified everyday English by sharing, adding, and subtracting word sums with everyday objects such as lollipops, sweets, friends, crayons, book pages, etc.

- The teacher writes the following word problem on the board: (learner's name) has 5 crayons and (learner's name) has 10 more. How many crayons does (learner's name) have? The teacher then asks the learners to pair up, and they try and solve the problem together (PARTICIPANT 5).

Participant 1 and 9 related to learners' everyday experiences when they discussed the weather and date at the beginning of the mathematics lesson.

- The teacher posed a variety of questions to the learners, getting them started on the mathematics lesson. She asked questions such as: 1) What is the date today? 2) Why is it not 31 September on Friday? 3) What number comes before 29? 4) How many magnets did we have yesterday? 5) How many magnets are there today?

Participant 9 gives learners an opportunity to engage in social discourse as a means to connect the learners with their own mathematical thinking by asking the learners to tell her anything about the number 29. Learners gave the following answers:

- "It is someone's age".
- "It's an odd number". The teacher asked the learner why the number is odd. The learner answered, "Because you can't share it". The teacher used the opportunity to ask the whole class, "What does he mean, you can't share it?" Learners answered, "Because there will always be one left". The teacher told the learners that they could share it, but it would not be exactly shared.
- "It's a 20 and a 9". The teacher told the learner that she was glad he did not say it was a 2 and a 9 because what is a 2 and a 9? Learners answered, "It's 11".
- "It comes before 30".
- "3 less than 32". The teacher asked the learners how we can see if he is correct, and she goes to the big number line on the board. Learners checked with the help of the teacher if the answer was correct and jumped 3 less than 32 on the number line.

Participants 3 and 7 used visual representations to connect with learners' everyday experiences. For example, Participant 7 mentioned that the learners go through different phases and they currently like monsters. Thus, the teacher incorporates monsters within the classroom activities to get concepts such as addition and subtraction across using a step-by-step approach. See the sketch below.

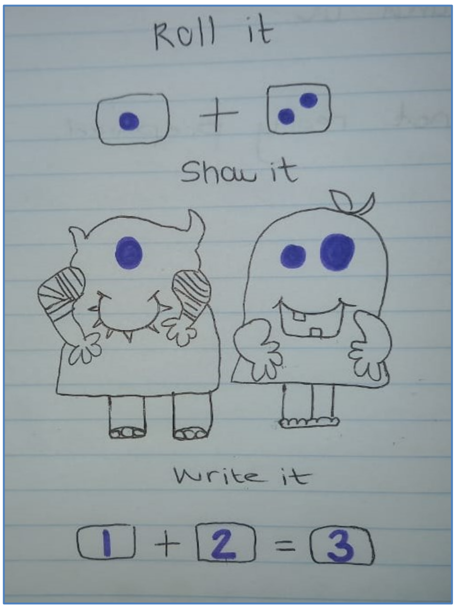

Figure 4.6: Sketch of monster activity related to learners' interest

The method of agreement also confirmed that different learning styles of Grade One learners were accommodated in the participants' lesson plans and subsequent teaching. The transcripts of the classroom observations depict various activities that the participants utilised to ensure that the different learning styles of learners are met during mathematics lessons.

When Participants 1, 3, and 5 engaged their learners with the concept of skip counting, three learning styles were apparent. They instructed the Grade One learners to take out their counting charts (visual) and use their index-fingers to "hop" (skip) the numbers on the chart while counting aloud. Learners also had the option of using their whiteboard markers to draw circles around their numbers as they skipped counts to grasp the counting pattern easily (auditory and kinaesthetic). On the other hand, Participant 9 showed a counting song video on the whiteboard and the learners counted and danced along with the movements of the person in the video. Participants 7 and 11 did the following activities, keeping in mind the different learning styles:

- In smaller groups, each learner received two dice, a whiteboard marker, and a laminated activity page with two monsters (see Figure 4.2). This was an activity to practice the concept of "addition". The teacher explained the activity. First, the learners had to throw the dice in order to get two numbers that they could add together (i.e., ● + ●●). They then had to "show it" by drawing one circle (representing the monsters' eyes) on the one monster, and two circles on the second monster. Thirdly, they had to "write it" by writing out the sum and calculating the answer (i.e., 1+2 = 3) (PARTICIPANT 7).

- The teacher told the learners to put their hands behind their backs. Learners immediately got excited because they knew that they were going to play the "double game" now. The teacher asked them to show her a "double two". Then learners quickly brought their hands to the front and showed two fingers on each hand, shouting out the answer, "four" (PARTICIPANT 11).

The adaptation of the curriculum was too abstract for observation. For example, as the researcher only observed mathematics lessons, she was unable to observe the integration of mathematics with other subjects. The only adaptation of the curriculum that the researcher could observe entailed all participants implementing several teaching approaches. The transcripts of the observations correlated with the analysis of the transcripts of the individual interviews, whereby it was found that all the participants made use of scaffolding strategies to support isiXhosa-speaking learners who struggled to make sense of mathematical concepts. Preferences were given to strategies that included visual aids.

Theme 2.2 Visual aids

Reflecting on the transcripts of the individual interviews, all the participants indicated that they employed visual aids as a semiotic resource in the form of pictures, drawings, and concrete objects during their mathematics lessons to support all the Grade One learners in their classrooms. The method of agreement confirmed that all the participants relied on visual aids to enhance the learners' understanding of mathematics. For instance, Participants 5, 9, and 11 and their learners used drawings when they solved word problems.

- The teacher posed a problem to the learners. She tells them they have 13 strawberries. She then asked if it was an even or an odd number. The learners replied that it was an odd number. Now the teacher instructs the learners to draw the 13 strawberries like she showed them to do on the board with the previous word problem. The learners drew the dots on their whiteboards. The teacher reminded them to make sure they kept enough space between the groups of strawberries. The teacher instructed the learners to share the strawberries "between" three children. She reminds them to cross one out and put it on the next plate, so they will not get confused (PARTICIPANT 9).

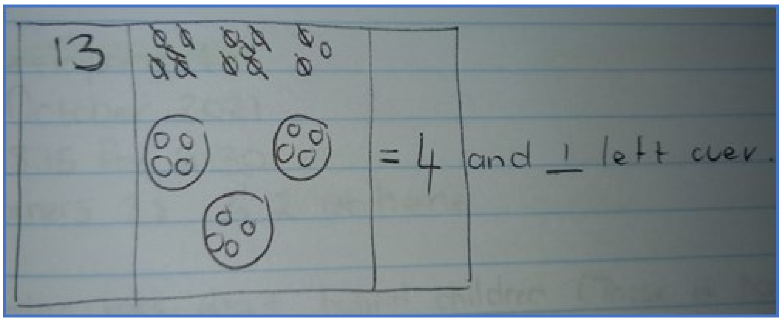

Figure 4.7: Sketch of word problem solving through drawings

Participants 3 and 7 supported the learners' number sense by presenting numbers in the form of pictures and/or objects, whereas Participant 1 gave the learners "unifix blocks" to manipulate and help them grasp the concepts of place value (tens and units).

- Learners had to do sums in their books. The teacher gave one of the isiXhosa learners counters to assist him with addition sums. She told the learner to pack out the counters on top of each number accordingly and add them together (PARTICIPANT 7).

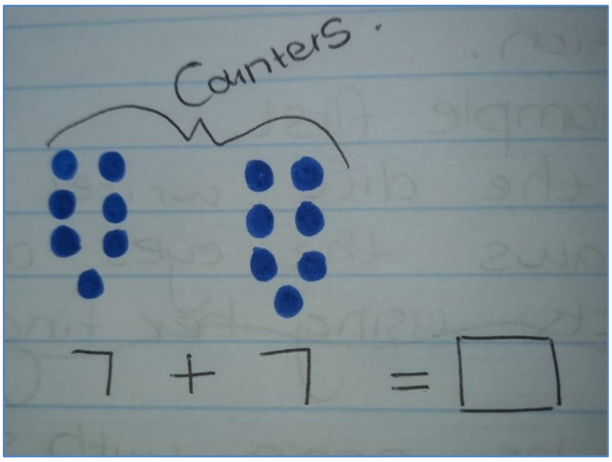

Figure 4.8: Sketch of sum with counters

Theme 2.3 Technology

When the researcher looked through the transcripts of the six observations, the method of difference revealed two participants employing technology as a method to teach mathematics. In this example, Participant 9 used the YouTube app to show videos of counting songs that learners could sing along with. Although Participant 11 did not acknowledge that she utilised technology, it was observed that she did indeed. She utilised a whiteboard on which she posted addition and subtraction sums via her laptop. However, she adapted this method by bringing in fun and competitive elements, whereby the learners had to complete the sums within a specified time frame. The teacher downloaded an application that acted as an electronic timer.

Theme 2.4 Maths is fun

The analysis of the transcripts of the individual interviews indicated that all six participants emphasised that mathematical learning can be enhanced if learners experience the mathematical activities as fun. Whilst the method of agreement indicated, in the transcripts of the observations, fun elements in the mathematics activities of five participants (Participants 7, 9, 11, 3 and 5), the method of difference revealed that the teaching style of Participant 1 was inclined to be more teacher centred.

Participants 7, 9 and 11 employed "game-ish" activities during their mathematics lessons as follow:

- Learners played a fun matching game with numbers. Learners had to match the chocolate chips on the cookies with the correct numerical number and number name, which represented the amount of chocolate chips on the cookies (PARTICIPANT 7).

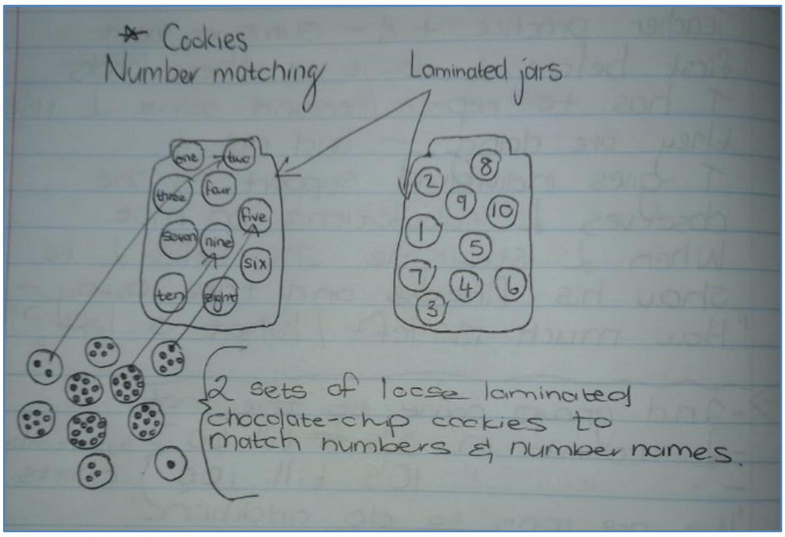

Figure 4.9: Sketch of number matching

- The teacher told the learners that they were going to play a game, girls against boys. Immediately, all the learners were excited. The teacher wrote different numbers on the board (these numbers were answers to mathematical problem-solving questions that she was going to ask). The game started off with one boy and one girl on each side of the board. The teacher asked different questions, and the answers to these questions were on the board. The learner (boy or girl) who saw the answer on the board first had to quickly erase it, and a point was awarded to that group (girls or boys). Boys and girls rotated when they got an answer correct, so that everybody got a chance to be in front (PARTICIPANT 9).

- The learners were excited when the teacher told them that they were going to play the halving game. For example, the teacher asked the learners to show her three fingers on each hand. Learners all hold up three fingers in each hand. Then she asked them what half of six was. The learners thought quickly and put one hand (three fingers) behind their backs and gave the answer of three (half of six) out loud (PARTICIPANT 11).

An element of fun was brought into the mathematics lesson of Participant 3 when the learners in her class engaged with interactive activities such as cutting out numbers and pasting them in the correct sequence (skip counting). Participant 5 used real-life objects to demonstrate the concept of sharing, and learners had the opportunity to be involved and manipulate these objects.

Theme 2.5 Positive reinforcement

Although only three participants, according to the transcripts of their individual interviews, highlighted the importance of positive reinforcement to support learners' mathematical learning, it was observed that all six participants did indeed encourage their learners spontaneously to master the mathematics content and skills. Subsequently, these positive reinforcements led to a classroom atmosphere where the Grade One learners were eager to participate in mathematical activities.

Theme 2.6 Parents

The theme "parents" was originally identified by the participants of the focus group interviews. In their individual interviews, the participants also made references to parental involvement in the Grade One classrooms. However, the focus of the on-site visits was to observe how mathematics was presented in an English Grade One classroom, where some isiXhosa learners might have trouble understanding the mathematics content due to the LOLT of the school. Thus, no observation notes were captured to reflect the theme of "parents" in this regard.

4.3.3.2.1 Conclusion of category two: Holistic and concrete teaching and learning strategies [comparison between the semi-structured individual interviews and observations of mathematics lessons]

In drawing up a comparison of the category of "Holistic and concrete teaching and learning strategies", the method of agreement and method of difference depicted discrepancies that occurred amongst the six participants' interviews and what happened in their classrooms, as summarised in Table 4.10 below:

Table 4.10: Conclusion of category two: Holistic and concrete teaching and learning strategies [comparison between the semi-structured individual interviews and observations of mathematics lessons]

CATEGORY TWO: HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES				
Theme	SEMI-STRUCTURED INDIVIDUAL INTERVIEWS		OBSERVATIONS OF MATHEMATICS LESSONS	
	PATTERNS		PATTERNS	
	Method of agreement	Method of difference	Method of agreement	Method of difference
Theme 2.1: Planning and teaching	Six participants are in agreement that planning and teaching need to incorporate isiXhosa-speaking learners' everyday experiences and cultures to enhance mathematical understanding.		Six participants connected their planning and teaching to the learners' everyday experiences and culture	
	Six participants admitted that they plan and teach according to learners' different learning styles.		Six participants catered for learners' different learning styles.	
	Six participants adapted the curriculum and/or their teaching approaches by building on what learners already know (prior knowledge).		Six participants employed various teaching approaches by building on what learners already know (prior knowledge).	
	Six participants responded that they employed scaffolding strategies (i.e., multiple semiotics) to enhance isiXhosa-speaking learners' mathematical understanding.		Six participants employed scaffolding strategies to enhance isiXhosa-speaking learners' mathematical understanding.	
		One participant (Participant 9) asserted the importance of integrating mathematics with other subjects.	The researcher could not find any evidence of the integration of mathematics across other subjects.	

Theme 2.2: Visual aids	Six participants considered visual aids (visual representations and concrete objects) to be the most suitable strategy to assist all Grade One learners, to come to understand mathematics.		Six participants employed visual aids (visual representations and concrete objects) as a strategy to enhance isiXhosa-speaking learners' understanding of mathematics.	
Theme 2.3: Technology	Three participants hesitated to implement technology during mathematics lessons.		Three participants still hesitated to implement technology during their mathematics lessons.	
		One participant utilised technology (i.e., educational videos) successfully in her mathematics lessons.	Two participants utilised technology (i.e., educational videos) successfully in their mathematics lessons.	
		One participant did not express any comments, beliefs, or perceptions about the use of technology in mathematics lessons.	The same participant that did not reveal any thoughts *vis-à-vis* technology, incorporated technology in her mathematics lessons.	
		One participant revealed no access to technology.		One participant still experienced a lack of access to technology.
Theme 2.4: Maths is fun	Six participants perceived that mathematics activities need to be fun and presented in a "game-ish" way, that will enhance incidental learning and a better understanding of mathematical concepts.		Five participants employed mathematics in a "game-ish" way which led to a better understanding of mathematical concepts.	One participant (Participant 1) did not employ fun activities.

Theme 2.5: Positive reinforcement	Three participants elaborated on the importance of positive reinforcements for encouraging mathematical learning, motivation, and achievement.		Six participants employed positive reinforcements during their mathematics lessons.	
		Three participants did not express any views on this theme.		
Theme 2.6 Parents	Six participants indicated that teacher-parent relationships and parental involvement in mathematics homework is important.		Due to the abstract nature of this component, no observation notes were captured to reflect the theme of "parents".	
	All participants perceived WhatsApp groups to be an effective platform for direct communication with parents.			
	Six participants regarded providing guidelines to parents in assisting their children with mathematics homework important.			

In sum, the theme "planning and teaching" pointed out that all the individual participants did not only believe in the scaffolding of various strategies but practiced what they preached. Therefore, multi-semiotic strategies such as connecting mathematical content to learners' everyday experiences, catering to learners' different learning styles, and building on learners' prior knowledge were highly regarded to enhance isiXhosa-speaking learners' understanding of mathematics. It can further be concluded that the integration of mathematics across subjects seemed to be problematic. Although only one participant raised during her individual interview the importance of building on mathematical concepts in other subjects as well, the method of difference indicated that none of the other participants shared this approach. However, due to the researcher's focus on the presentation of only mathematical lessons, no evidence of whether such integration of mathematics across subjects did materialise was obtained.

In support of the aforementioned analysis, Shepherd and Nompumelelo (2021:23) pointed out that, due to the shortened school year caused by COVID-19, certain curriculum modifications were implemented in 2020. In the FP, for instance, teachers were encouraged to incorporate the content and skills of one subject (such as mathematics) into the other subjects. However, they also mentioned that such an accomplishment may only be possible if teachers possess the necessary abilities and skills.

Following on the trend of the above agreement on the scaffolding of various teaching and learning strategies, all the participants deemed and experienced "visual aids" as a highly effective strategy (or semiotic resource) to assist isiXhosa-speaking learners' understanding of mathematics.

A discrepancy is experienced regarding the beliefs and utilising of "technologies" during mathematical lessons. Although most (five) of the participants were in favour of infusing their mathematical lessons with technologies, three participants were hesitant and, subsequently, did not implement technologies, specifically in their maths classes. The reason for not utilising this important resource was a lack of access to it as well as limited time available for teaching with technology. As a result, only two participants successfully implemented technology as a resource (i.e., educational videos and visual representations on the whiteboard) during their mathematics lessons.

Again, the method of agreement pointed to an overwhelming perception that maths should be fun as it leads to incidental learning and a better understanding of mathematical concepts. However, concerning the theme "Maths is fun", there was an inconsistency whereby one participant's teaching and learning style, despite this participant's vocal agreement with the view that maths teaching should include fun activities, was, however, predominantly teacher centred.

Like above, the theme "Positive reinforcement" was highly regarded and occurred spontaneously by the teachers during their mathematics lessons.

In concluding Category Two: Holistic and concrete teaching and learning strategies, all the participants believed and experienced the relationships and interactions with parents to be extremely valuable. In this respect, communication between teachers and parents was strengthened by WhatsApp messages and guidelines on how parents can assist their children in mastering some mathematical concepts.

4.3.3.3 Category Three: Intervention and consolidation strategies

The same pattern of using the agreement and difference methods was used to find patterns and/or differences between what the participants said in their interviews and what the researcher observed in their maths classes.

Theme 3.1 Intervention

During the analysis of the individual interview transcripts, the method of agreement revealed that all the participants stated that they make use of either a "buddy system" or "didactics classes" as additional support to isiXhosa-speaking learners. When the researcher reflected on the transcripts of the observations, the method of difference pointed to one intervention strategy being dominant in all the classes, namely one-on-one intervention. It was also observed that one participant (Participant 9) additionally used a "buddy system" as well.

In relation to the observation above, it was confirmed in a study by Sharp Nelson, Lucas, Julius, McCrone and Sims (2020:40) that teachers frequently employ intervention strategies such as small-group (i.e., didactic classes) or one-on-one sessions to assist learners in bridging mathematical learning gaps.

Despite what one participant (Participant 1) said in her interview, she adapted the "buddy system" by asking isiXhosa HL Grade One learners who understand maths problems and/or concepts to explain in their HL to a struggling learner how to solve the problem and understand the concepts. Yet, the transcripts of the observations did not disclose any such "Home Language-cum-buddy system" intervention strategy being implemented in this classroom, nor was the strategy of utilising isiXhosa-speaking learners to explain in their HL evident during the mathematics lessons in the other classes.

The intervention strategy referred to as "didactics classes" was not observed as this intervention strategy, by the teacher, took place after school. On the day of her visit to a school, the researcher's visit did not coincide with the learning support professionals rendered to Grade One learners struggling with mathematics and understanding the language medium in which mathematics is presented. In contrast to the transcripts of the individual interviews, the method of difference showed that none of the participants used isiXhosa-speaking learners' HL as a strategy for mathematical support during the mathematics lesson.

Theme 3.2 Repetition

The analysis of the individual interviews revealed that the theme "repetition" focuses on homework as a method of consolidation on the one hand, and, on the other hand, it involves utilising a variety of teaching and learning resources to attain an understanding of specific mathematics concepts. As previously stated in the above paragraphs (§4.3.3.2.1), the parents played a pivotal role in ensuring that homework was completed by their children. Even though all the participants viewed homework as a vital intervention strategy, the researcher did not observe in any of the classroom visits that the participants made references to such homework.

According to Cirillo, Herbel-Eisenmann and Otten (2015), an important aspect of homework is that it affords each learner the opportunity to develop skills and reflect on fundamental mathematical concepts. Thus, when reviewing mathematics homework in class, it enables learners to work together and have discussions about the mathematics homework (Cirillo et al., 2015). Additionally, learners can observe how their peers have solved problems that make more sense to them (Adam, 2018:13).

Yet, repetition in the form of consolidating mathematical concepts was evident during all the lesson observations. Hence, the method of agreement indicated that all the participants repeated mathematical terms and concepts in their lessons. For example, Participants 1 and 9 consolidated number sense and mathematical terminology when they asked questions every morning based on the calendar chart. Participants 7, 9 and 11 did mental maths, repeating and consolidating previous terms and/or concepts learnt. Example:

- Before the teacher embarked on the activity that entailed addition and subtraction, she first revised the meanings of the concepts "plus" and "minus". The teacher inquired of the learners, "What happens when we minus?" Learners answered, "You take away". The teacher then asked, "What is addition?" Learners answered, "You plus". The teacher also informed the learners that "adding" means we make something "more". When learners seemed to get confused between the concepts of plus and minus, the teacher repeated these “rules” during the lesson as well (PARTICIPANT 7).

Participants 3 and 5 continued to repeat skip counting in fives with the learners until they were all reciting it together and everyone pointed at the correct numbers as they counted.

Theme 3.3 Patience

Due to a lot of repetition, extra support, and consolidation to enhance isiXhosa-speaking learners' mathematical understanding, three participants, during the individual interviews, experienced that patience is key in this regard. According to the method of agreement, all the participants demonstrated patience whilst working with isiXhosa Grade One learners who struggled to comprehend mathematical concepts.

Silent theme 3.4 Pre- and In-service training

The silent theme "pre- and in-service training" was identified during the transcripts of the individual interviews when teachers responded that they do not have professional training with regard to the teaching and learning of mathematics to isiXhosa HL learners specifically. In this regard, it was revealed that the participating teachers relied on "book knowledge" and "trial and error". However, due to the abstractness of this theme, no observation notes reflecting this component were recorded.

4.3.3.3.1 Conclusion of category three: Intervention and consolidation strategies [comparison between the semi-structured individual interviews and observations of mathematics lessons]

Reflecting on the category of "Intervention and consolidation strategies", the method of agreement and method of difference detected the following patterns and inconsistencies (the inconsistencies are indicated in colour):

Table 4.11: Conclusion of category three: Intervention and consolidation strategies [comparison between the semi-structured individual interviews and observations of mathematics lessons]

<table>
<tr><th colspan="5">CATEGORY THREE: INTERVENTION AND CONSOLIDATION STRATEGIES</th></tr>
<tr><th rowspan="3">Theme</th><th colspan="2">SEMI-STRUCTURED INDIVIDUAL INTERVIEWS</th><th colspan="2">OBSERVATIONS OF MATHEMATICS LESSONS</th></tr>
<tr><th colspan="2">PATTERNS</th><th colspan="2">PATTERNS</th></tr>
<tr><th>Method of agreement</th><th>Method of difference</th><th>Method of agreement</th><th>Method of difference</th></tr>
<tr><td rowspan="4">Theme 3.1: Intervention</td><td rowspan="2">Six participants employed classroom level support in the form of “buddy systems” and/or didactic classes.</td><td rowspan="2"></td><td>Six participants implemented one-on-one interventions.</td><td>Only one participant utilised the "buddy system" in addition.</td></tr>
<tr><td colspan="2">As the intervention strategy "didactics classes" were a form of intervention that took place after school, this aspect could not be observed.</td></tr>
<tr><td></td><td>One participant (Participant 1) utilised the HL strategy (i.e., isiXhosa) by using other isiXhosa-speaking learners to explain difficult concepts.</td><td></td><td>None of the participants utilised the HL strategy (i.e., isiXhosa) during their mathematics lesson.</td></tr>
<tr><td>Three participants utilised additional learning support professionals in the form of a learning support teacher, a remedial teacher, and an intern to assist with mathematical support.</td><td></td><td colspan="2">The researcher could not record any observations on this aspect, as these were intervention strategies that were not rendered on the day of the observation.</td></tr>
</table>

Theme 3.2: Repetition	Six participants asserted that repetition and homework are strategies that help learners with the consolidation of mathematical concepts and the understanding thereof.		Six participants admitted that they repeated mathematical terms and concepts during their mathematics lessons.	
			Due to the abstract nature of homework as a method of consolidation, this aspect could not be observed.	
Theme 3.3: Patience	Three participants (1, 3 and 5) felt that patience is an important factor when teaching mathematics to isiXhosa-speaking learners.	Three participants did not express any views on this theme.	Six participants showed patience when working with learners who struggled to grasp mathematical concepts.	
Silent Theme 3.4: Pre- and in- service training	Six participants confirmed that they have not been professionally trained in how to support isiXhosa-speaking learners with mathematics education in an English LOLT classroom.		Due to the abstractness of this theme, no observation notes reflecting this component were recorded.	

Regarding the theme, “Intervention”, it can be deduced that one-on-one (teacher-learner) support was the primary intervention strategy when assisting an isiXhosa Grade One learner who struggles to understand the mathematical concepts or the language in which they are explained. The buddy system can also be effective, especially if other isiXhosa learners who understand the difficult mathematical concepts are included as buddies to explain in the mother tongue to their peers how to go about solving mathematical problems and/or grasping difficult concepts.

Nonetheless, the researcher was unable to observe the support strategies demonstrated by other learning support professionals, namely the learning support teacher, a remedial teacher, and an intern, as they were not present on the specific day the observation took place.

Repetition, in the form of either homework and/or the different teaching and learning strategies that the class teacher utilises in consolidating and refining mathematics concepts, is imperative. However, it was observed that the participants did not make any references during their maths lessons to prior mathematical knowledge and skills, in endeavouring to determine whether such knowledge and skills were mastered and strengthened by the said homework.

All the participants deemed "patience" as a virtue in assisting, guiding, and supporting isiXhosa Grade One learners who are confronted with two challenges in the classroom, namely understanding and mastering mathematical concepts and skills, as well as being confronted with having a limited understanding of the English LOLT.

Finally, paragraph 4.3.3.3 is referred to by the theme "Pre- and in-service training". The only observation, which underwrote the verbatim statements of the participants, pleading for pre- and in-service training, came to the fore when the researcher noted that none of the isiXhosa Grade One learners were addressed by their teachers in their HL.

4.3.3.4 Category Four: Challenges [Focus Group One & Two]

Theme 4.1 Lack of time

The transcripts of the lesson recordings proved that the three participants of Focus Group Two had challenges with time. Participant 7's lesson duration was 65 minutes, Participant 9's lesson 70 minutes, and Participant 11's lesson took 75 minutes, while some learners were still busy completing consolidation activities. Thus, the method of agreement asserted that it was only Focus Group Two who experienced a lack of time to cover the curriculum for the day, whereas Focus Group One's participants kept well within the allocated time of 60 minutes.

Theme 4.2 Additional challenges across themes and categories

The transcripts of the lesson observations could not physically observe any evidence pertaining to teachers' challenges with the "dreaded CAPS" document, Grade R as a foundation, and the continuously changing ATPs teachers received. The researcher could, however, observe some evidence with regard to the influence of the COVID-19 pandemic, the teacher-learner ratio, and insufficient resources

The transcripts of the individual interviews revealed that all six participants quoted their challenge with the COVID-19 pandemic's regulations concerning social distancing and that it had a negative influence on the implementation of specific intervention strategies such as group work and/or working in pairs. When the researcher analysed the transcripts of the lesson observations, classrooms were much smaller, and learners were sitting at least one metre apart from each other with plastic dividers/screens between them. However, concerning the restrictions on specific intervention strategies, all six participants applied one-on-one (teacher-learner) intervention, while Participant 9 additionally employed group-work in pairs, although it was not really allowed at the time. Furthermore, even though it is important for isiXhosa-speaking learners to engage in small group work, this intervention strategy was not allowed during the time of the COVID-19 restrictions (Schüler-Meyer et al., 2019:322). Hence, the method of agreement during the mathematics lesson observations revealed that the COVID-19 pandemic's regulations did, however, infringe on participants' use of certain intervention strategies, such as group work and/or working in pairs, from which learners could have benefited (Planas, 2017:65).

The method of agreement of the individual interview transcripts revealed that some participants grappled with teaching mathematics within a large teacher-learner ratio. According to Panthi and Belbase (2017:14), providing effective support and guidance to large groups of learners who struggle to understand mathematical concepts is easier said than done. In this regard, the data analysis of the field observations revealed that the COVID-19 pandemic's regulations seemed to be a blessing in disguise due to the limited number of learners being accommodated during this time period. The learners, and especially the isiXhosa learners with limited understanding of the LOLT, received one-on-one intervention and guidance from their teacher. This is consistent with Canbeldek and Isikoğlu Erdogan's (2017:259) belief that smaller groups of learners allow the teacher to provide more targeted support, guidance, and intervention.

Even though two participants (Participants 1 and 11) during their individual interviews were dissatisfied with the number of resources they had, the classroom observations revealed no glaring shortages in this regard. In this respect, there was evidence that all six participants had a word wall, base ten blocks, counters, number charts, number lines, etc. However, the classroom observations revealed that the participating teachers faced several challenges: Firstly, not being able to use isiXhosa learners' HL as a resource (i.e., code-switching and/or translanguaging) to explain difficult concepts during their mathematics lessons; and secondly, there was no evidence of bilingual teaching materials (i.e., English/isiXhosa). This is just another indication that the DBE's initiative to support teachers in teaching mathematics for better understanding is not adhering to their advocacy to provide teachers with the necessary training and bilingual mathematics teaching materials in this regard (South Africa. DBE, 2018:83). Govender (2018:1) supports the latter statement by stating that numerous initiatives have been implemented ineffectively and have failed to achieve their objectives. Consequently, the method of difference revealed that all six participants had the necessary manipulatives and other basic resources. Then again, the method of agreement revealed that the participants encountered challenges with strategies such as code-switching and/or translanguaging. Notwithstanding, their biggest need is access to bilingual mathematics teaching materials.

4.3.3.4.1 Conclusion of category four: Challenges [Focus Group One & Two] [comparison between the semi-structured individual interviews and observations of mathematics lessons]

Reflecting on the category, "Challenges", the method of agreement and method of difference alluded to the following (the discrepancies are indicated in colour):

Table 4.12: Conclusion of category four: Challenges [Focus Group One & Two] [comparison between the semi-structured individual interviews and observations of mathematics lessons]

CATEGORY FOUR: CHALLENGES [FOCUS GROUP 1 & 2]				
Theme	SEMI-STRUCTURED INDIVIDUAL INTERVIEWS		OBSERVATIONS OF MATHEMATICS LESSONS	
	PATTERNS		PATTERNS	
	Method of agreement	Method of difference	Method of agreement	Method of difference
Theme 1.1: Lack of time	All six participants indicated that there is not enough time for the consolidation of mathematical concepts for isiXhosa-speaking learners.		Three participants experienced a lack of time for the consolidation of mathematics concepts.	Three participants did not seem to be experiencing challenges with time.
Theme 4.2 Additional challenges across themes and categories	Three participants perceived the work allocation as stipulated by the Mathematics CAPS Grades R–Three document as problematic and content-heavy.	Three participants did not express any challenges with regard to the work allocation as stipulated by the Mathematics CAPS Grades R–Three document.	The researcher was unable to collect evidence pertaining to teachers' challenges with regard to the "dreaded CAPS" document.	
	Three participants experienced the continuous changing ATPs as frustrating.	Three participants did not share any frustration in this regard.	The researcher could not observe any evidence pertaining to teachers' challenges with the continuously changing ATP's.	
	Three participants felt that a large class hindered them from successfully reaching those learners who struggled to grasp mathematics.	Three participants did not point out challenges regarding large class sizes.		None of the six participants experienced challenges with regard to large classroom sizes at the time of the observations.

	Due to the COVID-19 pandemic's regulations concerning social distancing, all six participants were restricted to using certain intervention strategies, which they believe had an influence on learners' understanding of mathematics.		All six participants were experiencing difficulties with providing intervention to some isiXhosa learners as they were restricted to social distancing regulations.	
	Five participants experienced that learners who did not attend Grade R prior to Grade One, lacked the necessary mathematical skills for Grade One.	One participant did not make mention of experiencing Grade One learners who did not attend Grade R prior to Grade One.	The researcher could not record specific data of teachers' difficulties regarding Grade R as a foundation.	
	Four participants did not experience any lack of resources.	Two participants quoted that they have insufficient resources (including language as a resource).	All six participants had the necessary manipulatives and other basic resources.	

	All six participants encountered challenges with strategies such as code-switching and/or translanguaging. Notwithstanding, their biggest need is access to bilingual mathematics teaching materials.		All six participants experience challenges with strategies such as code-switching and/or translanguaging as well as not having bilingual mathematics teaching materials available.	

When working with isiXhosa-speaking learners who need more time to grasp mathematical concepts and struggle to integrate them within the curriculum's time constraints, some participants feel pressed for time.

In sum, the theme “additional challenges across themes and categories” is concluded as follows:

Although some participants expressed concerns about the work allocation requirements in the CAPS Mathematics Grades R–Three document, this theme could not be observed. The frustration that teachers felt regarding the ATPs was an abstract factor that the researcher was unable to observe. As a result, no evidence was gathered from the teachers in this regard. Some participants' verbatim responses revealed the difficulties they encountered while attempting to assist isiXhosa learners who were struggling to grasp mathematics in a large class. The method of difference, on the other hand, revealed that, at the time of the observations, no participant experienced difficulties with large classroom sizes because the COVID-19 restrictions on social distancing only allowed 50% of the learners in the classroom.

In line with the COVID-19 restrictions, the participants were limited to using specific intervention strategies such as group work and/or working in pairs ("buddy system"), which they believed influenced learners' mathematical progress. Nonetheless, while most participants mentioned the difficulties they face when Grade One learners, particularly isiXhosa-speaking learners, enter their classrooms at the start of the year, the researcher was unable to record specific data of teachers' challenges due to a lack of a Grade R foundation during the mathematics lesson observations. When the observations revealed that all six participants did indeed have all the necessary manipulatives and other basic resources available in their classrooms and during their mathematics lessons, there was a discrepancy. However, the method of agreement revealed that all six participants struggled with code-switching and/or translanguaging strategies, and lacked access to bilingual teaching materials for mathematics.

4.4 Deliberations on the findings

To answer the main research question, namely: “What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners’ mathematical understanding in their classrooms?”, the researcher had to first answer the four SRQs, namely:

- SRQ 1: “What are Grade One teachers’ understandings of mathematical language?”
- SRQ 2: “What are Grade One teachers’ *understandings* of teaching and learning strategies to enhance mathematical understanding?”
- SRQ 3: “What are Grade One teachers’ *experiences* of teaching and learning strategies to enhance mathematical understanding?”
- SRQ 4: “How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners’ mathematical understanding in English Grade One classrooms?”

To assess the knowledge of first-grade teachers, it is necessary to understand their qualifications, as this affects how they implement mathematics education in their English LOLT classrooms. The qualifications and experiences of participants in teaching mathematics in the first grade revealed that, despite varying levels of experience ranging from newly qualified to highly experienced teachers, they all possess the necessary qualifications to teach in the FP. However, all six participants expressed a lack of pre- and in-service training in mathematics instruction in an African language (i.e., IsiXhosa). Therefore, it can be concluded that the age and qualifications of first-grade teachers, in the context of African language instructions, have no or minimal impact on their experiences implementing teaching and learning strategies to improve mathematical understanding. Teachers throughout the South African education system struggle with how to effectively utilise African Language learners' (i.e., isiXhosa) linguistic knowledge for effective mathematics learning in early grade mathematics, given that the mathematics register in indigenous languages is not yet fully developed (Essien, 2018:55). The answers to the

SRQs are based only on the data analysis of the open-ended focus group interviews, semi-structured individual interviews, and mathematics classroom observations of the selected six Grade One participant teachers in this study.

4.4.1 SRQ 1: What are Grade One teachers' understandings of mathematical language?

Table 4.13: SRQs, objectives and deliberations on the findings

Sub-research question (SRQ)	Research objectives	Theme	Findings
SRQ 1: "What are Grade One teachers' understandings of mathematical language?"	**Objective 1:** The researcher used a qualitative data collection method to establish what (explore) Grade One teachers' understanding of mathematical language is.	**CATEGORY ONE: MATHEMATICAL LANGUAGE**	
		Theme 1: The language [of mathematics]	**Finding 1:** It was understood by all the participants that mathematics constitutes its own language, with a specific vocabulary and register. **Finding 2:** The language of mathematics needs to be simplified for mathematical understanding.

To answer SRQ 1, namely: *"What are Grade One teachers' understandings of mathematical language?"*, the researcher interpreted the analysed data by focusing on the category of mathematical language. Therefore, the researcher wished to gain insight into Grade One teachers' understanding of mathematical language.

According to Table 4.13 above, the category "Mathematical language" contains the theme "The language [of mathematics]". It was found that all the participants had a clear understanding that mathematics has its own register (mathematical terminology) and should be learnt like any other language. Moreover, the participants understood the significant role that language plays in learning mathematics and made claims that the language needs to be simplified (scaffolded) for mathematical understanding. Hence, according to Vygotsky (1931:106), language is linked to cognitive development and takes place within a social-cultural context. Furthermore, based on Vygotsky's learning theory, Moschkovich (2012b) asserts that the language of mathematics refers to communicative competence that is required and sufficient for participation in mathematical discourse. In this regard, Moschkovich (2012a:22-23) believes that the concept of "language" must be broadened to encompass the interplay of multi-semiotic systems involved in mathematical communication (i.e., natural language, mathematics symbol systems, and visual representations). Consequently, the processes of language development and conceptual mathematical understanding are interdependent and mutually related (CGCS, 2016:7). Thus, to assist isiXhosa learners to become proficient in English mathematics, it is necessary for teachers to provide targeted scaffolds (i.e., multi-semiotic systems) during mathematical discourse to meet isiXhosa learners' language needs that will enhance their English mathematical proficiency development (CGCS, 2016:7; Walshaw, 2017:294).

4.4.2 SRQ 2: What are Grade One teachers' understandings of teaching and learning strategies to enhance mathematical understanding?

Table 4.14: SRQs, objectives and deliberations on the findings

Sub-research question	Research objectives	Theme	Findings
SRQ 2: "What are Grade One teachers' understandings of teaching and learning strategies to enhance mathematical understanding?"	**Objective 2:** The researcher uses a qualitative data collection method to establish what (explore) Grade One teachers' understandings of teaching and learning strategies are to enhance mathematical understanding.	**CATEGORY TWO: HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES**	
		Theme 2.1: Planning & Teaching	**Finding 3:** The participants acknowledged the importance of knowing every individual learner (i.e., learners' everyday experiences and cultures) and his/her different learning styles (i.e., visual, auditory, and kinaesthetic) and asserted that isiXhosa-speaking learners gained a better understanding of mathematical content when teachers planned to accommodate their different learning styles as well as integrate mathematical concepts into other subjects. **Finding 4:** Participants emphasised the significance of adapting teaching methods and employing a variety of teaching strategies (i.e., multiple semiotic systems) as scaffolds.

		Theme 2.2: Visual aids	**Finding 5:** Visual aids are preferred in assisting isiXhosa-speaking learners' understanding of mathematics.
		Theme 2.3: Technology	**Finding 6:** Training on how to implement technologies.
		Theme 2.4: Maths is fun	**Finding 7:** Mathematics must be enjoyed.
		Theme 2.5: Positive reinforcement	**Finding 8:** Participation in mathematical activities and problem-solving needs to be positively reinforced.
		Theme 2.6: Parents	**Finding 9:** Healthy teacher-parent relationships and regular communication to enhance support for learners struggling with mathematics homework.
		CATEGORY THREE: INTERVENTION AND CONSOLIDATION STRATEGIES	
		Theme 3.1: Intervention	**Finding 10:** Intervention is important for the consolidation of mathematical concepts.
		Theme 3.2: Repetition	**Finding 11:** Repetition is critical for the consolidation of mathematics education. **Finding 12:** Lack of reference to previous homework.
		Theme 3.3: Patience	**Finding 13:** Patience is the most important virtue in teaching mathematics to isiXhosa-speaking learners.
		Silent Theme 3.4: Pre- and in-service training	**Finding 14:** There is an urgent need for pre-and in-service training on how to assist isiXhosa Grade One learners with their mathematics understanding.

In answering SRQ 2, namely: *"What are Grade One teachers' <u>understandings</u> of teaching and learning strategies to enhance mathematical understanding?",* the researcher interpreted the analysed data by focusing on the two categories, namely: "holistic and concrete teaching and learning strategies" and "intervention and consolidation strategies". According to Ramollo (2014:14), the mathematical proficiency model of Kilpatrick et al. (2001) is made up of "different strands that include understandings about the relationship between the teacher, the learner, and the content and embrace the context to successfully learn mathematics". Hence, teaching for mathematical proficiency requires similarly interconnected components for teachers (i.e., conceptual and procedural fluency, strategic competence, adaptive reasoning, and productive disposition) in order to teach mathematics effectively. In this regard, the researcher wanted to determine Grade One teachers' understandings of utilising different teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding.

As per Table 4.14 above, the category "holistic and concrete teaching and learning strategies" consists of the themes, namely: planning and teaching, visual aids, technology, Maths is fun, positive reinforcement, and parents.

Concerning the theme "planning and teaching", it was found that the participants understood the importance of accommodating individual isiXhosa learners' different learning styles (i.e., visual, auditory, and kinaesthetic) as well as connecting their planning to learners' everyday experiences and/or their culture, as this impacted their understanding of mathematical concepts. Furthermore, the participants highlighted the seriousness of adapting their teaching methods that focus on developing isiXhosa learners' mathematical understanding as well as employing various teaching strategies as scaffolds that are tailored to each learner's needs. This is in correlation with the component, "conceptual understanding", of Kilpatrick et al., which entails the teachers' having pedagogical knowledge of mathematics (i.e., the methods of presenting and implementing mathematics so that isiXhosa learners can comprehend it), learners (i.e., acknowledging learners' different learning styles and their cultural backgrounds), and instructional practices required for teaching (i.e., various scaffolding strategies) (Kilpatrick et al., 2001:10; Aksu & Kul, 2016:35-36).

With regard to the latter description of teachers' use of various scaffolding strategies in conjunction with the theme, "visual aids", it was found that participants preferred the use of visual and concrete representations as a significant scaffolding strategy that assisted isiXhosa learners with their mathematical understanding. According to Arzarello et al. (2009) and Moschkovich (2012a:22–23), multi-semiotic systems, such as visual representations, are essential during mathematics activities and should strategically be implemented to support ELLs' (i.e., isiXhosa-speaking learners') understanding of mathematics. Once again, the participants' strategic competence in planning effective instruction and solving problems that arise while teaching (i.e., employing visual representations) as well as their adaptive reasoning in justifying a particular instructional approach (i.e., visual representations promote mathematical understanding) came to the fore (Kilpatrick et al., 2001:10; Saussure, 1959; Vygotsky, 1997; Sfard, 2008:81; Radford & Sabena, 2015:168; Presmeg et al., 2016:19).

Furthermore, while the theme of "technology" was identified as another strategy that could assist isiXhosa learners with their mathematical understanding (Insorio & Macandog, 2022:2), the findings revealed that the participants needed training in this area because not all participants appeared to know how to utilise this strategy for improving mathematical understanding.

Regarding to the themes of "Maths is fun" and "positive reinforcement", the findings revealed that participants enforced both these strategies throughout their mathematical lessons. The findings disclosed the participants' knowledge that in order to teach mathematics for understanding, it is crucial to make mathematics enjoyable, especially when some isiXhosa learners are already sensitive due to their lack of proficiency in the classroom's LOLT (English). Moreover, the findings revealed that positive reinforcement is also critical for encouraging isiXhosa learners' mathematical learning, motivation, and achievement. This points out the participants' knowledge in correlation with Kilpatrick et al.'s component of their productive disposition towards mathematics, teaching, and the improvement of practice (Kilpatrick et al., 2001:10; Yulian & Wahyudin, 2018:2-3). Hence, the participants believe that a positive environment is required to improve mathematical learning (Khanal, 2015:294-295; Ayuwanti, 2021:665).

Additionally, findings regarding the theme of "parents" are related to teachers' conceptual understanding pertaining to their knowledge of various instructional practices required for teaching (Kilpatrick et al., 2001:10). In this regard, the findings revealed that participants believed that parents form part of their child's conceptual understanding and that the development of reasoning and sense-making skills is a shared objective (Kilpatrick et al., 2001:411; NCTM, 2014:3). This means that the participants acknowledged the importance of establishing a healthy teacher-parent relationship and regular communication that enhances parents' willingness to support their child with mathematics homework, which improves mathematical proficiency (Jourdain & Sharma, 2016:53; Dabell, 2021).

The themes of "intervention", "repetition", "patience", and "pre- and in-service training" are included in the category of intervention and consolidation strategies (see Table 4.14 above). Upon reflecting on the theme of intervention, it was found that this is a very important strategy for consolidating mathematical concepts (Hazell et al., 2019:50; Kilpatrick et al., 2001:411). According to Kilpatrick et al. (2001:411), intervention support can accelerate children's mathematical development as a means to build on their "informal" conceptual understanding, and the sooner this support is provided, the better.

Furthermore, “repetition” was also found as a critical strategy for consolidating mathematical concepts, especially for isiXhosa-speaking learners. In this regard, the participants repeated difficult concepts during mathematics lessons, as well as gave learners homework to further consolidate the mathematical concepts that were learnt in the class (Graven, 2016:37). Along the same lines as Kilpatrick et al. (2001:352), homework was used to increase procedural fluency and maintain mathematical skills through practice (Adam, 2018:6-7). In addition, if homework is to have educational value, it must be monitored and followed up on daily before the mathematics lesson (Kilpatrick et al., 2001:352). However, the results show that the participants did not understand the significance of referring to mathematics homework in the classroom.

Furthermore, as a means for teachers to accomplish a productive disposition towards the teaching of mathematics and improve learners’ mathematical understanding, it was found that “patience” was regarded as an important factor when teaching mathematics to isiXhosa-speaking learners (Kilpatrick et al., 2001:10; Ertac & Alan, 2018:2).

The final finding, addressing SRQ 2, was that participants identified an urgent need for “pre- and in-service training” to assist them in supporting isiXhosa learners with mathematical proficiency. As stated previously, just as mathematical proficiency consists of intertwined strands, teaching for mathematical proficiency requires correspondingly interrelated components for teachers to effectively teach mathematics (cf. Kilpatrick et al., 2001:10). In this regard, effective programmes for teacher training will prepare and develop teachers' understanding of the mathematics they must teach, how their learners acquire it, and how to assist their learning (Kilpatrick et al., 2001:10, DBE, 2018:8-13). As a result, collaboration between South Africa's ITE universities and the DBE is required to provide pre- and in-service teachers with the pedagogical training and discourse required to teach mathematics to African language learners in English LOLT classrooms (cf. Alex et al., 2020:12; South Africa, DBE, 2018:11-12). In addition, this training should be conducted in close collaboration with the DBE's most recent framework initiative of teaching mathematics for understanding, which is based on Kilpatrick's model of mathematics proficiency (cf. South Africa. DBE, 2018:11-13).

4.4.3 SRQ 3: What are Grade One teachers' experiences of teaching and learning strategies to enhance mathematical understanding?

Table 4.15: SRQs, objectives and deliberations on the findings

Sub-research question	Research objectives	Theme	Findings
SRQ 3: "What are Grade One teachers' experiences of teaching and learning strategies to enhance mathematical understanding?"	**Objective 3:** The researcher uses a qualitative data collection method to establish what (explore) Grade One teachers' experiences of teaching and learning strategies are to enhance mathematical understanding.	**CATEGORY TWO: HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES**	
		Theme 2.1: Planning and teaching	**Finding 15:** Effective mathematics instruction is experienced when the curriculum is adapted. **Finding 16:** Utilising scaffolding strategies to address the needs of the isiXhosa learners.
		Theme 2.2: Visual aids	**Finding 17:** Experienced visual representations and concrete objects are an effective strategy.
		Theme 2.3: Technology	See Finding 6: Technology implementation training.
		Theme 2.4: Maths is fun	See Finding 7: Mathematics must be enjoyed.
		Theme 2.5: Positive reinforcement	See Finding 8: Participation in mathematical activities and problem-solving needs to be positively reinforced.
		Theme 2.6: Parents	See Finding 9: Healthy teacher-parent relationships and regular communication enhance support for learners struggling with mathematics homework.
		CATEGORY THREE: INTERVENTION AND CONSOLIDATION STRATEGIES	
		Theme 3.1: Intervention	See Finding 10: Intervention is important for the consolidation of mathematical concepts.
		Theme 3.2: Repetition	See Findings 11 and 12: repetition is critical for the consolidation of mathematics education; lack of reference to previous homework.

		Theme 3.3: Patience	See Finding 13: Patience is the most important virtue in teaching mathematics to isiXhosa-speaking learners.
		Silent Theme 3.4: Pre- and in-service training	See Finding 14: There is an urgent need for pre-and in-service training on how to assist isiXhosa grade one learners with their mathematics understanding.
		CATEGORY FOUR: CHALLENGES	
		Theme 4.1: Lack of time	**Finding 18:** More time is needed to understand and consolidate mathematical concepts.
		Theme 4.2: Additional challenges across themes and categories	**Finding 19:** CAPS Mathematics Grades R–Three is content-heavy. **Finding 20:** COVID-19 pandemic regulations had an impact on mathematical intervention strategies both negatively and positively. **Finding 21:** The significance of Grade R-year. **Finding 22:** Lack of pedagogical skills regarding strategies such as code-switching and/or translanguaging. **Finding 23:** Lack of bilingual mathematics teaching materials.

To answer SRQ 3, namely: *"What are Grade One teachers' experiences of teaching and learning strategies to enhance mathematical understanding?",* the researcher interpreted the analysed data by focusing on the categories of "holistic and concrete teaching and learning strategies" (category two), "intervention and consolidation strategies" (category three), and "challenges" (category four). Consequently, the researcher attempted to gain an understanding of Grade One teachers' experiences of utilising various teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding.

In accordance with Kilpatrick et al.'s model of mathematical proficiency, it is asserted that understanding classroom practice involves knowing what mathematical content must be taught and how to plan, deliver, and evaluate effective lessons on that concept (Kilpatrick et al., 2001:379). It involves being aware of the learning objectives outlined in the CAPS as well as the resources available to assist learners in achieving those objectives. In addition, these understandings are obtained through classroom experiences, analysis, and reflection of one's own and others' practices (Kilpatrick et al., 2001:379). Consequently, the findings regarding SRQ 2 above, pertaining to the participants' understandings of employing various teaching and learning strategies, were derived from their own experiences with such strategies that assisted them in scaffolding isiXhosa learners' mathematical understanding. Hence, most of these experiences concerning the categories of "holistic and concrete teaching and learning strategies" and "intervention and consolidation strategies" consisting of the themes: *planning and teaching, visual aids, technology, Maths is fun, positive reinforcement, parents, intervention, repetition, patience*, and *pre- and in-service training* (see Table 4.15 above), were addressed in SRQ 2. Additional findings with regard to the participants' experiences of using teaching and learning strategies to enhance isiXhosa learners' mathematical understanding in terms of the categories of "holistic and concrete teaching and learning strategies" and "challenges" are discussed as follows:

In terms of "planning and teaching"**,** two additional findings revealed that the participants experienced effective mathematics instruction (i.e., enhancing procedural fluency) when they adapted the curriculum and/or their teaching methods to fit the individual needs of the isiXhosa learners. The findings revealed that these strategies were specific strategies (see Table 4.16 below) that were used as scaffolds to support isiXhosa learners' mathematical understanding. Moreover, in terms of the theme "visual aids", it was found that the participants' experiences of this strategy (i.e., visual representations and concrete objects) were one of the most effective strategies that supported isiXhosa learners' lack of language proficiency in English mathematics (cf. Kilpatrick et al., 2001:10; Saussure, 1959; Vygotsky, 1997; Sfard, 2008:81; Presmeg et al., 2016:19).

Furthermore, the category of "challenges" included participants' experiences of challenges in terms of the themes**, "**lack of time", and "additional challenges across themes and categories" (see Table 4.15 above).

With regard to the theme of "lack of time", the findings revealed that due to some isiXhosa learners taking longer to grasp mathematical concepts, the curriculum does not allow sufficient time for consolidation in this regard. In accordance with Kilpatrick et al.'s components of mathematical proficiency, the lack of time as well as the additional challenges across themes and categories described below, affect teachers' effectiveness in teaching mathematics for proficiency.

It was found that participants experienced the CAPS Mathematics Grades R–Three document as content-heavy, and to make things worse, they also had to deal with the continuous changing of ATPs. In this regard, curriculum reformers should eventually start recognising that it is difficult for teachers to adapt to curriculum changes if they are rushed and they are not provided with the proper training and resources (Govender, 2018:5). The findings further disclosed that CAPS has too many concepts to cover in a small amount of time, and as a result, teachers find it difficult to keep up as they plan and teach at the level of the isiXhosa learner, who is not always on par with the curriculum's time frame (cf. Goetze, 2016). The findings regarding the COVID-19 pandemic's regulations in terms of social distancing, restricted certain intervention strategies such as group work and/or working in pairs ("buddy system"), which participants believed influenced their chances of providing better support to isiXhosa learners, as these specific intervention strategies had great advantages (cf. Di Pietro et al., 2020:9). However, although this latter challenge was experienced as a negative, the positive finding revealed that a smaller intake of learners on a weekly rotational basis (i.e., an average total of 17 learners instead of the usual total of 29 to 37) enabled the participants to work more individually (teacher-learner) with isiXhosa learners who needed support and guidance.

Furthermore, challenges were experienced with regard to isiXhosa learners who did not have Grade R as a foundation. Hence, the participants deemed the Grade R-year as compulsory to lay the necessary foundations for conceptual understanding and mathematical skills for further learning in mathematics and language prior to entering formal teaching in Grade One (cf. Hazell et al., 2019:49; Kilpatrick et al., 2001:174). Finally, the findings regarding a lack of pedagogical skills in terms of second language acquisition strategies such as code-switching and/or translanguaging, as well as a lack of bilingual mathematics teaching materials, were highlighted as the remaining two challenges for which teachers require guidance and/or development to effectively teach mathematical proficiency (cf. Mahofa, 2014:30; Chikiwa & Schäfer, 2019:134).

4.4.4 SRQ 4: How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?

Table 4.16: SRQs, objectives and deliberations on the findings

Sub-research question	Research objectives	Theme	FINDINGS BASED ON IDENTIFIED TEACHING AND LEARNING STRATEGIES
SRQ 4: "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?"	**Objective 4:** The researcher uses a qualitative data collection method to establish how (describe) teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.	**CATEGORY TWO: HOLISTIC AND CONCRETE TEACHING AND LEARNING STRATEGIES**	
		Theme 2.1: Planning and teaching	**Strategy 1:** Step-by-step teaching in a simplified (everyday) English (i.e., instructions, methods and/or procedures) **Strategy 2:** Employ several planning and teaching strategies imbedded in a holistic approach. **Strategy 3:** Know every individual learner and plan for their various learning styles (through visuals, through auditory, movement, through sensory, role play) **Strategy 4:** Expose learners to different problem-solving methods (including drawings or concrete apparatus) **Strategy 5:** Link concepts to learners' everyday life **Strategy 6:** Adjust teaching methods (prior or during teaching) to fit the needs of the learner **Strategy 7:** Interactive mathematics lessons **Strategy 8:** Music, songs, rhymes **Strategy 9:** Build lessons on learners' prior knowledge **Strategy 10:** Incorporate mathematics into other subjects **Strategy 11:** Promote mathematical discourse (Opportunities for explaining and/or discussing mathematical problems; ask questions)

		Theme 2.2: Visual aids	**Strategy 12:** Maths wall (i.e., numbers, number names, counting posters, visual representations of difficult concepts, various terminology with pictures) **Strategy 13:** Manipulation of concrete objects and resources (colourful counters, base ten blocks, playdough, Maths games, number line, 100-chart, fingers, dice, whiteboard, other everyday objects in class) **Strategy 14:** Dramatising (word problems, difficult and/or new concepts, using the body to explain symmetry) **Strategy 15:** Visual "crutches" (Visual step-by-step methods to solve mathematical problems)
		Theme 2.3: Technology	**Strategy 16:** Educational videos
		Theme 2.4: Maths is fun	See Strategy 13: Manipulation of concrete objects and resources See Strategy 14: Dramatising
		Theme 2.5: Positive reinforcement	**Strategy 17:** A positive atmosphere is important **Strategy 18:** Small gestures (i.e., a smile) to show you are proud of a learner's progress **Strategy 19:** Reward learners for their achievements – big or small (positive words of encouragement, a sticker in book)

		Theme 2.6: Parents	**Strategy 20:** Develop and maintain good teacher-parent relationships (start interacting from an early stage, WhatsApp groups, parents as resources to help learners learn mathematics, guide parents with the mathematics homework) **Strategy 21:** Send apparatus home that assists with mathematics homework (lesson recordings, flash cards, clear step-by-step instructions via WhatsApp) **Strategy 22:** Maths flip-file (which includes: step-by-step methods, visual representations of difficult concepts, Maths games, activities, number names, number symbols, 100-block, number line, and terminology)
		CATEGORY THREE: INTERVENTION AND CONSOLIDATION STRATEGIES	
		Theme 3.1: Intervention	**Strategy 23:** One-on-one (teacher-learner) support **Strategy 24:** Buddy system for isiXhosa HL support **Strategy 25:** Didactic classes (extra classes in small groups) **Strategy 26:** Learning support professionals
		Theme 3.2: Repetition	**Strategy 27**: Repeat concepts in class **Strategy 28:** Homework for consolidating mathematical concepts
		Theme 3.3: Patience	See Finding 13: Patience is the most important virtue in teaching mathematics to isiXhosa-speaking learners. See Strategy 26: Repeat concepts in class
		Silent Theme 3.4: Pre- and in-service training	See Finding 14: There is an urgent need for pre-and in-service training on how to assist isiXhosa Grade One learners with their mathematics understanding.

In response to SRQ 4, *"How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?",* the researcher interpreted the data by focusing on the same two categories as SRQ 2 and SRQ 3, namely "holistic and concrete teaching and learning strategies" and "intervention and consolidation strategies", as these were the strategies acknowledged by the participants. Additionally, these strategies were also experienced by the participants as sufficient and significant teaching and learning strategies that enhanced isiXhosa learners' mathematical understanding. Thus, the researcher wanted to establish how Grade One teachers utilised these teaching and learning strategies that improved the mathematical understanding of isiXhosa-speaking learners in English Grade One classrooms.

As the five strands of Kilpatrick et al.'s (2001:5) mathematical proficiency model are known to be intertwined and the components interrelated, so are the teaching and learning strategies based on the findings (see Table 4.16 above). In this respect, the researcher discusses the teaching and learning strategies applicable to each component, respectively.

- **Conceptual understanding:**
  - **Category Two: Holistic and concrete teaching and learning strategies**

    With regard to "planning and teaching", the participants scaffolded their teaching and learning in a holistic approach. In this regard, the participants linked mathematical concepts to the isiXhosa learners' everyday experiences, which assisted them with their mathematical understanding (Naudé & Meier, 2019:1-2; Banse et al., 2016:101). The participants planned their mathematics lessons according to the learners' various learning styles (through visuals, through auditory (music, songs, rhymes), kinaesthetic (movement, role play), and through sensory) as these semiotic systems supported isiXhosa learners' understanding of mathematics (Radford & Sabena, 2015:168; Chou, 2021). Furthermore, the teachers planned mathematics lessons in accordance with the learners' prior knowledge (Bosman & Schulze, 2018:2). Incorporating mathematics into other subjects improved the isiXhosa learners' mathematical learning in more than one way (Schüler-Meyer et al., 2019:324).

    The participants found "visual (and concrete) resources" as the most sufficient strategy to accommodate the isiXhosa learners' lack of fluency in English mathematics proficiency (Chikiwa & Schäfer, 2019:127). IsiXhosa learners understood mathematics better when they could manipulate concrete and visual resources (i.e., colourful counters, base ten blocks, playdough, Maths games, number line, 100-chart, fingers, dice, whiteboard, and other everyday objects in class). Supplementing visual representations with dramatisations (i.e., drawing pictures of story sums on the board while the teacher also acts out the story), boosted the isiXhosa learners' conceptual understanding (Radford & Sabena, 2015:168; Chou, 2021). "Maths walls" with visual representations (i.e., numbers, number names, counting posters, visual representations of difficult concepts, various terminology with pictures) further supported the isiXhosa learners with their mathematical language proficiency (Radford & Sabena, 2015:168). Visual step-by-step methods to solve mathematical problems were grasped easily by the isiXhosa learners (Kilpatrick et al., 2001:413).

In terms of utilising "technology" during mathematics lessons, it was found that educational videos enriched isiXhosa learners' learning experiences and understanding (Rajadell & Garriga-Garzón, 2017).

The participants identified the significance of "parents" as an effective resource to assist isiXhosa learners with their conceptual understanding of mathematics. In this respect, the participants developed good teacher-parent relationships from the start and maintained these relationships via WhatsApp groups as these groups were used to guide parents with the mathematics homework (Jourdain & Sharma, 2016:53; Dabell, 2021).

- **Category Three: Intervention and consolidation strategies**

  With regard to "interventions", didactic classes (intervention in smaller groups) were identified as a strategy that enabled the isiXhosa learners to participate in mathematics discourse without the added stress of public speaking and developed their mathematical proficiency (Haynes, 2020).

  The participants disclosed the use of repetition and homework as two strategies for consolidating isiXhosa learners' understanding of mathematics content while also developing their overall English language abilities (Freeman, 2012:53).

- **Procedural fluency:**
  - **Category Two: Holistic and concrete teaching and learning strategies**

    It was found that due to isiXhosa learners' not always understanding what the teacher reads or speaks, using a simplified (everyday) English, the participants employed a step-by-step teaching approach by which they encouraged isiXhosa learners to demonstrate a deeper conceptual understanding of mathematics, such as through explanations of why a procedure works and how it relates to a previously-learned method; the use of multiple representations to illustrate the meaning of a method; or the successful completion of application-based activities (CGCS, 2016:11). Additionally, the participants equipped parents with the necessary resources such as lesson recordings, flash cards, clear step-by-step instructions via WhatsApp, and a Maths flip-file (which includes step-by-step methods; visual representations of difficult concepts; Maths games; activities; number names; number symbols; and terminology) to enable the parents to effectively assist their children at home, continuing to consolidate the mathematics learnt at school.

- **Strategic competence:**
  - **Category Two: Holistic and concrete teaching and learning strategies**

    The participants exposed the isiXhosa learners to different problem-solving methods and techniques, mostly concrete or visual representations such as drawings, to help the learners make connections to what they already know as a means of scaffolding, and to help them communicate their own thinking in this regard (Banse et al., 2016:102). In the same way, whenever isiXhosa learners seemed to be having trouble understanding a Maths concept, the participants always went back to drawings and/or physical tools (visual representation) to support them.

  - **Category Three: Intervention and consolidation strategies**

    The participants referred to one-on-one (teacher-learner) support as well as the "buddy system" (peer modelling) that assisted the isiXhosa learners in the classroom.

- **Adaptive reasoning:**
  - **Category Two: Holistic and concrete teaching and learning strategies**

    It was found that interactive lessons that promoted opportunities for mathematical discourse (i.e., asking questions, explaining and/or discussing Maths problems) helped the participants to develop isiXhosa learners' mathematical reasoning and knowledge of concepts (CGCS, 2016:5).

- **Category Three: Intervention and consolidation strategies**

  Didactic classes were identified as an effective strategy for supporting isiXhosa learners in addressing their individual learning needs in a small group setting. As a result, the small group settings aided and encouraged the isiXhosa learners to use the LOLT as often as possible (Haynes, 2020).

- **Productive disposition:**
  - **Category Two: Holistic and concrete teaching and learning strategies**

    The participants reported that a positive atmosphere during mathematics lessons is crucial. In this regard, the participants took out the fear of mathematics through positive words of encouragement, small gestures (i.e., a smile) to show their pride towards a learner and awarding learners' achievements (i.e., a sticker in their book). The participants' classrooms also displayed colourful Maths walls with visual "crutches" learners could look at to support their mathematical thinking (i.e., counting posters, visual representations of difficult concepts, terminology with pictures, numbers, number names, shapes etc.). isiXhosa learners enjoyed mathematics lessons when they engaged in the manipulation of concrete objects and resources (i.e., colourful counters, base ten blocks, playdough, Maths games, number line, 100-chart, fingers, dice, whiteboard, and other everyday objects in class).

  - **Category Three: Intervention and consolidation strategies**

    The participants indicated that, when necessary, additional support is provided by learning support professionals to further accommodate and assist the isiXhosa learner to become proficient in mathematics and not fall behind. The findings indicated that "patience" is the most essential virtue for teaching mathematics to isiXhosa-speaking learners, as everything must be repeated daily.

    The participants identified an urgent need for "pre- and in-service training" on how to assist isiXhosa learners in English Grade One classrooms to enhance their mathematical proficiency.

4.5 Conclusion

To summarise, this study's background, as well as a brief discussion of this study's methodological framework, were provided in Chapter One. A literature review was presented in Chapter Two as a backdrop to the theoretical framework, and was then used to articulate and formulate the findings presented in Chapter Four. Chapter Three gave an in-depth explanation of the research methodology as well as the techniques that were utilised to collect, analyse, and validate the participants' data. Additionally, Chapter Three discussed the ethical considerations and limitations encountered during the course of this research. The current chapter, Chapter Four, provided the reader with answers to the research questions, which were based on a description of the biographical profiles of the six selected Grade One participants, the themes that were derived from the data analysis, and the reviewed literature and deliberations on the findings. In Chapter Five, the research findings will be summarised, concluded, and recommendations will be made.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The aim of this study was to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. The first chapter introduced a synoptic overview of the research topic and background. It also provided the research problem, the main research question and SRQs, the research aim and objectives, as well as a short description of the research steps and methodology that were employed. Chapter Two presented an in-depth literature review related to this study. Chapter Three gave a detailed description of the research methods that were employed, as well as mentioned the limitations that were encountered during the study. Chapter Four presented a detailed analysis of the data and an in-depth discussion of the subsequent findings. In concluding this research study, Chapter Five provides a summary, conclusion, and recommendations of this study's methodology and findings in relation to the theoretical framework.

5.2 Summary, conclusions, and recommendations regarding the research methodology

5.2.1 Summary of the research methodology

The following research question served as a guide for addressing the research problem of this study, namely: "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?" Furthermore, the researcher formulated the following SRQs that assisted her in answering the research question, namely: 1) "What are Grade One teachers' understandings of mathematical language?"; 2) "What are Grade One teachers' *understandings* of teaching and learning strategies to enhance mathematical understanding?"; 3) "What are Grade One teachers' *experiences* of teaching and learning strategies to enhance mathematical understanding?"; and 4) "How are Grade One teachers using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms?" To answer the research question and four SRQs, the researcher used Northcutt and McCoy's IQA Systems Method (2004:44) to conduct a qualitative interpretive case study. The research design allowed the researcher to identify a population, draw a sample from that population, and then employ unstructured open-ended focus group interviews, semi-structured individual interviews, and lesson observations to explore, describe, and understand current mathematics practices within the context of English Grade One classrooms.

The population of the study was comprised of all Grade One teachers in the Western Cape. By employing the purposive sampling technique, the researcher drew a sample from the population by intentionally selecting four schools located in the MEED with isiXhosa HL-speaking learners in English Grade One classrooms and eleven Grade One teachers (nine teachers representing three public primary schools and two teachers representing one independent primary school) as participants for this research study (cf. Creswell, 2018:125; Okeke & van Wyk, 2015:295; Cohen et al., 2018:217). The participants were chosen to provide the researcher with a rich and complete narrative of their views, experiences, and feelings about using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms (cf. Mohajan, 2018:11-12; Cohen et al., 2018:375). The researcher gathered this information by employing an adapted IQA method of data collection. In this regard, original IQA studies usually collect data using two methods, such as unstructured open-ended focus group interviews and semi-structured individual interviews (cf. Northcutt & McCoy, 2004). However, the researcher added an additional data collection method, namely, field observations of mathematics lessons. As a result, data was gathered by the researcher through two focus group interviews to build an interview framework. This framework then guided the researcher to collect data during the observations of mathematics lessons and the semi-structured individual interviews.

Data analysis occurred in three successive stages. The **first stage** of data analysis transpired interactively with the participants of the unstructured open-ended focus group interviews. During this interactive engagement, the focus group participants brainstormed and wrote-up on cards [inductive analysis] their thoughts, perceptions, experiences, and feelings regarding the research statements [based on the SRQs]. The brainstorming activity was followed by a deductive analysis activity whereby the participants sorted and clustered the written cards into groups, which formed the themes. The written themes were furnished with descriptive paragraphs, which formed the interview framework. The **second stage** of the data analysis was another adaptation to the original IQA and took place when the transcribed semi-structured individual interviews were analysed with the aim of identifying patterns using John Stuart Mill’s Analytic Comparison technique as an analytical tool (cf. Neuman, 2014:493). The **third stage** involved analysing the transcripts of the field observations of mathematics lessons, again using John Stuart Mill's Analytic Comparison technique as an analytical tool, to gain a chronological perspective on what occurred in each of the individual participants' mathematics lessons. A synthesis was developed by comparing the data analysis of the individual interview transcriptions to the data analysis of the field notes from the mathematics lessons. After collecting and analysing the data, the researcher conducted a literature check by using current and relevant literature as a backdrop to articulate and formulate the findings. Maxwell's five categories of validity in qualitative research (Maxwell, 2016:37-64) and Auerbach and Silverstein's (2003) criterion of transferability were used to validate the data (as described by Thomson, 2011:77-82). The IQA interviewing techniques, data collection methods, and member checking were used to ensure the descriptive validity of the data in this study. Intertwined with the descriptive validity, the interpretive validity involved the participants' providing their own data and analysis during the focus group interview. Furthermore, transcripts of the individual interviews and classroom observations included both the verbal and non-verbal responses gathered from the participants to validate the data they supplied during the focus group interview. After the participants of the focus group interview identified the themes and sub-themes, the researcher had to conduct a literature review to ensure the theoretical validity. The themes and sub-themes were supported by literature and verbatim quotes. Based on the findings from the data and the literature, conclusions were subsequently drawn. Finally, by drawing inferences from the data analysis, the literature review, and the theoretical framework, the evaluative validity was confirmed.

In terms of this study's ethical considerations, participation was entirely voluntary and prior informed consent was necessary. Efforts were made to ensure that the participants were not harmed in any way. Additionally, anonymity, confidentiality, and privacy were protected to the greatest extent possible. From the preceding summary, the following conclusions were drawn.

5.2.2 Conclusions based on the implementation of the research methodology

Exploring, describing, and understanding the experiences of a particular population (i.e., selected Grade One teachers) made this study suited for the qualitative research approach. The design chosen for this research study allowed the researcher to make well-informed decisions on sampling, data collection, and data analysis methods. It was determined that the IQA Systems Method was the best approach to reduce the researcher's "subjectivity" and potential bias since the IQA participants, not the researcher, were actively involved in the data collection and analysis process (Bargate, 2014:11). Additionally, during the follow-up individual interviews, non-verbal responses, probing, encouragement, and reflective summaries were believed to be the most successful interviewing techniques for preventing the researcher from influencing the participants' responses. Moreover, the mentioned approach described in the summary above (§5.2.1) for this study's qualitative data analysis ensured that the researcher had in-depth data that accurately reflected reality and produced a structured sequence of events that occurred during the data collection process. Furthermore, the researcher conducted a preliminary literature review and identified a theoretical framework as the background for the study. After collecting and analysing the data, the researcher conducted a literature control by using current and relevant literature as a backdrop to articulate and formulate the findings. The structure for the data verification procedure ascertained that this study's data validity was successfully managed. This revealed that the descriptive, interpretative, theoretical, and evaluative components of validity were taken into account. The participants' anonymity, confidentiality, privacy of information, and informed consent were recognised as part of the ethical conduct and served as a framework for their participation decisions (Kumar, 2014:212; Okeke & Van Wyk, 2015). The conclusions guided the recommendations for the methodology of the research. The section that follows explains these recommendations.

5.2.3 Recommendations regarding the research methodology

The following recommendations are derived from the research methodology's findings and conclusions.

- When the research problem and research question(s) indicate the need to collect data that explores, describes, and understands people in their natural context, interpreting the research problem from the participants' perceptions, experiences, and feelings, the qualitative research approach is recommended (McMillan & Schumacher, 2014:370-371).
- The IQA case study research design is recommended for exploring, describing, and understanding the phenomenon in its natural context in which the participants operate. Furthermore, this IQA case study design, which is descriptive and interpretative in nature, can be used to assist the researcher to identify a population and conduct rich, in-depth descriptions of the case, analyse the themes, and, at the end, interpret the findings.
- As IQA case study designs focus on understanding the experiences of a specific group of individuals within a specific context, the purposive sampling technique is viewed as being specifically helpful (Cohen et al., 2018:375, 217).
- Furthermore, the IQA Systems Method is recommended since it reduces "subjectivity" and limits any possible form of researcher bias. This is due to IQA participants, rather than the researcher, actively participating in the data collection and analysis process (Bargate, 2014:11).

- It is also suggested that non-verbal responses, encouragement, reflective summaries, and probing techniques be employed to make sure that participants are motivated to fully explore the research topic from their individual perspectives while preventing the researcher from influencing the participants' responses.

5.3 Summary, conclusions and recommendations regarding the findings

5.3.1 Summary of the findings of this research study

The categories and themes derived from the data analysis will be discussed in brief.

5.3.1.1 Category One: Mathematical language

- Participants, in their own perceptions and experiences, shared a variety of viewpoints about the theme of *the language of mathematics*. For this aspect, the participants believed that mathematics is a language of its own with a special vocabulary (a distinct "register" belonging to mathematics) (cf. Le Cordeur & Tshuma, 2019:107). Hence, the participants asserted that the language of mathematics is a new language that needs to be acquired by both the English-speaking and isiXhosa-speaking Grade One learners. However, it was perceived that the isiXhosa learners are further behind than the English learners as they first need to understand the language that mathematics is taught in (i.e., English LOLT) before they will be able to make sense of mathematics itself (cf. Sibanda & Graven 2018:3; Mulaudzi, 2016:165). Aside from the reality that mathematics has its own register, two participants stressed that the mathematics terminology can be difficult for some learners because these specific terminologies are unfamiliar to learners from other cultural and/or linguistic backgrounds (cf. Ní Ríordáin et al., 2015:12-13). Consequently, the participants acknowledged the important role that language plays in the understanding of mathematics and endorsed the importance of understanding the English LOLT when mathematical concepts are introduced (cf. Bruner, 1975; Vygotsky, 1962; Moschkovich, 2012a:95; Sfard, 2008; Barwell, 2016; Presmeg et al., 2016:11-15; Robertson & Graven, 2020; Das, 2020:106-107). Therefore, the participants claim that learners need to hear both the English LOLT and the language of mathematics often enough in order to remember and utilise it when mathematical concepts are introduced (cf. Essien, 2018:50). One participant was also of the opinion that the language of mathematics requires the same didactic strategies that are similar to those utilised in acquiring any other language (cf. Le Cordeur & Tshuma, 2019:107; Robertson & Graven, 2019:20).

5.3.1.2 Category Two: Holistic and concrete teaching and learning strategies

In this category, the data from Focus Group One and Focus Group Two pointed to six themes, namely: 1) planning and teaching; 2) visual aids; 3) technology; 4) Maths is fun; 5) positive reinforcement; and 6) parents. These themes are discussed below:

- In terms of "planning and teaching", the participants reported that their planning and teaching strategies are imbedded in a holistic approach (cf. Mahmoudi et al., 2012:179). In addition, the participants believe that for learners to grasp mathematical concepts, teaching and planning must be linked to their everyday life and/or experiences (cf. Naudé & Meier, 2019:1-2). In this regard, the participants based their word sums on learners' everyday experiences, for example, using learners' names within the word sums. Furthermore, to bridge some language gaps, the participants used short and simplified everyday English when word sums such as sharing, adding, and subtracting were introduced with everyday objects such as lollipops, sweets, friends, crayons, book pages, etc. (cf. Jourdain & Sharma, 2016:51). The participants further acknowledged the importance of learners' different learning styles (i.e., visual, auditory, and kinaesthetic) and asserted that isiXhosa-speaking learners gained a better understanding of mathematical content when teachers planned to accommodate their different learning styles (cf. Chou, 2021). In this aspect, the participants stressed the importance of knowing every individual learner in order to plan and to provide for their various learning styles. Thus, the participants adapted their teaching methods and employed various teaching strategies. These adaptations of methods and/or strategies included the teaching of mathematical concepts through visuals (i.e. mathematics word-wall, counting charts, drawings, and educational videos), through auditory (i.e., songs, rhymes, and music), through kinaesthetic (i.e., through role playing story sums and/or difficult concepts and dancing to counting songs), through sensory (i.e., manipulating objects when solving Maths problems), and step-by-step methods for solving specific mathematical problems. Another aspect that the participants pointed out was adapting the curriculum itself to fit the needs of the isiXhosa learners by building on what they know (cf. Ayieko, 2017:31; South Africa. DBE, 2011a:5). Hence, the participants argue that they would rather move things around in the curriculum and/or their planning until the learners are ready to be taught a new concept. The findings pointed to the importance of holistically incorporating various scaffolding strategies (i.e., multi-semiotic systems), building on learners' prior knowledge, to relay mathematical concepts to isiXhosa-speaking learners who struggle to make sense of mathematical concepts (cf. Bosman & Schulze, 2018:2). Moreover, preferences were given to strategies that included visual aids. Additionally, one participant stated that she incorporates mathematics into other subjects which strengthens the holistic approach and enhances learners mathematical understanding (cf. Ariba, 2017:25-26; Schüler-Meyer et al., 2019:324).

- In terms of "visual aids", the participants reported the implementation of the semiotic resource of visual representations as a strategy related to the method of scaffolding. According to them, scaffolding during mathematics lessons takes place when they use visual manipulatives, either concrete objects or visual representations, to help learners make connections to what they already know as a means of scaffolding and communicating their own thinking. In this regard, the participants employed visual representations such as pictures, drawings, and concrete objects, supplemented in some instances by the bodies and/or dramatisations of the learners (cf. Arzarello et al., 2009; Banse et al., 2016:102). Furthermore, the participants emphasised how these visual aids aided isiXhosa learners who were not fluent in English to make sense of the mathematics activities (cf. Chikiwa & Schäfer, 2019:127). For example, the participants used drawings and/or pictures to teach learners various step-by-step methods for solving different word sums. The participants also highlighted the significance of engaging isiXhosa learners that struggle to grasp mathematical concepts by physically manipulating concrete objects and resources during their mathematics lessons for better understanding (cf. Chikiwa & Schäfer, 2019:128). Additionally, the participants also pointed out that they enhanced the manipulation of concrete apparatus by introducing mathematical games and play-money, which they believed to be one of the best ways to reach isiXhosa-speaking learners and make Maths more sense to them. As a result, the findings revealed that the participants valued visual aids (visual representations and concrete objects) as the most suitable strategy to help isiXhosa learners with the understanding of mathematics.
- Most of the participating teachers were specifically in favour of infusing their mathematical lessons with "technology" as a means for reinforcement, making Maths fun, and using technology as a semiotic tool to relate mathematics to learners. However, despite believing in the advantages of technologies, the findings indicated that there was a lack of access to it as well as limited time available for teaching with technology. As a result, only two participants successfully implemented technology as a resource (i.e., educational videos and visual representations on the whiteboard) during their mathematics lessons (cf. Morgan et al., 2014:12; Rajadell & Garriga-Garzón, 2017).
- With regard to making "mathematics fun", the participants in this study recommended that mathematics activities be taught in a joyful and playful manner, which leads to incidental learning and a better understanding and memory of mathematical concepts (cf. Arthur et al., 2017:21; Bakar & Samsudin, 2021:279). Activities such as matching number games, competitive mental Maths games (girls vs. boys), playing shop with

paper money, manipulating concrete objects, interactive activities, and using real-life objects to demonstrate certain mathematical concepts were employed by the participants.

- In terms of "positive reinforcement", the findings revealed that positive reinforcement was highly regarded and occurred spontaneously by the participants during their mathematics lessons. These participants believe that acknowledging a learner's efforts and showing the learner that the teacher believes in him or her motivates the learner to improve his or her mathematical abilities (Ayuwanti, 2021:665; Khanal, 2015:294-295). Thus, when teachers employ positive reinforcement strategies, they encourage learners by using small gestures (i.e., a smile), a sticker in learners' books, praising learners' progress (i.e., whole class clapping hands), and other reward systems. Although only the participants from Focus Group One acknowledged the importance of positive reinforcement to support learners' mathematical learning, it was observed during the mathematics lessons that all the participants did indeed encourage their learners spontaneously in mastering mathematics content and skills. Subsequently, these positive reinforcements led to a classroom atmosphere where the Grade One learners were eager to participate in mathematical activities.
- The participants in this study acknowledged the pivotal role "parents" and regular communication between teachers and parents play in their children's holistic development. The participants explained that establishing and maintaining good teacher-parent relationships is very important in order to assist both the learner and his or her parents with mathematics challenges when the learner struggles with homework. In this aspect, the participants recommended that a digital platform, such as WhatsApp groups, is a useful tool to interact and communicate between parents and teachers on a regular basis (cf. Dabell, 2021). Thus, the participants regard parents and/or guardians as resources to help learners learn mathematics and enhance their understanding of mathematical concepts. However, as all parents and/or guardians have very different maths experiences, the findings reported that the participants guided the parents via WhatsApp groups to help with their child's mathematics homework (cf. Jourdain & Sharma, 2016:53; Dabell, 2021). These guidelines and support strategies include simple homework instructions; making the maths homework as visual as possible; sending resource apparatus home to assist struggling learners; a mathematics homework file with all the necessary explanations and/or examples of concepts and step-by-step problem-solving methods; and lesson recordings. As a result, in this present study, providing clear and simple step-by-step instructions on how to assist the isiXhosa-speaking learner with mathematics homework has a positive effect on parents' willingness to support their child.

5.3.1.3 Category Three: Intervention and consolidation strategies

The findings regarding this category identified four themes, namely: 1) intervention; 2) repetition; 3) patience; and 4) pre-and in-service training.

- The findings regarding the theme "intervention" revealed three classroom-level support strategies that teachers employed in an English LOLT classroom to assist isiXhosa-speaking learners with the understanding of mathematics, namely: 1) buddy system; 2) didactic classes; and 3) one-on-one (teacher-learner) support. In terms of the buddy system together with the means to support learners with the mastering of mathematics outcomes, the participants explained that they would pair learners up with a buddy to discuss possible solutions to mathematical problems and/or consolidate mathematical concepts without the fear of embarrassing themselves. Another example includes, weaker learners playing mathematical games with a stronger learner as this teaches them certain mathematical skills incidentally (cf. Hazell et al., 2019:50; Haynes, 2020). Furthermore, while only one participant mentioned using learners' HL as a strategy, the buddy system can be effective as well, especially if other isiXhosa learners who understand the difficult mathematical concepts are included as buddies to explain to their peers in the mother tongue how to go about solving mathematical problems and/or grasping difficult concepts. The findings further determined that specific interventions (i.e., didactic classes) took place after school hours to help isiXhosa learners consolidate the work that had been done during the day, which the teacher and learners also enjoyed (cf. Ji Yeong, 2011:22; Haynes, 2020). However, the findings revealed that one-on-one (teacher-learner) support was the primary intervention strategy when the participating teachers assisted the isiXhosa Grade One learners who struggled to understand the mathematical concepts or the language in which they are explained. In addition, some participants identified the value of other professionals, such as 1) a learning support teacher, 2) a remedial teacher, and 3) an intern (i.e., teaching assistant). These support systems are usually provided by the SBST (cf. Hay, 2018:4-5). According to the participants, these learning support professionals would assist very weak learners, learners who do not know a word of English (i.e., the classroom's LOLT), and learners who struggle to grasp difficult concepts (cf. Van Niekerk & Pienaar, 2018:9-11).
- Concerning the theme "repetition", the participants reported that repetition is critical for consolidation in mathematics education, especially for the isiXhosa-speaking learners. They argue that learners who do not understand the LOLT in which mathematics is taught (i.e., English mathematics register) needs repetitive teaching of concepts in different ways in order to consolidate mathematical concepts and the understanding thereof (cf. Freeman, 2012:53). In this regard, the findings indicated that repetition

focused on homework as a strategy for consolidation, as well as the repetitive use of a variety of teaching and learning resources (i.e., different scaffolding strategies) to consolidate learners' understanding of specific mathematics concepts learned during mathematical lessons (cf. Graven, 2016:37). However, even though the participants viewed homework as an important intervention strategy, the findings revealed that the participants did not make any references to prior mathematical knowledge and skills during the observations of their maths lessons as a means to determine whether such knowledge and skills by learners were actually mastered and strengthened by the said homework (cf. Cirillo et al., 2015; Adam, 2018:13).

- Due to a lot of repetition, extra support, and consolidation to enhance isiXhosa-speaking learners' mathematical understanding, participants regarded "patience" as a key factor in this regard. The participants believed that patience needs to be exercised by the teacher if a specific mathematical concept is to be understood and internalised by learners. The participants elaborated further on the concept of patience, as they pointed out that teachers need to be empathetic to learners and what they experience when they struggle to master mathematical concepts in a language that is different to their HL (cf. Ertac & Alan, 2018:2). Consequently, the findings confirmed that all the participants deemed "patience" as a virtue in assisting, guiding, and supporting isiXhosa grade one learners who are confronted with two challenges in the classroom, namely understanding and mastering mathematical concepts and skills, as well as being confronted with having a limited understanding of the English LOLT.
- In terms of the silent theme "pre- and in-service training", findings indicated that teachers believe that knowing how to communicate in isiXhosa could help them support isiXhosa learners with their mathematical understanding (cf. Chikiwa & Schäfer, 2019:134). However, participants reported that they are not able to speak the isiXhosa learner's HL, especially when it comes to the teaching of mathematics. Hence, they "stick to the (English) LOLT" (i.e., English) of the classroom. One participant pointed out that she was aware of the strategy "code-switching" but said she never used it in her mathematics lessons as she only had training on supporting learners with language barriers in general, which did not focus on learning mathematics (cf. Chikiwa & Schäfer, 2019:134). Furthermore, participants reported receiving no specific training at university on how to support isiXhosa-speaking learners concerning the teaching and learning of mathematics (cf. Alex et al., 2020:12). Additionally, findings further revealed that participants also experienced a lack of in-service training focusing on mathematical support for isiXhosa-speaking learners. As a result, the findings described a dire need for pre- and in-service training, specifically in how to support isiXhosa-speaking learners

with mathematics education in an English LOLT classroom at both university and occupation/school level (cf. Alex & Roberts, 2019:71; Graven, 2020:86).

5.3.1.4 Category Four: Challenges

The category challenges pointed to two themes, namely: 1) lack of time; and 2) additional challenges across themes and categories. These are discussed below:

- In terms of "limited time", participants believed the time allocation of mathematics in Grade One is problematic. On the one hand, a lack of time limits the time available to introduce, explain, clarify, and give opportunities to experience mathematical concepts concretely and hands-on by grade one learners. On the other hand, the lack of time further complicates matters since the participants need to convey mathematical concepts in a language (LOLT) that some isiXhosa learners are not proficient in and which is thus very time-consuming. As a result, participants reported that some isiXhosa-speaking learners took longer to grasp mathematical concepts and that there was not enough time to consolidate these concepts (cf. Jourdain & Sharma, 2016:45).
- With regard to "challenges across themes and categories", participants experienced challenges in terms of CAPS, inconsistent ATPs, teacher-learner ratio, the impact of the COVID-19 pandemic, Grade R as a foundation, and insufficient resources.
    - The participants experienced the work allocation as stipulated by the CAPS Mathematics Grades R–Three document as content-heavy as there were just too many concepts to cover, which does not allow for the creation of a strong foundation in mathematical understanding (cf. Goetze, 2016).
    - Furthermore, the participants elaborated on their frustration with the continuously changing ATPs, especially due to the COVID-19 pandemic (cf. DBE, 2021). In this regard, the findings revealed that curriculum reformers are not aware that it is difficult for teachers to adapt to curriculum changes if they are rushed, and if they are not provided with the proper training and resources (Govender, 2018:5).
    - Moreover, the participants experienced difficulties in assisting the isiXhosa learners one-on-one when the classroom sizes are too large (cf. Panthi & Belbase, 2017:14; Canbeldek & Isikoğlu Erdogan, 2017:259).
    - With regard to the COVID-19 pandemic regulations, the restrictions on social distancing compelled the participants to make adaptations in their classroom arrangements and specifically how to render support and intervention to Grade One learners struggling to grasp mathematical concepts. Hence, the participants were not allowed to teach in smaller groups and/or in pairs. Moreover, the participants also acknowledged the influence that the COVID-19 pandemic had on learners'

progress, as learners were attending school on a rotational basis (cf. Di Pietro et al., 2020:9; Shepherd & Mohohlwane, 2021:23).

- Furthermore, the participants believed that learners who did not have Grade R as a foundation prior to entering Grade One, had a negative influence on their mathematical performance as they lacked the necessary mathematical skills for Grade One (cf. Hazell et al., 2019:49).
- Concerning insufficient resources, the findings revealed that although the participants had the necessary visual and physical resources, they were unable to use isiXhosa learners' HL as a resource (i.e., code-switching and/or translanguaging) to explain difficult concepts during their mathematics lessons; and secondly, there was no evidence of bilingual teaching materials (i.e., English/isiXhosa) (cf. Robertson & Graven, 2020:2). This was just another indication that the DBE's initiative to support teachers in teaching mathematics for better understanding is not adhering to their advocacy to provide teachers with the necessary training and bilingual mathematics teaching materials in this regard (South Africa. DBE, 2018:83). Govender (2018:1) supports the latter statement by stating that numerous initiatives have been implemented ineffectively and have failed to achieve their objectives.

The aforementioned summary of the findings served as the basis for the following conclusions and suggested recommendations. These are discussed in the following sections.

5.3.2 Conclusion regarding the findings of this research study

As was previously stated, this research was conducted under the theoretical framework of Vygotsky's learning theory, which was incorporated into the five strands of the mathematical proficiency model by Kilpatrick et al. (2001). As indicated in Chapter Three, the conclusions will be based on the findings and presented alongside a literature control. In accordance with the conclusions that will be connected with the theoretical framework, the recommendations will relate to the five main strands in which teachers need to provide the necessary support to isiXhosa-speaking learners receiving mathematics education in an English Grade One classroom. The following table depicts the conclusions and recommendations:

Table 5.1: Conclusion based on Vygotsky's learning theory embedded within the five strands of the mathematical proficiency model by Kilpatrick et al. (2001)

FIVE STRANDS FOR MATHEMATICAL PROFICIENCY	STRATEGIES (SCAFFOLDS) BASED ON FINDINGS TO SUPPORT ISIXHOSA LEARNERS' MATHEMATICAL UNDERSTANDING
CONCEPTUAL UNDERSTANDING **Teacher:** Conceptual understanding of core mathematics knowledge, learners, and instructional practices required for teaching. **Learner:** Understanding or proficiency in mathematical concepts, operations, and relationships.	**Theme 1.1: The language [of mathematics]** It was found that participants had a clear understanding that mathematics has its own register (mathematical terminology) and should be learnt like any other language. Participants understood the significant role that language plays in learning mathematics and recommended that the language needs to be simplified (scaffolded) for mathematical understanding (Vygotsky, 1931:106). Findings highlight that it is necessary for teachers to provide targeted scaffolds (i.e., multiple semiotic systems) during mathematical discourse to meet isiXhosa learners' language needs to enhance their English mathematical proficiency development (CGCS, 2016:7; Walshaw, 2017:294). **Theme 2.1: Planning and teaching** Participants recommended that mathematical planning and teaching should be scaffolded through building on learners' prior knowledge, linking mathematical concepts to isiXhosa learners' everyday experiences, and teaching mathematics for various learning styles – through visuals (i.e. mathematics word-wall, counting charts, drawings, and educational videos), through auditory (i.e. songs, rhymes, and music), through kinaesthetic (i.e. through role-playing story sums and/or difficult concepts, and dancing to counting songs), and through sensory (i.e. manipulating objects when solving maths problems) (Naudé & Meier, 2019:1-2; Chou, 2021; Bosman & Schulze, 2018:2; Radford & Sabena, 2015:168). Mathematics should be incorporated into other subjects, which strengthens the total development of the learner and enhances their mathematical understanding on various levels (Ariba, 2017:25-26; Schüler-Meyer et al., 2019:324).

	<u>Theme 4.1 Lack of time</u> Participants reported that the time allocation for mathematics in Grade One does not allow enough time to introduce, explain, clarify, and give opportunities to experience mathematical concepts concretely and hands-on by Grade One learners. Furthermore, participants stated that some isiXhosa learners require more time to grasp mathematical concepts and that there is insufficient time to consolidate these concepts (Jourdain & Sharma, 2016:45). **<u>Theme 2.2: Visual aids</u>** It was found that semiotics such as visual (and concrete) resources (i.e., Maths wall, colourful counters, base ten blocks, playdough, Maths games, number line, 100-chart, fingers, dice, whiteboard, and other everyday objects in class) assisted the isiXhosa learners to grasp and understand mathematical concepts easily (Chikiwa & Schäfer, 2019:127). It was also recommended by the participants that teachers should give learners the opportunity to manipulate concrete and visual resources themselves. Participants recommended that dramatisation, together with visual representations (i.e., drawing pictures of story sums on the board while the teacher also acts out the story), boosted isiXhosa learners' conceptual understanding (Chou, 2021). Findings revealed that visual (i.e., pictures) step-by-step methods to solve mathematical problems were grasped more easily by isiXhosa learners (Kilpatrick et al., 2001:413; Radford & Sabena, 2015:168; Banse et al., 2016:102). **<u>Theme 2.3: Technology</u>** Educational videos and visual representations on the interactive whiteboard were identified as effective strategies that enriched isiXhosa learners' learning experiences and understanding (Morgan et al., 2014:12; Rajadell & Garriga-Garzón, 2017). Although participants recommended the infusion of mathematical lessons with technology for reinforcement, making Maths fun, and using technology to relate mathematics to learners, findings indicated that there was a lack of access to technology as well as limited time available for teaching with technology (Morgan et al., 2014:12; Rajadell & Garriga-Garzón, 2017).

	<u>**Theme 2.6: Parents**</u> Parent involvement was identified as an effective resource and strategy to assist isiXhosa learners with their conceptual understanding of mathematics (Jourdain & Sharma, 2016:53; Dabell, 2021). <u>**Theme 3.1: Intervention**</u> Didactic classes (intervention in smaller groups) were found to be an effective strategy that enabled isiXhosa learners to participate in mathematics discourse without the added stress of public speaking and develop their mathematical proficiency (Haynes, 2020). <u>**Theme 3.2: Repetition**</u> The participants recommended the use of repetition and homework as two strategies for consolidating isiXhosa learners' understanding of mathematics content while also developing their overall English language abilities (Freeman, 2012:53). Homework was regarded as an essential intervention strategy for consolidation. During the participants' mathematics lesson observations, however, they did not mention the learners' maths homework from the previous day. This was to be done to determine if the homework, which should be an important daily activity, aided in the learners' mathematical knowledge and skill development (cf. Cirillo et al., 2015; Adam, 2018:13). <u>**Theme 4.2 Additional challenges across themes and categories:**</u> o **Insufficient resources:** Findings revealed that, although participants believed that knowing how to communicate in isiXhosa could help them support other isiXhosa learners with their mathematical understanding, they were, however, unable to use isiXhosa learners' HL as a resource (i.e. code-switching and/or translanguaging) to explain difficult concepts during their mathematics lessons; secondly, there was no evidence of bilingual teaching materials (i.e. English/isiXhosa) (cf. Robertson & Graven, 2020:2). This was found to be an indication that the DBE's initiative to support teachers in teaching mathematics for better understanding is not adhering to their advocacy to provide teachers with the necessary training and bilingual mathematics teaching materials in this regard (South Africa. DBE, 2018:83).

	○ **CAPS:** The participants reported that the work allocation as stipulated by the CAPS Mathematics Grades R–Three document is content-heavy (cf. Goetze, 2016). ○ **Continuously changing ATPs**: Participants were found to be frustrated with the continuously changing ATPs (South Africa. DBE, 2021). In this regard, the findings also revealed that curriculum reformers are not aware that it is difficult for teachers to adapt to curriculum changes if they are rushed, and if they are not provided with the proper training and resources (Govender, 2018:5). ○ **COVID-19 pandemic regulations:** Participants reported that learners' progress was influenced due to the loss of school contact time (Di Pietro et al., 2020:9; Shepherd & Mohohlwane, 2021:23). ○ **Grade R as a foundation:** Learners who did not have Grade R as a foundation prior to entering Grade One lacked the necessary mathematical skills for Grade One mathematics (cf. Hazell et al., 2019:49).
FIVE STRANDS FOR MATHEMATICAL PROFICIENCY	**STRATEGIES (SCAFFOLDS) BASED ON FINDINGS TO SUPPORT ISIXHOSA LEARNERS' MATHEMATICAL UNDERSTANDING**
PROCEDURAL FLUENCY **Teacher:** Procedural fluency in carrying out basic instructional routines **Learner:** Procedural fluency refers to the ability to carry out procedures with adaptability, precision, efficiency, and competence. [The foundation for procedural fluency is conceptual comprehension, strategic reasoning, and problem solving].	**Theme 2.1: Planning and teaching** Participants recommended that teachers use simplified (everyday) English when mathematics is taught. For example, participants based their word sums on learners' everyday experiences, for example, using learners' names within the word sums and utilising everyday objects such as lollipops, sweets, friends, crayons, book pages, etc., to solve word sums (cf. Jourdain & Sharma, 2016:51). A step-by-step teaching approach was recommended to assist isiXhosa learners to effectively employ mathematical procedures. Findings revealed that teachers should equip isiXhosa learners with a variety of strategies to illustrate the meaning of a method or solving various maths problems and completing application-based activities successfully (CGCS, 2016:11).

	Theme 2.6: Parents Enabling parents to effectively assist their children with mathematics at home, participants recommended that teachers equip parents with the necessary resources such as lesson recordings, flash cards, clear step-by-step instructions via WhatsApp, and a Maths flip-file (which includes: step-by-step methods; visual representations of difficult concepts; maths games; activities; number names; number symbols; and terminology) (Jourdain & Sharma, 2016:53; Dabell, 2021).
FIVE STRANDS FOR MATHEMATICAL PROFICIENCY	**STRATEGIES (SCAFFOLDS) BASED ON FINDINGS TO SUPPORT ISIXHOSA LEARNERS' MATHEMATICAL UNDERSTANDING**
STRATEGIC COMPETENCE **Teacher:** Strategic competence in planning effective instruction and solving problems that arise while teaching. **Learner:** The ability to formulate, represent, and solve mathematical problems strategically.	**Theme 2.1: Planning and teaching** It was found that whenever isiXhosa learners appeared to be having difficulty grasping a mathematical concept, visual representations (drawings and/or physical tools) was found to be an essential strategy to assist them with their understanding (Radford & Sabena, 2015:168; Banse et al., 2016:102). **Theme 3.1: Intervention** Participants recommended one-on-one (teacher-learner) support as well as the "buddy system" (peer modelling) as two effective intervention strategies to assist isiXhosa learners when they encounter mathematical difficulties. The buddy system was found to work best when other isiXhosa learners who understand difficult mathematical ideas are paired with their peers to help them solve maths problems or understand difficult ideas in their mother tongue (Hazell et al., 2019:50; Haynes, 2020). **COVID-19 pandemic regulations** It was discovered that the restrictions on social distancing hampered participants' support and intervention to Grade One learners who were struggling to grasp mathematical concepts because they were not allowed to teach in smaller groups and/or pairs (Di Pietro et al., 2020:9; Shepherd & Mohohlwane, 2021:23).

FIVE STRANDS FOR MATHEMATICAL PROFICIENCY	STRATEGIES (SCAFFOLDS) BASED ON FINDINGS TO SUPPORT ISIXHOSA LEARNERS' MATHEMATICAL UNDERSTANDING
ADAPTIVE REASONING	**Theme 2.1: Planning and teaching** It was found that interactive lessons that promoted opportunities for mathematical discourse (i.e., asking questions, explaining and/or discussing maths problems) helped the participants to develop isiXhosa learners' mathematical reasoning and knowledge of concepts (CGCS, 2016:5). **Theme 3.1: Intervention** Participants recommended didactic classes as an effective strategy for supporting isiXhosa learners in addressing their individual learning needs in a small group setting, which aided and encouraged isiXhosa learners to use the LOLT as often as possible (Haynes, 2020).
Teacher: Adaptive reasoning for justifying a particular instructional approach.	
Learner: Adaptive reasoning is used to connect concepts and situations for logical thought, reflection, explanation, and justification.	
FIVE STRANDS FOR MATHEMATICAL PROFICIENCY	**STRATEGIES (SCAFFOLDS) BASED ON FINDINGS TO SUPPORT ISIXHOSA LEARNERS' MATHEMATICAL UNDERSTANDING**
PRODUCTIVE DISPOSITION	**Theme 2.4: Maths is fun** The participants reported that a positive atmosphere during mathematics lessons is crucial (Arthur et al., 2017:21; Bakar & Samsudin, 2021:279). Findings highlighted that colourful maths walls with visual "crutches" (i.e., counting posters, visual representations of difficult concepts, terminology with pictures, numbers, number names, shapes, etc.) supported isiXhosa learners' self-esteem and assisted their mathematical thinking (Acharya, Kshetree, Khanal, Panthi & Belbase, 2021:37) Engaging with mathematical resources (such as colourful counters, base ten blocks, playdough, maths games, number line, 100-chart, fingers, dice, whiteboard, and other everyday objects in class) made mathematics more enjoyable for isiXhosa learners. Activities such as matching number games, competitive mental maths games (girls vs. boys), playing shop with paper money, manipulating concrete objects, interactive activities, and using real-life objects to demonstrate certain mathematical concepts were found to make mathematics enjoyable (Arthur et al., 2017:21; Bakar & Samsudin, 2021:279).
Teacher: A productive attitude toward mathematics, teaching, and practice improvement.	
Learner: A productive attitude toward mathematics that recognises it as sensible, useful, and worthwhile, combined with trust in one's own perseverance and effectiveness.	

	<u>Theme 2.5: Positive reinforcement</u> It was found that positive words of encouragement, small gestures (i.e., a smile) to show pride towards a learner and awarding learners' achievements (i.e., a sticker in their book), made maths less frightening (Ayuwanti, 2021:665; Khanal, 2015:294-295). **<u>Theme 2.6: Parents</u>** Participants recommended that teachers develop good teacher-parent relationships from the start and maintain these relationships via WhatsApp groups, as these groups were used to successfully guide parents in supporting their children with mathematics homework (Jourdain & Sharma, 2016:53; Dabell, 2021). **<u>Theme 3.1: Intervention</u>** Participants suggested that additional professional assistance could support the isiXhosa learners in overcoming a possible language barrier that is preventing them from learning mathematics (Van Niekerk & Pienaar, 2018:9-11). **<u>Theme 3.3: Patience</u>** Findings indicated that patience is the most important virtue for teaching mathematics to isiXhosa-speaking learners (Ertac & Alan, 2018:2). **<u>Silent theme 3.4: Pre- and in-service training</u>** It was found that participants were not proficient in the isiXhosa learners' HL. However, they believed that using the isiXhosa learners' HL as a resource for mathematics instruction could contribute to mathematical understanding (Chikiwa & Schäfer, 2019:134). Participants acknowledged that they did not receive specific training at university or during their in-service teaching practice on how to teach mathematics to isiXhosa learners in English LOLT classrooms. Thus, participants reported an urgent need for pre-service and in-service training on how to assist isiXhosa learners in English Grade One classrooms to enhance their mathematical proficiency (Alex & Roberts, 2019:71; Graven, 2020:86).

	Theme 4.2: Additional challenges across themes and categories Participants reported that too large classes make it difficult to provide one-on-one teaching (Panthi & Belbase, 2017:14; Canbeldek & Isikoğlu Erdogan, 2017:259).

5.3.3 Recommendations regarding the findings of this research study

The findings in the table above have prompted several recommendations that emphasise the significance of knowledge, training, and providing sufficient teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms, which are aimed at various support systems. The following tables present these recommendations separately:

Table 5.2: Recommendations to parents and/or guardians

Parents	• Parent involvement is very important to enhance the learners' mathematical understanding. This can be accomplished by building and maintaining a good teacher-parent relationship and assisting the learner with his or her mathematics homework (Jourdain & Sharma, 2016:53; Dabell, 2021).
Additional challenges across themes and categories	• Parents should consider sending their child to Grade R prior to Grade One.

Table 5.3: Recommendations to teachers

The language [of mathematics]	• Teachers must know that mathematics has its own register (mathematical terminology) and is learnt like any other second and/or third language. • Teachers need to understand the significant role that language plays in learning mathematics, and therefore, it is recommended that the language of mathematics needs to be simplified (scaffolded) for isiXhosa learners to support their mathematical understanding (Vygotsky, 1931:106). • Scaffolding strategies during mathematics discourse must be tailored to the isiXhosa learners' individual language needs to promote mathematical proficiency in the English-LOLT (CGCS, 2016:7; Walshaw, 2017:294).

Planning and teaching	• Lessons should be scaffolded through building on isiXhosa learners' prior knowledge. • Link mathematical concepts to isiXhosa learners' everyday experiences. • Teach mathematics for various learning styles (through visuals, auditory, kinaesthetic, and sensory) (Naudé & Meier, 2019:1-2; Chou, 2021; Bosman & Schulze, 2018:2). • In order to strengthen the total development of the isiXhosa learner and enhance their mathematical understanding on various levels, mathematics needs to be integrated with other subjects too (Ariba, 2017:25-26 & Schüler-Meyer et al., 2019:324). • Use simplified (everyday) English when teaching mathematics to isiXhosa-speaking learners (Jourdain & Sharma, 2016:51). • Employ a step-by-step (structured) teaching approach when mathematical procedures are taught (i.e., solving word sums and/or algorithms) to aid isiXhosa learners' deeper conceptual understanding (CGCS, 2016:11). • Teach and equip isiXhosa learners with various options for utilising multiple representations to illustrate the meaning of a method or the successful completion of application-based activities (CGCS, 2016:11). • It is recommended that whenever isiXhosa learners seem to be having trouble understanding a maths concept, they always resort back to drawings and/or physical tools (visual representation) to support them (Banse et al., 2016:102). • To develop isiXhosa learners' mathematical reasoning and knowledge of concepts, mathematics lessons must be interactive and mathematical discourse encouraged (i.e., asking questions, explaining and/or discussing maths problems) (CGCS, 2016:5).

Visual aids	• Teachers should utilise visual and concrete resources to assist isiXhosa learners to grasp and understand mathematical concepts more easily (Chikiwa & Schäfer, 2019:127). • Give isiXhosa learners the opportunity to manipulate concrete and visual resources themselves. • Dramatisation, together with visual representations (i.e., drawing pictures of story sums on the board while the teacher also acts out the story), boosts isiXhosa learners' conceptual understanding (Chou, 2021). • To teach and equip isiXhosa-speaking learners to solve mathematical problems with more confidence, use visual step-by-step methods (Kilpatrick et al., 2001:413; Banse et al., 2016:102).
Technology	• Infuse mathematics lessons with educational videos and visual representations to enrich isiXhosa learners' learning experiences and understanding (Rajadell & Garriga-Garzón, 2017).
Maths is fun	• In order to boost the self-esteem of isiXhosa learners, teachers must cultivate a positive learning environment for mathematics (Arthur et al., 2017:21; Bakar & Samsudin, 2021:279; Bosman & Schulze, 2018:2). • A print-rich classroom with fun and colourful maths representations on the maths wall (i.e., counting posters, visual representations of difficult concepts, terminology with pictures, numbers, number names and shapes) serves as a visual "crutch" for isiXhosa learners, encouraging participation and mathematical thinking (Acharya et al., 2021:37). • Allow isiXhosa-speaking learners to interact with mathematics resources on their own to make mathematics more enjoyable. • Fun maths activities are recommended to encourage effective mathematics learning, such as matching number games, competitive mental maths games (girls vs. boys), playing shop with paper money, manipulating concrete objects, interactive activities, and using real-life objects to demonstrate certain mathematical concepts were found to make mathematics enjoyable (Arthur et al., 2017:21; Bakar & Samsudin, 2021:279).

Positive reinforcement	• It is recommended that teachers use positive words of encouragement, small gestures (i.e., a smile) to show pride towards a learner, and award learners' achievements (i.e., a sticker in their book), which also leads to a relaxed and anxiety-free environment (Bosman & Schulze, 2018:2; Ayuwanti, 2021:665; Khanal, 2015:294-295).
Parents	• It is crucial that teachers guide parents on how to effectively assist their children with mathematics at home. • Equip parents with the necessary resources such as lesson recordings, flash cards, clear step-by-step instructions, and a Maths flip-file (which includes step-by-step methods; visual representations of difficult concepts; Maths games; activities; number names; number symbols; and terminology) (Jourdain & Sharma, 2016:53; Dabell, 2021). • WhatsApp is recommended as a very effective and critical online platform to communicate regularly with parents and provide the necessary support. • It is recommended that teachers establish and maintain positive teacher-parent relationships from the beginning of the year to assist parents in helping their children with mathematics homework (Jourdain & Sharma, 2016:53; Dabell, 2021).
Intervention	• Didactic classes are recommended to help isiXhosa learners participate in English mathematics discourse without adding the stress of public speaking while also developing their mathematical proficiency (Haynes, 2020). • When group or pair work is not possible, one-on-one (teacher-learner) support is highly recommended as an intervention strategy to assist the isiXhosa learner. • The "buddy system" (peer modelling) is recommended as an effective intervention strategy to help the isiXhosa learner, especially if other isiXhosa learners who understand difficult mathematical concepts are included as buddies to teach their isiXhosa peers how to solve maths problems and/or understand difficult concepts in their mother tongue (Hazell et al., 2019:50; Haynes, 2020).

Repetition	• Repeating and revising mathematical concepts is necessary to consolidate the understanding thereof. • Homework is important for consolidating isiXhosa learners' understanding of mathematics content while also developing their overall English language abilities (Freeman, 2012:53). • Teachers need to refer to the previous day's homework at the start of every mathematics lesson to determine if the necessary knowledge and skills were mastered before building on a new concept and/or lesson (Cirillo et al., 2015; Adam, 2018:13).
Patience	• Teachers should be patient when working with learners who take longer to grasp mathematical concepts (Ertac & Alan, 2018:2).
Pre- and in-service training	• Demand for specific training needs from the DBE, such as how to assist isiXhosa learners in English Grade One classrooms with mathematical proficiency and/or understanding.

Table 5.4: Recommendations to School

Technology	• Technology does not have to be disruptive. If schools have technology at their disposal, they should demand training for teachers on how to use technology to promote mathematical teaching and learning through technology (Rajadell & Garriga-Garzón, 2017).
Intervention	• It is recommended that every school implement additional support strategies, such as a learning support professional (which should be provided by the DBST), to assist isiXhosa learners in overcoming potential language gaps that are impeding their progress in mathematics (Van Niekerk & Pienaar, 2018:9-11).
Additional challenges across themes and categories	• Schools need to strategise how they can support teachers with large class sizes. • Schools can designate time during the school day for small-group or one-on-one sessions to support learners who have fallen behind with their mathematics (Sharp et al., 2020:5). • Schools need to strategise a plan of action and be prepared should the education system face another pandemic in the future. In this case, schools need to demand training on the technology, security concerns, and pedagogy of remote teaching and learning (Sharp et al., 2020:35).

Table 5.5: Recommendations to WCED and DBE

Pre- and in-service training	• Teachers need in-service training on how to apply second-language learning strategies such as code-switching and/or translanguaging when teaching mathematics to isiXhosa HL learners.
Lack of time	• The DBE can revise the curriculum in terms of content and time allocation, while acknowledging that learners with limited language proficiency in the classrooms' LOLT (i.e., isiXhosa learners) require more time to grasp mathematical concepts (Jourdain & Sharma, 2016:45; Goetze, 2016).
Additional challenges across themes and categories	• While Grade R is not yet required by law, the WCED and/or DBE must educate parents on the importance of their child attending Grade R in order to develop the foundational skills needed for formal education (starting in Grade One) (Hazell et al., 2019:49). • In line with the DBE's initiative to support teachers on how to teach mathematics for understanding, it is recommended that they adhere to their advocacy to provide teachers with the necessary training and bilingual mathematics teaching materials in this regard (South Africa. DBE, 2018:83). • Teachers need to be educated to increase their knowledge and pedagogical skills so that they can effectively assist isiXhosa-speaking learners with mathematical understanding in an English-LOLT classroom. • It is difficult for teachers to adapt to curriculum changes if they are rushed and they are not provided with the proper training and resources (Govender, 2018:5; DBE, 2021). • It is critical that the BELA Bill be finalised by 2022 so that Grade R can be mandatory as many studies have shown that this is a critical stage in a young child's development and acquiring the necessary skills prior to Grade One will hold significant benefits for learners in their future school progress (Gitonga, 2021; Lorber, 2021). • The WCED and/or DBE needs to strategise a plan of action and be prepared to support schools should the education system face another pandemic in the future. In this case, teachers need training on the technology, security concerns, and pedagogy of remote teaching and learning (Sharp et al., 2020:35).

Table 5.6: Recommendations to university's offering the ITE programmes (B. Ed.) for primary school teachers is South Africa

Pre- and in-service training	• The relevant departments can revise ITE programmes aimed at the FP to provide effective pre-service training to student teachers and equip them with the necessary pedagogical knowledge and skills needed to support isiXhosa and/or African language learners in English-LOLT Grade One mathematics classrooms.

In addition to the recommendations made in the previous section, the following section suggests conducting additional research on the subject at hand.

5.4 Recommendations for further research

It is suggested that additional research be conducted in the following areas to inform current practice:

- The development of educational training programmes in accordance with the findings of this research.
- The carrying out of such an educational training programme and the monitoring of its outcomes.
- Additional research to determine how the recommendations made in this study can support other language-speaking learners (those who do not speak isiXhosa) overcome mathematical difficulties.
- Additional research to investigate issues such as terminology in mathematics for African languages.
- Investigating the availability and accessibility of bilingual teaching materials that could assist learners with limited mathematical proficiency in the LOLT.

5.5 Conclusion

This chapter's primary objective was to explain the study's findings, conclusions, and recommendations. The study's aim was to investigate how teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' understanding in English Grade One classrooms. Due to this study's exploratory nature, the qualitative research approach was well-suited to achieving the study's purpose and answering the research question adequately, namely: "What teaching and learning strategies are utilised by selected Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in their classrooms?" The findings of this study led to several recommendations for mathematical support strategies for isiXhosa-speaking learners in English Grade One classrooms. The uniqueness of IsiXhosa first language learners in an English-medium classroom in Grade One lends originality to this study and thus to its contribution to knowledge. Therefore, the researcher is hopeful that this study's findings will further contribute to: 1) knowledge in the field of teaching mathematics in multilingual contexts; 2) mathematics education in general; 3) enhancing current practice in terms of mathematical support to isiXhosa-speaking learners in English Grade One classrooms; 4) the various support systems and their roles and responsibilities for isiXhosa-speaking learners as well as teachers in an inclusive education and training system; 5) the current implementation of the mathematics teaching and learning framework for South Africa; and 6) developing research methodology because of how the IQA was adapted and integrated with Mills' analytical comparison technique.

The words of Charles Colton (2019) aptly bring this study to a close:

"The study of mathematics, like the Nile,
begins in minuteness but ends in magnificence".

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APPENDICES

APPENDIX A: LETTER OF INVITATION TO WESTERN CAPE EDUCATION DEPARTMENT AND TEACHERS IN PRIMARY SCHOOLS IN THE METRO EAST EDUCATION DISTRICT

For Attention: Western Cape Education Department and teachers in primary schools in the Metro East Education District

I, Tanja Coetzer, the undersigned, am a lecturer and also a part-time D.Ed. student in the Department of Education and Social Science, Cape Peninsula University of Technology—Wellington Campus. In fulfilment of requirements for the D.Ed. degree, I have to undertake a research project and have consequently decided to focus on the following research topic:

Teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms

In view of the reality that you are currently teaching Grade One, I hereby approach you with the request to participate in the study. The purpose of the study is not to evaluate you as a teacher but to gain knowledge regarding Grade One teachers' perceptions, experiences, and feelings about the implementation of teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms; to get insight obtained from best-practices; and to understand the successes and/or obstacles experienced in this regard.

For you to decide whether or not to participate in the research project, I will provide you with:

- Information regarding the need for the study
- The goal of the study
- What you will be asked to do during the research
- The risks and benefits involved in participating in this research project
- Your rights as a participant

The *aim of the research study is to explore, describe, and understand how Grade One teachers are using teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. It is also envisioned that such exploration and investigation could inform a knowledge base from which teaching and learning strategies for Grade One teachers could be developed to support isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.*

Should you agree to participate, you would be asked to take part in a focus group interview, one follow-up individual interview, and make available your classroom and teaching for observation. It is estimated that the focus group interview will last approximately 3 hours, the individual interview approximately 60 minutes, and the classroom observation approximately 2 hours. During the interviews, the following issue statements will be directed at you:

- Tell me what you think or feel or call to mind when I use the term "mathematical language."
- Tell me about your understanding of teaching and learning strategies to enhance mathematical understanding.
- Tell me about your experiences of teaching and learning strategies to enhance mathematical understanding.
- Tell me how you are using teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics in your classroom.

With your permission, the interviews will be audio recorded. The recorded interviews will be transcribed word-for-word. Your responses to the interview (both the taped and transcribed versions) will be kept strictly confidential. The audiotape will be coded to disguise any identifying information. The tapes will be stored in a safe place, and only I will have access to them. The transcripts (without identifying information) will be made available to my research supervisor, a translator (if needed), and an independent coder with the sole purpose of assisting and guiding me with this research undertaking. They will each sign an undertaking to treat the information shared by you in a confidential manner. The audiotapes and the transcripts of the interviews will be destroyed upon completion of this study.

Please note that participation in the research is completely voluntary. The agreement to sign the attached consent form does not compromise your rights of participation in any way. If you agree, you still have the right to withdraw your consent at any time during the study. However, if you do withdraw from the study, you would be asked to grant me an opportunity to engage in an informal discussion with you so that the research partnership that was established can be terminated in an orderly manner.

As the researcher, I also have the right to dismiss you from the study if you fail to follow the instructions or if it appears that you want to use the study as a platform to promote an individual need that will not be part of the study.

You are a possible participant in this research because you meet the following inclusion criteria:

- Schools in the Western Cape:
  - Independent primary schools of the Metro East Education District
  - Public primary schools of the Metro East Education District
- Grade One English classrooms with a focus on
- Grade One teachers utilizing teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding.

If you have any questions or concerns about the study, please contact me at the following number:

The researcher, Tanja Coetzer, can be reached at 072 11 82 703 or via email at coetzert@cput.ac.za. Please note that this study has been approved by the Research Committee of the Cape Peninsula University of Technology as well as the research directorate of the Western Cape Education Department. Should you have any questions/queries not sufficiently addressed by me, you are more than welcome to contact my study promoters, Dr C. Livingston, telephone number: 021 864 5251 or e-mail: LivingstonC@cput.ac.za; and Dr E. Barnard, telephone number: 021-864-8201, or e-mail: barnarde@cput.ac.za. Based upon the above-provided information and the rights of the participants, you are requested to give written consent should you want to participate in this research study. Please find attached the consent form.

Thank you for your participation.

Kind regards

Tanja Coetzer

APPENDIX B: INFORMED CONSENT FORM (TEACHER PARTICIPANTS)

Cape Peninsula University of Technology

Faculty of Education

Ethics informed consent form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Category of Participants (tick as appropriate):

Principals		*Teachers*	✓	*Parents*		*Lecturers*		*Students*	
Other (specify)									

You are kindly invited to participate in a research study being conducted by Tanja Coetzer from the Cape Peninsula University of Technology. The findings of this study will contribute towards (tick as appropriate):

An undergraduate project	✓	*A conference paper*	
An Honours project		*A published journal article*	✓
A doctoral thesis	✓	*A published report*	✓

Selection criteria

You were selected as a possible participant in this study because you comply with the following criteria for inclusion:

- Schools in the Western Cape:
  - Independent primary schools of the Metro East Education District
  - Public primary schools of the Metro East Education District
- Grade One English classrooms with a focus on
- Grade One teachers utilizing teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding.

The information below gives details about the study to help you decide whether you would want to participate.

Title of the research:

Teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

A brief explanation of what the research involves:

Why is this research important?

This research is important to explore, describe, and understand how Grade One teachers utilize teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. The researcher also envisioned that such exploration and investigation could inform a knowledge base from which teaching and learning strategies for Grade One teachers could be developed to support isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

Benefits of research

As a result of your participation in this study, you could provide teaching and learning strategies that may support Grade One teachers to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

Incentives

Participants will receive a formal report on the findings of this study to compensate for their time and effort.

Procedures (duration)

Should you agree to participate, you would be asked to take part in a focus group interview, one follow-up individual interview, and make available your classroom and teaching for observation. It is estimated that the focus group interview will last approximately 3 hours, the individual interview approximately 60 minutes, and the classroom observation approximately 2 hours. During the interviews, the following issue statements will be directed at you:

- Tell me what you think or feel or call to mind when I use the term mathematical language.
- Tell me about your understanding of teaching and learning strategies to enhance mathematical understanding.
- Tell me about your experiences of teaching and learning strategies to enhance mathematical understanding.
- Tell me how you are using teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics in your classroom.

With your permission, the individual interviews will be audio recorded. The recorded interviews will be transcribed word-for-word. Your responses to the interview (both the taped and transcribed versions) will be kept strictly confidential. The audiotape will be coded to disguise any identifying information. The tapes will be stored in a safe place, and only I will have access to them. The transcripts (without identifying information) will be made available to my research supervisor, a translator (if needed), and an independent coder with the sole purpose of assisting and guiding me with this research undertaking. They will each sign an undertaking to treat the information shared by you in a confidential manner. The audiotapes and the transcripts of the interviews will be destroyed upon completion of this study.

Right to withdraw/ voluntary

Please note that participation in the research is completely voluntary. The agreement to sign the attached consent form does not compromise your rights of participation in any way. If you agree, you still have the right to withdraw your consent at any time during the study. However, if you do withdraw from the study, you would be asked to grant me an opportunity to engage in informal discussion with you so that the research partnership that was established can be terminated in an orderly manner. As the researcher, I also have the right to dismiss you from the study if you fail to follow the instructions or if it appears that you want to use the study as a platform to promote an individual need that will not be part of the study.

Confidentiality and anonymity

The researcher will have a conversation with the participant in this regard. The participant will understand that

- He/she will have access to the results of the project.
- The participant's anonymity is ensured and that he/she will enter this project on a voluntary basis.
- He/she can withdraw from the project at any time.
- Only the researcher, translator (if needed), editor, independent coder, and the researcher's promoters will have access to the data.

Potential risks, discomforts or inconveniences

The information that the participant shares might unsettle him/her emotionally. Should that happen in any way, the participant may voluntarily withdraw from the study without penalty. Should the researcher come to the conclusion that this exercise is harming the participant in any way, she might exercise the right to withdraw the participant from the study and/or refer him/her for counselling services or other appropriate resources of service delivery, which the participant has the right to decide whether or not to use.

What will happen to the data when the study is completed?

After data collection has ended, consent forms will be scanned to pdf and the originals securely shredded. These pdfs along with all other data, will be stored on a password protected computer.

Kindly complete the table below before participating in the research.

	Tick the appropriate column	
Statement	**Yes**	**No**
1. I understand the purpose of the research.		
2. I understand what the research requires of me.		
3. I volunteer to participate in the research.		
4. I know that I can withdraw at any time.		
5. I understand that there will be no form of discrimination against me because of my participation or non-participation.		
6. Comment:		

You may request a copy of this form.

Signature of participant	Date	Participant email address	Participant contact number

Researcher:

	Name:	Surname:	Contact details:
1.	Tanja	Coetzer	CoetzerT@cput.ac.za
2.			
3.			

Contact person: Tanja Coetzer	
Contact number: 072 118 2703	Email: CoetzerT@cput.ac.za

APPENDIX C: LETTER OF CONSENT (PARENTS)

Cape Peninsula
University of Technology

September 2021

Dear Parent/Guardian,

I, Tanja Coetzer, the undersigned, am a lecturer and also a part-time D.Ed. student in the Department of Education and Social Science at Cape Peninsula University of Technology (CPUT) – Wellington Campus. In fulfilment of requirements for the D.Ed. degree, I have to undertake a research project at CPUT.

I am interested in gaining knowledge regarding Grade One teachers' perceptions, experiences, and feelings about the implementation of teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. It is also envisioned that such exploration and investigation could inform a knowledge base from which teaching and learning strategies for Grade One teachers could be developed to support isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

I talked to the school where your child goes and told them about the study. The school was kind enough to agree to send these letters to you.

Please read the information sheet attached to this letter. The focus of my research involves observation of teachers during mathematics lessons, and there will be no direct contact with any of the children. I hope, therefore, that you will agree to your child being involved in my research.

If you have any further questions about the research project, please contact me at: CoetzerT@cput.ac.za. If you have any concerns about the research, please contact my supervisor, Dr C. Livingston, at LivingstonC@cput.ac.za.

Yours sincerely,

Mrs T. Coetzer

INFORMATION SHEET

Teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

Researcher: Tanja Coetzer

Supervisor: Dr C. Livingston

This information sheet explains why I am doing this research and what it will involve. Please take the time to read this information carefully together with your child. Please contact me if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is this study about?

This research is important to explore, describe, and understand how Grade One teachers utilize teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms. The researcher also envisioned that such exploration and investigation could inform a knowledge base from which teaching and learning strategies for Grade One teachers could be developed to support isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

How will my child be involved?

Your child will be working in a normal mathematics lesson, and your child's learning will not be affected in any way. I will be observing the teacher and taking written notes.

Who will have the access to the research information (data)?

Data management will follow the 1998 Data Protection Act. I will not keep any information about your child that could be used to identify them to another person. The data will be stored safely and will be destroyed when my project is completed. The data will only be used for my work and will only be seen by myself, my supervisor, and those who mark my work.

Who has reviewed the study?

The research study has been approved under the regulations of the Cape Peninsula University of Technology's Ethics Committee.

Who do I speak to if I have questions about this research?

If you would like more information or have any problems with this research project, please let me know. You can contact me via the university at the following address:

Tanja Coetzer
Department of Education and Social Science
Cape Peninsula University of Technology
Wellington
CoetzerT@cput.ac.za

If you would like to speak to someone else, you can contact my supervisor:

Dr C. Livingston
LivingstonC@cput.ac.za
021 864 5251

What do I do next?
If you are happy for your child to be involved in my research, you do not need to do anything. Please keep this information for reference.
If you do not want your child to be involved in this research, please complete one copy of the attached form and return it to your child's class teacher. Please keep the letter, information sheet, and the 2nd copy of the form for your information.

Can you change your mind?
You and your child have the right to withdraw from the research at any time.

Thank you very much for your time.

PARENT/GUARDIAN OPT-OUT FORM

(1ST COPY FOR RETURN TO RESEARCHER VIA CLASS TEACHER)

Teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

I have read the information about the study and talked about this with my child.

Please tick the box below.

I am not willing for my child to take part in the study. ☐

Name of child: ……………………………………

School: …………………………………………….

Class: ……………………………………………..

Signature of parent/guardian: ………………………………………………………….

Date: ……………………………………………..

PARENT/GUARDIAN OPT-OUT FORM

(2ND COPY FOR PARENT/GUARDIAN RECORDS)

Teaching and learning strategies to enhance isiXhosa-speaking learners' mathematical understanding in English Grade One classrooms.

I have read the information about the study and talked about this with my child.

Please tick the box below.

I am not willing for my child to take part in the study. ☐

Name of child: …………………………………

School: ………………………………………….

Class: …………………………………………..

Signature of parent/guardian: ………………………………………………………….

Date: …………………………………………..

APPENDIX D: APPROVED ETHICAL CLEARANCE FORM

Western Cape Government

Education

Directorate: Research
Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20200220-4737
ENQUIRIES: Dr A T Wyngaard

Mrs Tanja Coetzer

18 Chardonnay, Cabernet Close

Aurora

Durbanville

7550

Dear Mrs Tanja Coetzer

RESEARCH PROPOSAL: GUIDELINES TO ENHANCE ISIXHOSA HOME LANGUAGE LEARNERS' UNDERSTANDING OF MATHEMATICS IN ENGLISH GRADE ONE CLASSROOMS

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **02 April 2020 till 30 September 2023**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services

    Western Cape Education Department

    Private Bag X9114

CAPE TOWN

8000

We wish you success in your research.

Kind regards.

Signed: Dr Audrey T Wyngaard

Directorate: Research

DATE: 05 March 2021

Lower Parliament Street, Cape Town, 8001
tel: +27 21 467 9272 fax: 0865902282
Safe Schools: 0800 45 46 47
Private Bag X9114, Cape Town, 8000
Employment and salary enquiries: 0861 92 33 22
www.westerncape.gov.za

APPENDIX E: APPROVED ETHICAL CLEARANCE FORM

Cape Peninsula University of Technology

***For office use only	
Date submitted	14/1/2020
Meeting date	21/1/2020
Approval	P/Y/N
Ethical Clearance number	EFEC 3-12/2019

FACULTY OF EDUCATION

RESEARCH ETHICS CLEARANCE CERTIFICATE

This certificate is issued by the Education Faculty Ethics Committee (EFEC) at Cape Peninsula University of Technology to the applicant/s whose details appear below.

1. **Applicant and project details (Applicant to complete this section of the certificate and submit with application as a Word document)**

Name(s) of applicant(s):	T Coetzer		
Project/study Title:	Grade One teachers' experiences using mathematical language learning strategies to enhance the comprehension of mathematical concepts in multilingual Grade one classrooms.		
Is this a staff research project, i.e. not for degree purposes?	N/A		
If for degree purposes the degree is indicated:	D.Ed		
If for degree purposes, the proposal has been approved by the FRC	Yes		
Funding sources:	N/A		

2. **Remarks by Education Faculty Ethics Committee:**

Ethics clearance is valid until 31st December 2023		
Approved: X	**Referred back:**	**Approved subject to adaptations:**
Chairperson Name: Dr Candice Livingston **Chairperson Signature:**	**Date: 2/2/2020**	
Approval Certificate/Reference: EFEC 3-12/2019		

EFEC Form V3_updated 2016

APPENDIX F: INTERVIEW FRAMEWORK: FOCUS GROUP ONE

Interviewer: Thank you for having this interview with me. Thank you for your time and sharing your perceptions, knowledge, feelings, and expertise with me today. As you already know, the research is about Grade One teachers' experience of implementing teaching and learning strategies for isiXhosa-speaking learners in English Grade One classrooms. I want to point out that at any stage during the interview, if you feel uncomfortable or do not want to participate anymore, you have the right to leave. The interview will be recorded to assist with transcription. All transcriptions will be rendered anonymous prior to analysis. Nowhere will you be identified. When I transcribe this conversation, I will not use your name but will refer to you as participant 1, 2, or 3. This recording will only be available between myself and my supervisor. Is it okay if I record this interview with you today?

Participant	Gender	Age	Qualification	Years' experience	How many learners are in the classroom	How many learners are not receiving education in their HL	Own first language
1							
3							
5							

Interviewer: First, I would like some background information about you.

<u>QUESTION 1</u>

Interviewer: During the unstructured focus group interview, the following themes were generated by the participants, namely:

- Mathematical language
- Maths is fun
- Visual aids
- Intervention
- Repetition

- Technology
- Patience
  - Sub theme: Positive reinforcement
- Parents

A descriptive paragraph was also given to each theme.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

The first theme was **Mathematical language**.

Mathematical language was identified as:

- Simplifying mathematical terms
- Numbers and symbols
- Story sums
- Concentration
- Numbers, patterns and relationships, patterns, Space and shape, measurement, data
- Is a language of its own (like music)
- Relatable terms first thereafter formal terms
- Relating concepts to learners own experiences
- Speak slowly

The **descriptive paragraph** was:

"Maths is a language of its own. It includes symbols, signs, numbers, patterns, space and shape, measurement, data handling etcetera. When introducing a new mathematical concept, speak slowly, clearly and use repetition as well as visual aids. Simplify words and relate it to their everyday lives so they can make meaning of it."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

1.1. I now want you to tell me about your own perception and feelings about Mathematical language.

QUESTION 2

Interviewer: The next theme was **Maths is fun**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Maths is fun was identified as:

- Teaching learners how Maths is used in everyday life
- Positive learning environment is important
- Complex terms for higher achievers
- Learners learn via having fun and tend to remember games and songs or rhymes better
- Once learners start showing progress it feels rewarding

The **descriptive paragraph** was:

"Maths is all around us, it's part of our daily lives. It is important to understand mathematical concepts and language in order to understand the world around us."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

1.1 I now want you to add or give me your own feelings and perception about Maths is fun.

1.2 According to the descriptive paragraph, tell me how you are using language to enhance the isiXhosa learner's understanding of mathematical concepts?

1.3 Are there specific mathematical concepts that the isiXhosa learners in your classroom struggle to understand? If yes, please tell me what these concepts are.

QUESTION 3

Interviewer: The next theme was **Visual aids**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Visual aids were identified as:

- Having resources makes it easier to teach the concept as learners understand best by visuals
- Using concrete objects for counting
- Number charts on desk
- Real life situations
- Playdough to make different numbers
- Use whiteboard page for shapes
- Worksheets
- Work from concrete then pictures
- Various strategies: visual, textual, practical, auditory

The **descriptive paragraph** was:

"Visual aids in the classroom are very important in order to help children struggling in the language. There are different types of visual aids for e.g. number charts on the desk, posters, pictures, concrete apparatus, abacus, counters, playdough, blocks, number lines, 2D and 3D shapes, calendar etc. Visual aids can also include technology, e.g. video games,

videos etc. It is important for children to see the concrete to the abstract (concrete – picture – abstract).”

(Interviewer’s note: Further questions will be generated from the answers by the participant.)

3.1 I now want you to add or give me your own experiences and feelings about Visual aids.

3.2 Do the isiXhosa learners in your classroom get to the stage where they are able to work without the visual aids (abstract only)?

3.3 Do you use technology in your classroom as a visual aid? If yes, what are these programmes, videos or games called and which mathematical concepts do they cover? (e.g. story sums, counting, patterns, shapes, measurement, calculations etc.)

3.4 Are there any other aids besides visual aids that could be used to assist the isiXhosa learner to understand mathematics? If yes, wat are they?

QUESTION 4

Interviewer: The next theme was **Intervention**.

(Interviewer’s note: The interviewer will tell the participant what was said during the focus group interview.)

Intervention was identified as:

- Repetition
- Visual aids with terms
- Allow learners to use all of their senses
- Make games and use games as aids
- One-on-one
- Learners learn from each other
- Small groups
- Extra time
- Including their home language
- Concrete
- Practical examples
- Use Maths vocabulary
- Always looking for ways to incorporate, e.g. octopus = 8 arms make art activity rainbow = 7 colours write name in
- Interactive activities
- Whiteboard activities
- Displaying terms and concepts
- Simplify terms
- You need individual intervention plans
- Homework

The **descriptive paragraph** was:

“It needs to take into account the ability or inability of the child. After baseline assessment, learners in need of help would’ve been identified. Observation on an ongoing basis is

important. Intervention should start as soon as possible. Individual support plan (ISP) needs to be put in place for the needs of individual learners. Get parents involved as soon as possible and show them how to help. Learners at risk need to be discussed as school based support team (SBST). SBST or learning support teacher might refer learner to a specialist if needed."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

4.1 I now want you to add or give me your own feelings, perceptions and experiences about Intervention.

4.2 How does the baseline assessment help to determine that an isiXhosa learner needs intervention in mathematics?

4.3 How do you monitor the isiXhosa learner's ongoing progress?

4.4 What individual support do you put in place for the isiXhosa learners struggling to understand mathematics in your classroom?

4.5 What kind of support regarding mathematics do you require from the parents?

4.6 What specialist in your opinion would be able to assist an isiXhosa learner with mathematical understanding?

4.7 How do you use the isiXhosa learner's home language as a method of intervention – to help him/her understand mathematics? ("Translation", "including their home language")

4.8 What type of intervention activities are given as homework that assists the isiXhosa learner with mathematical understanding?

<u>QUESTION 5</u>

Interviewer: The next theme was **<u>Repetition</u>**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

<u>Repetition</u> was identified as:

- Constant reinforcement
- Teach the same concept through various methods

The **descriptive paragraph** was:

"Constant repeating – assists with language barriers. Repeat with various strategies catering to all learners. Very important to find different ways of reinforcing a concept."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

5.1 I now want you to add or give me your own feelings, perceptions and experiences about Repetition.

5.2 How does repetition assist the isiXhosa learner in overcoming his/her language barrier to understand mathematics?

5.3 Give examples of different methods that you use in your classroom to reinforce mathematical concepts to isiXhosa learners who struggle to understand mathematics.

QUESTION 6

Interviewer: The next theme was **Technology**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Technology was identified as:

- Technology is your best friend
- Including music into lessons, as learners become more eager to explore the English language

The **descriptive paragraph** was:

"Use technology as much as possible for reinforcement. Use it to make Maths fun and relate to the learners."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

6.1 I now want you to add or give me your own feelings, perceptions and experiences about using **Technology** to enhance isiXhosa learners understanding of mathematics.

QUESTION 7

Interviewer: The next theme was **Patience**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Patience was identified as:

- Patience is key
- Repetition
- Each learner learns in a different way
- Learners not understanding English is extremely challenging
- Each day – trial & error
- Always willing to try learn new strategies

The **descriptive paragraph** was:
"This is a very important quality for an educator to have when working with children."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

7.1 I now want you to add or give me your own feelings, perceptions and experiences about patience.

7.2 Tell me about your training regarding teaching and learning strategies to support isiXhosa-speaking learners with the understanding of mathematics during your study years.

7.3 Have you ever, during your years of teaching, officially been trained for implementing teaching and learning strategies to enhance isiXhosa-speaking learners' understanding of mathematics?

7.4 Do you feel there is a need for training regarding strategies for teachers to support isiXhosa home language learners to enhance their mathematical understanding in English classrooms? If yes, what strategies would you want to be trained in?

QUESTION 8

Interviewer: The next theme was **Positive reinforcement**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Positive reinforcement was identified as:

- Positive reinforcement only
- Reward learners for progress

The **descriptive paragraph** was:

"Look for ways to implement positive reinforcement every day. Small achievements should be seen and acknowledged – success breeds success."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

8.1 I now want you to add or give me your own feelings, perceptions and experiences about using positive reinforcement.

8.2 Give examples of positive reinforcement strategies that you apply in your classroom for the isiXhosa learner.

QUESTION 9

Interviewer: The next theme was **Parents**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Parents was identified as:

- Get parents involved
- Good communication with parents

The **descriptive paragraph** was:

"Get the parents involved as soon as possible! Have good communication with parents. Make yourself available to parents. Praise and guide parents even when they seem to be doing a very little to support."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

9.1 I now want you to add or give me your own feelings, perceptions and experiences about parents.

9.2 How do you get the parents involved?

9.3 What are the guidelines you give to the parents to help their child with mathematics at home?

9.4 Are there parents who make use of other support systems outside the school to help their child overcome their language barrier with mathematical understanding (e.g. extra mathematics classes)

QUESTION 10

Interviewer: Is there anything else you would like to add to this discussion?

CLOSING COMMENT

Interviewer: Thank you again for you time and for providing your insight into the implementation of teaching and learning strategies for mathematical understanding in your classroom. Do you have any questions for me? Thank you again. This concludes the interview.

APPENDIX G: INTERVIEW FRAMEWORK: FOCUS GROUP TWO

Interviewer: Thank you for having this interview with me. Thank you for your time and sharing your perceptions, knowledge, feelings, and expertise with me today. As you already know, the research is about Grade One teachers' experience of implementing teaching and learning strategies for isiXhosa-speaking learners in English Grade One classrooms. I want to point out that at any stage during the interview, if you feel uncomfortable or do not want to participate anymore, you have the right to leave. The interview will be recorded to assist with transcription. All transcriptions will be rendered anonymous prior to analysis. Nowhere will you be identified. When I transcribe this conversation, I will not use your name but will refer to you as participant 1, 2, or 3. This recording will only be available between myself and my supervisor. Is it okay if I record this interview with you today?

Participant	Gender	Age	Qualification	Years' experience	How many learners are in the classroom	How many learners are not receiving education in their HL	Own first language
7							
9							
11							

Interviewer: First, I would like some background information about you.

QUESTION 1

Interviewer: During the unstructured focus group interview, the following themes were generated by the participants, namely:

- The Language
- Holistic and Concrete learning
- Sub Theme: Planning and Teaching
- Intervention and Consolidation
- Challenges

A descriptive paragraph was also given to each theme.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

The first theme was **The Language**.

The Language was identified as:

- "Buddy" system
- We sing Xhosa counting songs to help them feel included + relevant
- LOLT is English: Learners understand English although they can speak isiXhosa
- Comprehension of what is being asked and understanding concepts
- Simple understandable language
- Words that mainly relate to understanding of how to do Maths
- Using body language/signs alongside new term
- Overwhelmed with what is expected
- Difficult to comprehend for learners (who are more concrete/visual)
- Mathematical terminology
- Numbers
- Learning how to write/ say/ read number names
- Introduce vocabulary alongside a concrete example
- Using a problem solving approach

The **descriptive paragraph** was:

"The language is all about understanding which may incorporate words/ signs/ symbols and rhythm. Start with (and revise) prior knowledge. Make use of body or sign language while introducing a concept with an everyday problem or experience. Introduce a symbol alongside a term. There must be a relationship between a visual concept and the verbal instruction. Pair up a non-English speaker with an English speaker."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

1.1 I now want you to tell me about your own perception and feelings about The Language.
1.2 What challenges do you experience with the language of mathematics and how do you overcome these challenges?
1.3 Are there specific concepts and/or terms that the isiXhosa learners in your class struggle to understand?
1.4 How do you simplify mathematical vocabulary and/or terms to isiXhosa learners?
1.5 How are you using the isiXhosa learner's Home Language to enhance his/her understanding of Mathematics?

1.6 Do you use body language and/or signs alongside the teaching of new terms? If yes, how are you using your body and/or signs?
1.7 How can rhythm be utilised to enhance mathematical understanding?

QUESTION 2

Interviewer: The next theme was **Holistic and Concrete learning**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Holistic and Concrete learning was identified as:

- Using concrete activities and objects/apparatus (Learners need to actually 'feel' to 'do' the problem)
- Use of number line
- Use many different colourful apparatuses for manipulation
- Child will be more keen to learn if it's fun
- Adaptive approach
- Use lots of visual aids – everything we teach has a visual representation
- Basics first – Fun games to understand concepts
- Introduce vocabulary alongside a concrete example

The **descriptive paragraph** was:

"Any and all new concepts should be introduced using concrete or personal experience. Introduce concepts using visual aids, i.e. teach them HOW to use visual aids or apparatus. Ensure that all senses are involved, e.g. music, rhythm, dancing, movement, games and discussions."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

2.1 I now want you to add or give me your own feelings and perception about Holistic and Concrete learning.
2.2 What are the visual aids or apparatus that you use to introduce concepts to isiXhosa learners in your classroom?
2.3 What are the guidelines you give learners on HOW to use visual aids or apparatus?
2.4 What mathematical concepts do you cover when using music, rhythm, dancing, movement, games and/or discussions? (How is this implemented?)
2.5 Do you use many colourful apparatuses for manipulation? If yes, please elaborate.
2.6 Please elaborate on the term "adaptive approach" when teaching mathematics to isiXhosa learners.

<u>QUESTION 3</u>

Interviewer: The next theme was the **Sub Theme**: **<u>Planning and Teaching</u>**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

<u>Planning and Teaching</u> was identified as:

- Always start with what they know before building on concepts
- Let them make their own games – so I know they understand the concepts
- Making lessons interactive makes children learn better
- Lots of songs – they learn through rhythm and repetition
- Always take the learners experiences into consideration
- Love teaching Maths
- Get children so involved that they learn incidentally

The **descriptive paragraph** was:

"Start where your learners are and where their difficulties lie. Start with introducing vocabulary or Mathematical language. Teach many different strategies and asking "how else can we do this?" Plan for the different abilities."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

3.1 I now want you to add or give me your own experiences and feelings about Planning and Teaching.

3.2 What are the different strategies you use to enhance isiXhosa learners' mathematical understanding?

3.3 What are the methods that you use to make your mathematics lessons interactive?

<u>QUESTION 4</u>

Interviewer: The next theme was **<u>Intervention and Consolidation</u>**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

<u>Intervention and Consolidation</u> was identified as:

- Adaptive approach
- Encourage many varied methods of finding answers
- Use lots of fun games, music and activities to consolidate concepts, especially for the tactile learners and slow workers to get more practice.
- Pair a struggling learner with a competent learner so they don't feel threatened by the teacher, e.g. "Buddy system"
- Step by step teaching, then consolidate
- We provide 'Academic Intervention' for those struggling, after school
- Repetitive teaching of certain concepts is necessary
- Smaller groups for those learners struggling with certain concepts
- More one on one attention

The **descriptive paragraph** was:

"Intervention and consolidation is for the "weaker" learners not coping with the rest. The remedial department would immediately be involved straight after Baseline for language enrichment programmes. A "buddy system" in class works, where a strong learner is put next to a "weaker" learner, playing "games" together. Furthermore, repetition to consolidate is important. For example: Weekly didactics lessons after school, home programmes, lesson recordings, adapting teaching lessons or strategies for these individuals and incidental teaching through stories to connect with the learner. "

(Interviewer's note: Further questions will be generated from the answers by the participant.)

4.1 I now want you to add or give me your own feelings, perceptions and experiences about Intervention and Consolidation.

4.2 Give examples of various methods that are used to encourage learners to find answers.

4.3 What kind of games, music and activities are used to consolidate mathematical concepts?

4.4 What in your opinion is meant by step-by-step teaching?

4.5 What academic intervention do you put in place for the isiXhosa learners struggling to understand mathematics in your classroom?

4.6 According to your experience, what concepts need repetitive teaching for the isiXhosa learners?

4.7 How are mathematical concepts taught differently in smaller groups in relation to whole class teaching – what is the difference?

QUESTION 5

Interviewer: The next theme was **Challenges**.

(Interviewer's note: The interviewer will tell the participant what was said during the focus group interview.)

Challenges were identified as:

- Time is always a problem
- Lots of patience needed
- Not always enough lessons on the mat or lessons starting with the concrete first
- Learners can't always repeat or use their methods at home (Don't have the materials or counters)
- Certain strategies work for certain learners
- Most of my experience is "book work"
- Taking away negative or fearful connotations often attached to 'Mathematics'
- Can cause learners to be disruptive – "Hype of fun activities"

The **descriptive paragraph** was:

"Challenges are anything that inhibits true mathematical learning or understanding. Time constraints prevents consolidation. CAPS has too many concepts. There is not enough time for a proper introduction to concepts and no time for concrete learning. Due to COVID no small or mat group activities take place, in other words no individual teaching. Also, some learners did not attend Grade R or preschool. It is a challenge to take into account learners' different background and academic history or ability. The class numbers are also challenging. Again, CAPS! There are constant changes. ATP changes all the time and there are not enough resources."

(Interviewer's note: Further questions will be generated from the answers by the participant.)

5.1 I now want you to add or give me your own feelings and perceptions about Challenges that you experience.

5.2 How did you adapt your teaching and learning strategies to support isiXhosa learners with mathematics during COVID?

5.3 Due to time constraints, which mathematical concepts do you focus on mostly and which concepts are neglected?

5.4 What resources do you currently have available in your classroom that helps to enhance isiXhosa learners understanding of mathematics?

5.5 What other resources do you “wish” you had that could help isiXhosa learners’ understanding of mathematics?
5.6 Tell me about your training regarding teaching and learning strategies to support isiXhosa-speaking learners with the understanding of mathematics during your study years.
5.7 Have you ever, during your years of teaching, officially been trained for implementing teaching and learning strategies to enhance isiXhosa-speaking learners’ understanding of mathematics?
5.8 Do you feel there is a need for training regarding strategies for teachers to support isiXhosa home language learners to enhance their mathematical understanding in English classrooms? If yes, what strategies would you want to be trained in?

QUESTION 6

Interviewer: Is there anything else you would like to add to this discussion?

CLOSING COMMENT

Interviewer: Thank you again for you time and for providing your insight into the implementation of teaching and learning strategies for mathematical understanding in your classroom. Do you have any questions for me? Thank you again. This concludes the interview.