

**GRADE 4 LEARNERS' EXPERIENCES OF
LEARNING MATHEMATICS USING ENGLISH AS
A SECOND LANGUAGE: A CASE STUDY OF 3
PRIMARY SCHOOLS IN KZN**

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Master of Education in the discipline of Curriculum Studies

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SEPTEMBER 2013

DECLARATION

I, **Funani Esther Shezi**, hereby certify that this research project, conducted under the supervision of **Dr Lokesh R. Maharajh** at the Faculty of Education, University of KwaZulu-Natal, is my own work and has not been submitted in any form for the acquisition of any degree or diploma at another tertiary institution. Where use was made of the work of others, this has been duly acknowledged in the text.

F. E. Shezi

Date

SUPERVISOR'S STATEMENT

As the candidate's supervisor, I have approved this dissertation for submission.

Dr Lokesh R. Maharajh

September 2013

DEDICATION

I would love to dedicate this work to the following persons; I strongly believe their sincere contributions in my life are worth the dedication. My dear Father, my beloved Mother and my Husband, all of whom are of blessed memory.

ACKNOWLEDGEMENTS

I wish to thank God for giving me the grace and strength to undertake this study in the rural area of Nkandla where learning through the medium of English as the language of instruction has some challenges to the learners who are not privileged to communicate in English with the community when out of school.

I thank my supervisor, Dr Lokesh Maharajh, for his guidance and direction, support and encouragement during the course of the study. I acknowledge his dedication and commitment to supervising my study, which encountered many twists and turns.

The contribution of Doh Nubia cannot be ignored; his timely intervention and dynamic contribution brought another dimension to the study. The quality he added to the study could only be provided by someone of his calibre.

To my two sons and nephew I say “Thank you for your help, support and the love you displayed.” To all research participants, thank you for your sincere support.

LIST OF ACRONYMS

ANA	Annual National Assessment
LiEP	Language in Education Policy
LoLT	Language of Learning and Teaching
CAPS	Curriculum Assessment Policy Statement

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ABSTRACT

The purpose of this study was to investigate Grade 4 learners' experiences in the teaching of mathematics using English as a second language. The study sought to determine whether learners were able to understand mathematics using English as a second language. If they were not able to do so, since English is the language of learning and teaching from Grade 4, it also needed to be determined why this was the case.

Thirty learners from three different rural schools were sources of data for the study, all from a deep rural area. Data were collected using a test given first in English and then in IsiZulu, along with classroom observations. Learners wrote the tests at their schools and were also observed during lessons as they engaged in the learning of mathematics in their natural settings.

The data collected revealed that learners are having some difficulties in understanding mathematics using English as a second language. The study also revealed that teachers were still using a teacher-centred approach, while mathematics requires a learner-centred approach, as discussed in the section on the theoretical framework of the study.

The study recommends that teachers need to use constructivist and mediated learning approaches in their teaching of mathematics to Grade 4 learners who are being taught in English as their second language, and that a variety of assessment techniques should be used.

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CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Introduction

It is part of the responsibility of an educator to encourage and develop learners' natural and personal abilities; to ensure that, learners are prepared for their future. It is for this reason that teaching is being considered as the most important avenues for advancing learning and for the accomplishment of learning's instructional needs. For the purpose of educational innovations James and Pollard (2006), requires that educators should reflect on their beliefs, be prepared to develop new skills and adopt to their context of teaching and learning in order to promote learning and achievement of their learners. A task team appointed by the Minister of Basic Education in 2006 was given the mandate to evaluate the implementation of the curriculum. Based on the recommendations of the task team, the then minister made a decision to reduce the learning areas and provide more priority to the teaching of English Language as First Additional Language together with the Mother Tongue Language to learners. This was to be implemented from Grade One. The results from the Annual National Assessment (ANA) in English and Mathematic for learners in rural areas have been so far very disappointing (Thuzini, 2011). Suggesting that much work needs to be done in the teaching of mathematic using the English Language as a language of instruction. The findings of this study showed that learners experience difficulties understanding mathematics when they are being taught with English Language as the language of instruction. From this perspective, the introductory chapter of the study will therefore begin with the background to the study followed by a discussion of the focus and purpose of the study. The contexts of the schools attended by the participants in this study are presented, and the key research question to be answered is introduced. A brief description of the research design and methodology is provided, and the chapter ends with an overview of each chapter that makes up this study.

1.2 The topic and critical questions and Key research question

The study explores grade 4 learners' experiences of learning mathematics using English as a second language: A case study of 3 schools in Nkandla, KZN. The exploration study was underpinned and guided by a single research question; therefore the study was geared to answer the question stated below:

1. How do Grade 4 English second language learners experience the learning of mathematics?

1.3 Background to the study

The learning of mathematics in Grade 4 using English as a second language has been a challenge in many rural South African schools, where learners had previously been taught in their mother tongue¹ in the Foundation Phase rather than in English as the medium of instruction (Setati, 2005). According to Botes (2010) learners come to Grade 4 having limited English language proficiency, and the learners are expected to be competent in mathematics using English as the language of learning and teaching (LoLT). These learners need more English vocabulary, mathematical language and mathematics register in order to be able to solve mathematics problems when learning mathematics (Govender, 2010). Mathematics register in English is different from that of most African languages which are predominantly written in Zulu whilst that of mathematics is written in English language. For this reason the teacher's administrative work becomes challenging and perplexing to the teachers that are not efficient with English language. The content knowledge of mathematics is based mostly on English vocabulary for the Grade 4 learners. An understanding of the language and mathematics learning in second- language speakers is important in designing mathematics instruction for English second-language speakers (Moschkovich, 2005, as cited in Nasir & Cobb, 2007).

The situation becomes even more complex when one realises that there are eleven official languages in South Africa: Afrikaans, English, isiZulu, isiXhosa, isiNdebele, siSwati, Setswana, Sepedi, Xitsonga, Tshivenda and Sesotho. The Constitution of the Republic of South Africa states that every child has a right to be taught in their mother tongue in the Foundation Phase; in the South African context this would be one of the African languages, except in schools which offer English as the main language of instruction.

Learners who have acquired mathematics vocabulary in another language (that is, any other one of the indigenous South African languages) in the Foundation Phase would not use that knowledge in their further learning. This is simply because in Grade 4 all learners write mathematics using English at the Annual National Assessment, without taking into

¹ This is any one of South Africa's black indigenous languages, which form part of the eleven official languages in the country.

consideration the starting- point of all learners. Zuma (2008) pointed out that this is the reason for the poor performance of Black South African learners in science subjects in the Matric examination and in international studies of mathematics. Setati (2003) commented that the English language is used as a language of power both educationally and for socio-economic advancement of South African society.

Although the South African Constitution recognises eleven official languages for the teaching of Grade 4 onwards, English is still the only medium of instruction being used in most South African primary schools. Furthermore, English is widely spoken as an ‘international language’ and has a high status, being used in many cases in education, trade, science and technology and diplomacy (Bergman, 2008; Govender, 2010). This influence of the English language both nationally and internationally has therefore made English the main language of instruction for the learning of mathematics in Grade 4. Therefore, how learners experience this language change in instruction and their subsequent understanding of mathematics at Grade 4 in rural South African schools, and those of Nkandla in particular, are of great interest to the researcher. The researcher has been teaching in the area for almost 32 years, and had realised that there was a problem with learning of mathematics in the rural areas.

1.4 Focus and purpose of the study

This study aims to explore the experiences of Grade 4 learners among whom English is their second language in mathematics. Most Grade 4 learners seem to struggle with the learning of mathematics when English is used as the medium of instruction, when English is their second language and they have been taught throughout the Foundation Phase in their mother tongue (Howie, 2003). This immediate switch of the language of instruction from isiZulu to English provides a profound challenge to the Grade 4 learners. Some Grade 4 learners have limited English proficiency in terms of mathematics terminology, language, communications and vocabulary (Setati & Adler, 2001).

The predominant LoLT in Grade 4 and onwards in South African schools is English (Setati, 2003). Learners who are being taught through the use of English as their second language need more vocabulary in English in order to be competent in their learning of English as a subject and as well as learning mathematics where English serves as the language of instruction. Grade 4 learners are therefore expected to be proficient in the English language in order to be able to solve mathematics problems (Karlsson, 2004).

The absence of any study related to how Grade 4 learners experience the change in their language of instruction as they leave Grade 3 and move into Grade 4, and most especially for learning the subject of mathematics, is a gap which this study hoped to address. This study therefore aims to explore the experiences of Grade 4 learners being taught mathematics through the medium of English as their second language, particularly in a deep rural area where English is like a foreign language (Adler, 2001). Some parents take their children to urban areas so that the children can become competent in English. Nevertheless, some researchers have found that learners learn better in their mother tongue as the medium of instruction (Adler, 2001; Setati, 1998; Setati, & Adler, 2001).

Contemporary English is a universal language, and everywhere in the world you can find someone who can communicate using English. In most cases African people mix English and African language in their daily lives; for example, when calling out the cellular phone number 072 974 8216 it will be pronounced zero, seven, two, nine, seven, four, eight, two, one, six, that is, in English. The naming of numbers in the mother tongue is limited. Calling out a number in isiZulu is too long and confusing; the example given would be *'izinkulungwane ezimbili namakhulu ayisishiyagalombili namashumi ayisikhombisa nemivo emihlanu,'* in English this means 'two thousand eight hundred and seventy-five.' These daily mathematical challenges and experiences are common in contemporary South African society.

According to the researcher's experience, parents are unable to help their children to do their homework. Number names in isiZulu are confusing and people use English number names. Learners are taught number names in isiZulu, which are not used in their daily communication. From the perspective of learning psychology, learners learn better when they are young. It is therefore important to acquire the right knowledge and skills for further studies, especially in mathematics because mathematics has its own register, which is very different in isiZulu than in English.

The South African education system seems to be divided into three sections: urban, township and rural, and one can notice the differences between the school settings and the academic progress of learners in their further studies. Therefore the rural Grade 4 learners are at the transition point where they have to adapt to the change in language in order to further their education.

A study by Botes (2010) and a similar one by Thuzini (2011) regarding learning and teaching of mathematics in a second language in _____ and Lesotho respectively revealed that there is a great problem with learners in acquiring understanding of mathematics when learning it in a second language. That is why the researcher is interested in exploring the experiences of learners in South Africa in doing so. The study also aims to determine the factors that impede or facilitate the learning of mathematics through English in Grade 4. The researcher believes that this study is significant in that it will provide insight into this problem that will go a long way towards helping to achieve effective learning of mathematics in those schools in the rural areas of South Africa where English is not commonly used by the community.

1.5 Context of schools studied

The schools studied are situated in the Nkandla circuit. Nkandla is one of the deep rural areas in the northern part of the province of KwaZulu-Natal, South Africa. This province which was once a renowned colony of the British Empire, and is mostly inhabited by people who are isiZulu speaking (Govender, 2010). In the Nkandla area English seems to be a ‘foreign’ language; it is only used in schools, and not at home or in the community. Most of the time IsiZulu-speaking people are proud about their culture, language and traditions, and so are reluctant to learn or speak in English, irrespective of whether they know it or not. Most schools in western part of Nkandla are not well resourced in terms of teaching and learning aids, as there are no computers, photocopiers, overhead projectors, worksheets or newspapers and no infrastructure (electricity, running water, public library). The absence of these essential resources has negatively impacted the process of teaching and learning in the Nkandla circuit.

Some homes are headed by elderly persons by means of their pension fund because parents of learners are unemployed; other learners are from single-parent homes, and others are orphans due to HIV/AIDS. The area in the western part of Nkandla is also underdeveloped as there are no factories, big cities, tarred roads, electricity, running water or proper sanitation. Most parents are working far away from home. The learners then stay with their grandparents, who are unable to help the learners with homework (learning needs support from home). Some of the parents are illiterate and unable to help their children with homework, and others leave schools at an early stage and cannot understand English. Learners sometimes report that their grandmothers complain about doing homework because candles are wasted. Learners have to

do many jobs after school: fetch water and fetch the cattle from the fields, and there is no time for study at home. If teachers try to retain learners to do their homework at school, the parents complain that the jobs that children are expected to do at their homes after school are not getting done.

Even teachers in the area experience some difficulties in living in the area. Teachers have to fetch water for consumption from the river daily by carrying buckets on their heads. Some schools have no accommodation (cottages) for migrant teachers. Teachers have to lodge in community houses, which needs a lot of patience because teachers have to adapt to that family. The landlord can chase the teacher out of his/her house any time he/she feels like it. Schools that have cottages require security for the properties to be safe during holidays. Some teachers have not received a rural allowance, while others have received such an allowance.

Teachers have to travel a distance of about 400 km to get to university; this is why most teachers in the area are un/under qualified. If a teacher wants to attend lectures at university, he/she must have his/her own transport so that they can be back and on duty the following day, and travelling expenses are higher compared to those for colleagues near big cities. Teachers who like to study also have to buy solar panels, batteries and an inverter to get the power to use a laptop for studying and writing of assignments, and candles to get light for studying. One cannot have power during the night and on cloudy days, and have to wait for sunny days to get power.

The government aims for quality education for all in South Africa, but in reality it is not like that. Conditions in rural areas are stressful for learners as well as teachers. There are no cleaners in the schools –even Grade 1 learners are expected to scrub and polish their classrooms and also to clean the toilets if it is their turn. People are gradually leaving the area, complaining about under-development of the area and that leads to bad effects on the education of learners. Multi-grade teaching² has started, without teachers being trained to handle the situation. By multi-grade teaching, the researcher refers to teaching more than one grade at the same time by one teacher, without teachers being trained to handle a multi-grade classroom situation. In most cases teachers are under-qualified. Some qualified teachers leave the area to go to better equipped and situated areas.

² This is a type of teaching and classroom organisation where two or more grades are put in one classroom and the different grade are being taught by one teaching using their respective grade curriculum within a time table period (Doh Nubia, 2013)

Having explained the context of the schools being studied, I will proceed to present a brief explanation of the design and structure of the study.

1.6 Design and structure of the study

The study will use a qualitative research approach, and has been located within the interpretive and post positivist paradigms. A case study research method was implemented, where three primary schools were used, therefore making this a case study. The phenomenon being studied was the experiences of Grade 4 learners with a focus on their experiences in the teaching and learning of mathematics as second-language English learners. The qualitative research approach is useful since it uses a small scale of data production and a search for in-depth information (Cohen, 2007). On the other hand, interpretivists believe that reality is socially constructed (Maree, 2007). Therefore, the researcher of a social phenomenon where learners are participants observed learners while learning mathematics in each of the three schools. The writing of tests formed part of the research design. This gave the researcher an insight into how the learners construct their reality through their experiences of being taught mathematics in their second language.

Learners for the schools selected for this research, wrote tests to determine if the learners can successfully answer questions using English as a second language. Furthermore, the researcher sought to find out how learning and teaching took place through observation during teaching, as well as of the learners' performances in written tests.

1.7 Definition of key concepts

In order to ensure common understanding of terms and for the reader to understand the researcher's position and understanding of these, the definition of key terms is presented below.

Experience: This refers to all the activities learners came across or engaged with during the learning of mathematics. These can be challenges and/or problems they encountered in their learning of mathematics.

Second language: A language that a person learned after his/her first language. It is any language that one learner acquires after first-language acquisition (Thuzini, 2011). The first language acquired in this study is usually the mother tongue or indigenous language. For the purposes of this study second-language English speakers of mathematics means learners who

are not taught in their main language or are taught in a language that they do not frequently speak.

1.8 Overview of the study

This study is presented in five chapters that are arranged logically and are outlined below.

Chapter one: Introduction

This chapter discussed the background to the study, and the focus and purpose of study. The chapter also discussed the context of the studied schools, the key research question, and the design and structure of the study. The chapter therefore provided an overview of the entire study.

Chapter two: Literature review

This chapter outlines the review of related national and international literature that supports the study. The focus is on learners' experiences in the learning of mathematics in Grade 4 using English as a second language. The literature review includes a discussion of the language policies in different countries, the learning of mathematics in bi/multilingual classrooms, code switching used in the mathematics classroom and the use of mother tongue as a medium of instruction. The chapter also presents literature regarding two theories that underpin the learning of mathematics: constructivism and mediated learning. These two theories provide the theoretical framework of the study and therefore frame the study.

Chapter three: Research design and methodology

This chapter presents the research design and methodology employed in the study, providing various instruments and methods that facilitated the collection of data. The methodology includes the paradigm, the approach and the research method. The chapter also discusses field study and data production procedures, which were tests and participant observations. The chapter goes on to discuss selection of respondents, data analysis methods and ethical considerations.

Chapter four: Analysis and discussion of data

This chapter answers the research question presented in Chapter one by analysing and discussing the findings that emerged from the data that were collected in Chapter three. The findings from test scores and observations are presented and discussed. The data will be

presented according to the schools concerned and will be supported by the literature presented in Chapter two.

Chapter five: Concluding remarks and recommendations

In this chapter the research findings allow a conclusion to be made with an outline of the insights drawn from analysis of the data. The findings reflect the experiences of learners of mathematics in Grade 4 using a second language (English). Findings show that Grade 4 learners experience some difficulties in learning mathematics using English as a second language. The chapter also provides the recommendations which emanated from this study, which are for an improvement in the quality of education the learners receive, with a suggestion for further research. This chapter concludes the entire study.

1.9 Conclusion

This chapter presents an overall introduction of the entire study. It discussed the background of the study, its focus and purpose, and the critical research question. A brief overview of the research design and methodology was provided; this is a qualitative study within an interpretivist paradigm. A summary overview of the five chapters that make up the study was also provided.

In the next chapter the researcher will discuss the review of related literature pertaining to the experiences of learners being taught in a second language. The theoretical framework for the study will also be presented.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter focuses on reviewing national and international literature related to this study, the purpose being to provide a comprehensive summary of what has been written by others about the learning of mathematics using English as a second language in bi/multilingual classrooms. The review offers a synthesis of what has been written on and around the focus of the study, what has not been written in terms of concepts and methodology, and how the researcher's study is going to address the gap in the existing knowledge (Vithal, 1997). It will summarise findings on the subject of learning mathematics using English as a second language after learners have initially been taught in their mother tongue in the Foundation Phase. The Learning of mathematics in grade 4 using English as a second language seems to be problematic (Setati, 1998; Setati, & Adler, 2001; Nasir, 2007; Van der Walt, 2008; Botes, 2010). This study explores the experiences of Grade 4 learners in mathematics using English as a second language. Van der Walt (2008) claims that South Africa as a developing country urgently needs a mathematically and scientifically literate population in a postmodern world.

Before we proceed into the literature, the researcher wishes to record that for the purposes of this study second-language English speakers of mathematics means learners who are not taught in their main language or are taught in a language that they do not frequently speak. Mother tongue or main language means the language that learners speak at home or most of the time.

English is used for communicative purposes and as a language of learning and teaching worldwide. English has spread all over the world as an international language (Moschkovich, 2005; Muke, 2005; Warschauer, 2000; Woolman, 2001). Using English as a second language takes place in most countries around the world, since preference is given to the countries' indigenous language. The increasing number of migrant learners in the United States of America led to bi/multilingual mathematics classrooms (Moschkovich, 2005).

Review from international (both African countries and overseas) perspectives for this study also, focuses on the learning and teaching mathematics in bi/multilingual classrooms. That

notwithstanding, the languages used in the various multilingual contexts internationally varies from one country to the next. This literature review discusses the impact of learning and teaching within a bi/multilingual classroom environment using English as second language.

2.2 Language policies of different countries

Almost every country in the world has a language policy, and some African countries adopted their language policy as the mother tongue to be used for instruction in the low primary education years, then switching to English as the LoLT from the Intermediate Phase/higher primary onwards (Bunyi, 1999; Francis, 2005; Muke, 2005; Nasir, 2007; Warschauer, 2000). Language policies differ from one country to another (McKinley, 2005; Sefa Dei, 2000). As a result, the experiences of learners also vary from one country to another. The experiences of the learners will not be limited to the teaching of mathematics alone, but will incorporate those of other subjects. Bunyi (1999) argues of Kenya's language policy that it overvalues English as the LoLT and undervalues indigenous languages throughout the education system, from the primary to the tertiary level of learning. Using English as a second language takes place from Grade 7 in Hong Kong secondary schools (Mak, 2011). Lesotho's language policy states that mother tongue instruction should be used from Standard 1 to Standard 3, and then from Standard 4 onwards English is used (Thuzini, 2011). While the experiences of learners are different from country to country, what about the language in a mathematics bi/multilingual classroom? It is this that I turn attention to now.

2.3 Learning and teaching mathematics in the bi/multilingual classroom

When the LoLT is not the learners' first language, it creates some difficulties in the learning and teaching processes. Assessing learning in a bi/multilingual environment is long overdue, and the effects of bi/multilingualism on learners was perceived a long time ago (Muke, 2005; Setati, 1998, 2008). Learning mathematics and English at the same time has a bad impact on learners' achievement (Nasir, 2007). The question of language of instruction and assessment in many African countries is challenging, with poor performance in Matric and in international assessments of mathematics for most African learners (Thuzini, 2011; Zuma, 2008). Many mathematics classrooms make use of code switching to deal with the challenges mentioned above.

2.4 Code-switching or bi/multilingual learning and teaching in mathematics

The phenomenon of code-switching is not only found in South Africa but can be found in many countries where there is more than one official language (Nasir, 2007). For example, countries such as Cameroon, the Democratic Republic of Congo and Switzerland have more than one official language (although those of Cameroon are limited to French and English, with none of its indigenous languages regarded as ‘official’). According to Moschkovich (2005) code-switching is an unacceptable practice and associated with deficiency in the quality of communication, specifically in the lower grades. Barbara (1990) argues that learners who are not good in English should be put in a separate classroom to support them with their limited English proficiency, so that they can improve their competency in all subjects and specifically mathematics. This will not only improve on the learners’ grasping of the concepts but will also improve on their class participation and interaction with their teacher and peers (Moschkovich, 2005).

Setati (2009) considers code-switching³ as a learning and teaching resource in bi/multilingual classrooms, and further argued that multilingualism has become world norm and has not dealt with socio-political issues relating to the context in which learning and teaching take place. Moodley (2001) sees code-switching as alternative use of two or more languages.

The challenges of relationships between bi/multilingualism and learning of mathematics have long been recognised (Setati, 2001). According to Uys (2010) sometimes teachers use code-switching for the sake of maintaining social relationships and to display humour to learners. Code-switching is a strategy used by teachers trying to make learning easy when learners have a problem understanding second-language instructions. To understand second language is not an overnight thing – it takes some time to develop English language proficiency. In Nkandla English is like a foreign language, because it is not commonly used at home; also, most families do not have television and there are no English newspapers, and most of time they listen to isiZulu medium radio programmes.

Code-switching is used during socialisation and for educational and understanding purposes (Auer, 1998; Bayley, 2003.; Moodley, 2001). In bi/multilingual classrooms code-switching is possible mostly where teachers and learners share the main languages, for the sake of the

³ Code-switching is the ability of learners and teachers to make explanations of some concepts that are not familiar to learners by mixing languages.

learners' understanding of the subject matter being learned (Nasir, 2007; Setati, 1998, 2003; Setati, & Adler, 2001; Thuzini, 2011). Setati (2005) reports on a mathematics classroom where the teachers use both English and Setswana to facilitate learners' understanding of mathematics concepts. Not only learners are code-switching, teachers are also code-switching and code-mixing (Thuzini, 2011). Teachers use code switching to make the language of mathematics accessible to learners.

2.5 Mathematics language

Mathematics language is sometimes different from everyday usage, more particularly mathematics registers. Mathematics is not about knowing English, because mathematics language is sometimes different from daily spoken English language. According to Moschkovich, cited in Nassir and Cobb (2007), a register is a language variety associated with a particular situation of use; he highlights that there are multiple meanings for the same term, and that mathematics learners need to use these different meanings appropriately in different situations. Multiple meanings in mathematics – for example, the word 'prime' can have different meanings depending on whether it is used to mean 'prime number', 'prime time' or 'prime rib' – is challenging for English second-language learners of mathematics (Nasir, 2007).

The preceding sections have covered the international literature on language of instruction, mother tongue as a medium of instruction in South Africa, mathematics language, pronunciation, teaching strategies, teaching and learning resources and teachers' experiences in teaching mathematics using English as a second language. The next section will discuss the above mentioned aspects as contained in the national literature.

As previously mentioned, the South African Constitution adopted eleven official languages (Setati, 2003) for the country. Learning and teaching in the Foundation Phase (according to the Curriculum Assessment Policy Statement (CAPS), (Grades R-3) is through the medium of the learners' mother tongue, and from the Intermediate Phase (according to the CAPS, Grades 4-6) onwards English is used as the LoLT. In a study conducted in the Gauteng province Nel (2008), it has been reported that at the Intermediate Phase⁴ second-language English speakers/learners of mathematics face challenges because they are not adequately

⁴ Although the intermediate phase will include grades 4-6, the researcher limits the reference to grade 4 only as this is the area of the focus of the study.

prepared to learn mathematics in their second language of instruction. Nel goes further to suggest that many teachers lack the required skills to support English second language learners with the knowledge, tools or time required for them to efficiently learn mathematics. This suggestion also motivated the researcher to carry out the study. The discussion to follow focuses on the language of instruction, the mother tongue as an instructional language, mathematics language, and code-switching /bi-multilingual learning and teaching in mathematics.

2.6 Language of instruction

English dominates as the LoLT in most South African schools, and as a result learners use English as a medium of instruction (Jordaan, 2011; Nel, 2008; Setati, 2003, 2008). The language used in transitional or rural classrooms is challenging for teachers and learners when learning and teaching is in a second language of instruction, which in this case is English (Thuzini, 2011). The transitional or rural classes are where learners start to be taught in English as the medium of instruction after having been taught in their mother tongue in the Foundation Phase (Nel, 2007). Bamgbose, as cited in Thuzini (2011), observes that all countries which were formerly under colonial rule use African languages in learning and teaching, more especially in the lower primary education, and thereafter English is used as the medium of instruction from the Intermediate Phase onwards. South Africa as one of former colonial countries, adopted the same system.

The Language in Education Policy (LiEP) states that every child has a right to be taught in their mother tongue in the Foundation Phase (Grades 1-3), and from the Intermediate Phase onwards the medium of instruction changes to English. Thuzini, (2011) reports that grade 4 is where most learners start to experience difficulties, since they start being taught in English as the LoLT. Setati (2005) argues that mathematics learning needs attention to many aspects, such as fluency in mathematics language (in English as second language in this case), words, phrases, abbreviations, mathematics communications and writing, and further argued that multilingualism is encouraged for mathematical communications.

It is in Grade 4 that most learners start to experience difficulties because the medium of instruction is now English, their second language, and learners' ability to use English is limited (Nel, 2010). As a rule, all of the learners in Grade 4 are expected to complete the

common paper Annual National Assessment in writing,⁵ and not taking into consideration when the learners (those in rural areas) began their learning in English, and this leads to poor performance of those learners who started learning in their mother tongue at the Foundation Phase, because they may or may not understand the questions. A majority of the learners come from homes and environments where English is mostly not used; hence the use of English comes with some difficulties in their education (Thuzini, 2011).

In some cases where learners use English as a second language, learners seem to be passive in their learning and are not active participants in their learning, compared when using their mother tongue (Botes and Mji, 2010). Teachers do not seem to know whether the problem is with English or with the solving of mathematics problems (Botes, 2010). Setati (2001) and Nel (2010) point out that schools in the rural areas fail because of limited support from home for English as a medium of instruction.

The learning and teaching can be affected by non-communication of learners in class, and learner involvement in their learning is also affected, because the South African education system adopted a learner-centred approach where learners are expected to be active participants in their learning; this in turn lead to “code-mixing” (Bayley, 2003.). Furthermore, learner’s limited proficiency in English contributes to learning difficulties in many ways. For example, being unable to understand questions, which leads to incorrect responses from the learners; incorrect spellings; being unable to participate effectively in group discussions; being unable to be active participants in their learning; being unable to read for information and for enjoyment, and many more (Botes, 2010). Jusoff (2009) and Ong (2006), as cited in Thuzini (2011), provide some of the factors that contribute to the inability of learners to communicate effectively in mathematics using English as a second language. Among those factors are teachers who are not proficient in English; learners’ background; poor relationship between teachers and learners; poor relationship of teachers among themselves; peer group feeling towards mathematics as a subject; learners’ frequent absenteeism; and the lack of good mathematics materials. Pretorius (2000) affirms the need for proficiency in the language in order for learners being taught in English to improve their academic performance.

⁵The researcher was not granted access to the results of the ANA for mathematics; the schools’ administration considered the documents confidential and therefore she could not analyse them. Hence they could also not be used in the data analysis.

English as a second language sometimes has a bad effect on learning and teaching of mathematics, since these learners in Grade 4 started with mother tongue instruction in the Foundation Phase. Mathematics learning is not only about computations and figures but also competence of the language of instruction being used (Nasir & Cobb, 2007). The need for learning mathematics through the medium of English is important from early grades so that learners can be successful in mathematics competence (Howie, 2003).

To communicate mathematically using language is important in learning mathematics; this view is held by many researchers (Adler, 2001; Cai, 2011; Ginsburg, 2008). According to Botes (2010) acquiring language skills and vocabulary in monolingual children is easier than in bi/multilingual children of the same grade and age. Limited English proficiency can have a bad impact on learners' intelligence, and inadequate language acquisition may result in inefficient actualisation of intelligence (Botes, 2010, p.2). Sometimes learners who are taught in a second language do not achieve academic excellence, not because they are less able but because of language barriers in mathematics of second-language English speakers (Adler, 2001; h. Botes, & Mji, A., 2010; Nasir, 2007; M. Setati, 2008). In the next section the mother tongue as a medium of instruction is discussed.

2.7 Mother tongue as medium of instruction in South Africa

Mathematics register is not developed in African languages, and English still dominates as the language of trade and development (Setati, 2008; Setati, & Adler, 2001). The LiEP states that every child has a right to be taught in his/her main language in the Foundation Phase in the South African context, as indicated earlier: "... this policy is intended to address the overvaluing of English and the undervaluing of African languages, in practice English still dominates" (Setati, 2003, p.152). The use of mother tongue instruction in the early grades is supported by some researchers, claiming that learners learn better in their mother tongue (Setati, & Adler, 2001).

According to Karlsson (2004) isiZulu-speaking parents emphasise that they want their children to be taught in English, so that they can be fluent in English and later get better jobs. English is widely used and is an international language of high status, English is also used in education, science and technology, trade, research, diplomacy, and as a language of development (Setati, 2003). Thuzini (2011) claims that learners who are starting Grade 4 after having been taught in their mother tongue in the Foundation Phase experience

challenges in the fourth year of schooling when English is used, while learners who are English second-language speakers who start their first year in English medium schools experience these challenges in Grade one and thereafter become proficient in English for the rest of their school years.

According to Thuzini (2011) the use of mother tongue instruction can help to minimise the problem of learning and teaching in English as a second language. When using mother tongue instruction there would be no misunderstanding between the learners and teachers sharing the same first language. However, this idea limits learners to a particular place and they will not be nationally and internationally marketable, since not all African languages of South Africa are used nationally. If other second-language English learners are able to adapt themselves to an English-speaking environment, why not have all learners start with English as medium of instruction at the same pace, preparing them for their future learning and development?

Govender (2010) argues that isiZulu-speaking learners who start their Foundation Phase in English medium schools face some challenges in their first years in these schools, such as: negotiating difficult transitions between school and home, entering a new environment, psychological trauma, and reduced self-image and self-confidence. Children learn better when they are still young, and at a later stage these learners become English proficient.

Karlsson (2004) claims that the use of African languages must be encouraged in schools, more especially isiZulu in KwaZulu-Natal, but the report is written in English. English is universal and dominating, as has been said earlier in this chapter. Parents are taking their children to English medium schools and there is a drastic drop in enrolment in the rural schools, which leads to multi-grade teaching in one classroom.

Setati (2008) argued about valuing of English to be the medium of instruction by teachers and learners, while researchers support the use of mother tongue instruction. These competing ideas are perhaps caused by the lived experiences of learners and teachers. To be competent in mathematics is important, because then one can choose from a variety of careers (mathematician, medical doctor and pilot, to mention a few) which have high status, while government wants good results, not considering the conditions in schools. Learning through mother tongue instruction is not supported by parents, students and teachers (Karlsson, 2004;

Setati, 2008; Setati, & Adler, 2001). Studies that recommend the use of main language instruction are framed in the concept of mediated learning, and do not take into account the political role of language (Setati, 2008).

2.8 Mathematics language

Botes (2010) claims that language and education are interwoven because all learning and teaching, discussions, group work and presentations are through the medium of language, and continues to argue that monolingual children acquire language skills and vocabulary more easily than bi/multilingual children. Mathematical communication using language is important in learning and teaching of mathematics because this subject is not only about computations but also competence, solving problems and mathematical communications (Adler, 2001; Botes, 2010; Cai, 2011; Ginsburg, 2008; Setati, 2003; Van der Walt, 2008).

Mathematics register most times is different from African languages, and sometimes different from everyday spoken language, even in English. Thuzini (2011) argues that mathematics language becomes most difficult for English second-language speakers, and further argues that there is a difference between English language in mathematics and English language in other subjects and everyday speaking. Some concepts have meanings that are different in mathematics to their daily use; for example, the opposite of ‘more’ in everyday life is ‘no more’ and in mathematics it is ‘less’ (Setati, 2003). Thuzini (2011) claims that some people consider any fraction as half – any part of the whole is taken as half – while in mathematics half is one part of two equal parts. The word ‘table’ also has different meanings; in everyday life a table has four legs, and in mathematics it is a drawing that has columns and rows. Mathematics teachers have to teach mathematics and also English at the same time, as learners are still learning English as a language.

2.9 Pronunciation

The pronunciation of English words by teachers is vital in helping second-language English learners in their understanding of English as well as their acquisition of knowledge of mathematics. Thuzini (2011) argues for the importance of correct pronunciation in the teaching of mathematics, because pronunciation leads to common understanding and correct spelling. Pronunciation in itself can affect the extent to which learners experience the teaching of mathematics and any other subject that they engage in (Govender, 2010). The pronunciation of most English words is very different from that of the African languages and

spelling. During classroom interaction some learners become shy to speak, not because they do not know the answer but by limited English proficiency regarding pronunciation, especially learners from rural areas, and teachers experience difficulties in knowing whether learners have grasped the work or not (Thuzini, 2011). Learners in Grade 4 experience some difficulties in pronouncing mathematics terms since they had learnt them in their main language, which is very different from English (Bayley & Schechter, 2003).

2.10 Teaching strategies

Teaching strategies are techniques used by teachers to teach learners subject matter (Thuzini, 2011). The most used teaching methods in mathematics are: problem-solving, group discussions, question and answer computation, sequencing, textbooks, group work and play, to mention a few. Different teaching methods give different outcomes, and some methods are suitable for learners to work in groups to help each other and learn from one another; this would also help with the use of English. Problem-solving strategies help learners to become problem solvers. Group work has been a commonly used method of teaching mathematics in recent years; learners can practice their English as they learn better when learning from each other. Thuzini (2011) sees group discussions as a useful strategy in mathematics learning and teaching; teachers can teach the whole class and thereafter facilitate learning in small groups, and learners construct meanings for themselves using their experiences and the resources available. In this way learners become active, creative participants and practice the language of instruction. Learning through interaction plays an important role in learners' minds because they become part of knowledge formulation; Wells & Wells-Chang (1992) argued that all knowledge needs to be actively constructed by each individual knower interacting with the external world.

The previous South African educational curriculum, Curriculum 2005, encourages a learner-centred approach in learning and teaching settings (Taylor, 1999), so group work is one of the teaching strategies that teachers can use. Group discussions can take one of two forms: firstly, between the teacher and learners discussing a topic in class, the role of the teacher being that of a facilitator; and secondly, a class is divided into groups consisting of 4–8 members or in pairs, and facilitated by the teacher. All groups are usually given the same task, with group leaders and a recorder to control and record the group's findings respectively (Thuzini, 2011). In group discussions learners develop social skills such as listening, presenting, interactions,

waiting for their turn to speak, collective agreement, leadership, sharing ideas, writing, co-operation and many more (Thuzini, 2011). Learners learn better when they learn from others and the teachers are there only to provide guidance. This approach to teaching gives learners a varied learning experience across South Africa, depending on where the school is located, that is, in an urban or rural area. During group work teachers are able to assist a group of learners rather than attending to the individual, and the teacher can scaffold complex learning (Ginsberg, 2000). This further diversifies the type of learning experience the learners engage in during learning and teaching.

Learning of mathematics needs discussions so that learners can construct meaning and knowledge on mathematical computations and problem-solving. Learners should be encouraged to experience mathematics learning through explorations and share their personal experiences. Gardner (1983), as cited in Thuzini (2011), highlights the importance of group work in development of social skills: communication, presentation, problem-solving, leadership, delegation and organisation, and development of interpersonal intelligence. As learners interact in a situation which is guided by ground rules, skills such as argument used in debates are developed. According to Vygotsky's theory (Thuzini, 2011), learners construct their own knowledge sometimes through interacting with others, the teacher and the environment, and even using their home background knowledge in mathematics learning.

2.11 Teaching and learning resources

This section discusses the types and importance of different resources used in learning and teaching situations in mathematics. Learning and teaching of mathematics requires the use of learning and teaching aids in order to make meaning of the concepts being taught, since most mathematical concepts progress from the simple to the abstract. Learning and teaching materials are resources that are used by both teachers and learners to make teaching and learning more effective. Learning and teaching aids include textbooks, concrete objects, pictures, apparatus and substances (Thuzini, 2011). The availability of these resources has a huge impact on how learners experience the learning of mathematics since they are second-language English learners.

For learners around the Foundation Phase it is important to use concrete objects in their learning. Nel (2010) mentions some of the resources that can help English second language speakers / learners: newspapers; magazines; television and radio; exposure to English-

speaking environment; teachers who are proficient in English and English reading material at school and at home. Harley and Wedekind (2004), as cited in Thuzini (2011), argue that the limitation of smooth learning and teaching of mathematics and science is lack of resources, and continues to argue that South African schools which were most historically advantaged are doing well, while those which were and still are most disadvantaged appear to be struggling. In a review of the literature Botes and Mji (2010) found that group work with the necessary material can be a useful strategy in teaching and learning of mathematics.

Another resource that is useful in learning and teaching is support. Education has an obligation to support teachers in their profession to produce quality learning and teaching; such support comes from the school principal, colleagues and parents. This obligation has an advantage, in that it provides the learners with a richer experience in their learning of mathematics (Setati, 2001). Passion for one's work plays a major role in producing a high performance in that particular job. According to Thuzini (2011) the support teachers receive must be both psychological and through resources; this will improve on the quality of education that learners receive through their rich learning experiences.

2.12 Teachers' experiences in teaching mathematics using English as second language

Some teachers, parents and learners supported the use of English as the medium of instruction in the learning and teaching of mathematics in grade 4 (Karlsson, 2004; Setati, 2008), while at the same time researchers and government support the use of a child's main language in the early grades of schooling. This notion accounts for the LiEP and as well as some of the research projects that have been done to support this stand (Botes, 2010).

Thuzini (2011) argues that non-English-speaking mathematics teachers face challenges in mathematics using English as second language, because teachers cannot predict whether learners have understood the concepts or if it is because of limited English proficiency when learners do not respond to questions or fail tests.

Creating a positive learning environment for learners is important, and motivation for learners as well as teachers is crucial (Ginsberg, 2000). When learners desire their teacher's admiration, most of the time they work to their best ability and do not want to disappoint the teacher. Developing good relationships with all stakeholders – principal and staff, among

teachers, school and learners' homes, school and community, and learners among themselves – can assist in creating a positive attitude in learning (Veugelers, 2005).

Muijs (2001) values collaborative small group work rather than individual practices during lessons, and this holds an attraction for many researchers around the world. In recent years teachers, parents and students have valued English as the medium of instruction in learning and teaching (Howie, 2003; Karlsson, 2004). Grade 4 second-language English speakers learning mathematics first have to master English as a language and secondly as a medium of instruction, and sometimes the teachers themselves are not good at speaking English. The next section of this review will be discussing the theoretical framework that has framed the study.

THEORETICAL FRAMEWORK

As Bonk and Cunningham (1998) argued, instructional strategies and tools must be based on some theory of learning and cognition. Theory is a combination of views and ideas which constructs a logical view of events, behaviour or relationships with the aim of explaining or predicting a phenomenon (Cohen, 2007; Neuman, 2006). Therefore a theory aims at explanation and prediction of a phenomenon (Thuzini, 2011). A theoretical framework is crucial in connecting the researcher to existing knowledge. This research study is informed by the two theories, namely mediated learning theory and constructivism based on Piaget's and Vygotsky's theories for their relevance on my study.

2.13 Mediated learning theory

There are many different types of mediated learning and audio-visual aids are one of the most useful materials to mediate learning in the learning of mathematics. Mediated learning theory is seen and strongly recommended by a majority of learning psychologist as one of the useful teaching strategies in mathematics learning and teaching that can enhance learner's performance (Bradbury and Zingel, 1998). Mediated learning is where learners are involved in their learning experiences and the role of the teacher is that of mediator/facilitator. Kozulin (1995) and Oliver and Herrington (2003) state that adults or more competent peers place themselves between the environment and the child, and further state that the work of the mediator is to select, change, amplify and interpret objects and processes for learners. Feuerstein, Rand, Hoffman and Miller (1980) conducted numerous studies on mediated learning with thousands of orphans and young immigrants from over seventy countries after

the Second World War. They concluded that a lack of mediated learning experience is the single most important cause of retarded performance. Furthermore, Bradbury and Zingel (1998) have demonstrated the effectiveness of mediated learning in South Africa by facilitating peer interaction within a sample of primary school children from diverse cultural backgrounds. Therefore from this perspective, the experiences of grade 4 learners will be explored on how they experience the teaching of mathematics through English as their second language of instruction.

This theory will inform the researcher about the support which learners receive from their teacher in constructing their knowledge cognitively and socially in the learning of mathematics using second language in Grade 4. Craig (1989) argues that mediated learning theory is based on the premise that learners have the opportunity to demonstrate how they think or how they have assimilated a taught concept by the way they respond to a standardised test or any form of assessment at one moment in time. Through this framework therefore, the data collected by the researcher will reveal whether teachers are able to apply appropriate teaching methods within the frames of this theory to help their learners to have a better understanding of mathematics concepts. Since the study is about exploring the experiences of learners in the teaching of Grade 4 mathematics it is therefore important to also frame the study within the constructivist theory, for the reasons outlined below.

Although mediated learning theory have been used as a theory to frame the study, the researcher bears in mind that it is empirically not enough to frame a study based on the exploration of learning on a single theory, since learning is governed by many relevant perspectives. For this reason, constructivism theory has also been used to guide the researcher frame the study in a more comprehensive theoretical view to accommodate a majority of learning related aspects. The use of two theories is not to create a dichotomy of views but to precisely locate the positioning of the researcher as to how she framed the study using the point where both theories intersect with each other.

2.14 Constructivism theory of learning

Von Glasersfeld (1995) states that constructivist thoughts are so closely interwoven with other principal perspective of learning that are presented separately. For this reason the experiences of the Grade 4 learners can likewise be best explored through the lens of the theory of constructivism. This theory caters for learners' classroom participation through

interactions with their peers and teacher, and communication as well as their understanding of the concepts being taught in mathematics. Powell and Kalina (2009), as cited in Thuzini (2011), divide constructivism theory into two kinds: cognitive or individual constructivism, and social constructivism theory. Cognitive constructivism is based on Piaget's theory, and social constructivism is influenced by Vygotsky's theory (Thuzini, 2011). Although this assertion is not universally acceptable, Von Glasersfeld (1995) suggests that constructivism is concerned with establishing universal principles that lie behind thinking. It therefore assumes that all learners of normal intellect are faced, at a general level, with the same forms of adaptation towards their learning.

Constructivism as the intellectual development theory focuses on mental processes that construct meaning. The theory suggests that ideas are constructed in individuals through one's mind. Phillips (1995) states that constructivists like Piaget and Vygotsky have been concerned with how the individual learner goes about the construction of knowledge. Constructivism theory helps with the idea of being learner-centred in the learning and teaching situation, where learners use their prior knowledge to solve problems individually or as a group, and not just through the transferring of knowledge from the teacher's mind to the learner's mind. Bonk and Cunningham (1998) explains that the basic issues in teaching and learning can be described through key words as "constructivism," and "learner-centred." They continued to argue that at the heart of constructivism and learner-centeredness is the idea that learners learn best when engrossed in the topic, motivated to seek out new knowledge and skills because they need them in order to solve the problem at hand. This theory will inform the researcher about whether the experiences of learners learning mathematics using second language fit within the frames of constructivism. In other words, when learning mathematics in Grade 4, the researcher will be keen to know if teachers give learners the opportunity to construct their own understanding from their prior knowledge? And if teachers give learners the chance to build on the knowledge acquired in the Foundation Phase and also in their environment and at home. From this perspective the learners' experiences would be effectively and efficiently explored by the researcher.

Through the lens of these two theories at their point of intersection, the researcher will therefore explore the learners' experiences in the teaching of mathematics. While the mediation theory concerns itself with the teacher and how he/she mediates the lesson, thereby

facilitating the learners' understanding in the teaching of mathematics, the theory of constructivism on the other hand concerns itself with how the learners construct their meanings of the mathematics concepts. The meanings constructed could be individual or collective. There is however an assumption that teachers carefully structure the problems so that in the course of solution, the learners naturally pass through and acquire all concepts of relevance in their learning of mathematics. As expected the learners might not even notice that they are undergoing instruction and learning, for they learn naturally in the course of classroom activities due to a combination of mediated learning and constructivism.

2.15 Conclusion

This chapter presented a literature review from both the national (South African) and international perspectives, as well as the theoretical framework used in this study. The literature consulted was grouped into language, learning and teaching strategies, learning and teaching resources and support. As far as language is concerned, learners are faced with the challenge of a second language, which in the South African context is English, as well as the mathematics register that is used in mathematics. When learners are taught in English they do not speak in class or participate actively in group discussions, and this affects their performance and pass rate.

For effective learning and teaching for deeper understanding of mathematics, learners should have English proficiency (Howie, 2003). Some terms that are used in everyday English may mean something different when used in the subject of mathematics (Barbara, 1990; Taylor, 1999) This causes challenges for those with limited English, and as a result they fail to understand mathematics concepts. To remedy this most teachers use code-switching since they want their learners to understand the mathematics concepts and to be active in their learning, and at the same time to learn the English language.

This study is informed by two theories, those of mediated learning and constructivism, which suggest that learners construct their own knowledge through their prior knowledge, experiences and interaction with teachers, other learners and the environment.

The next chapter presents the research design and methodology used in this study which explored Grade 4 learners' experiences of learning mathematics using English as a second language.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology, which includes instruments and methods that facilitated the investigation. It discusses the research paradigm, approach and research style followed. Thereafter, the selection of participants is discussed and how data were collected for the exploration of Grade 4 experiences of learning mathematics using English as second language, as well as the data analysis process. Lastly, the chapter discusses the issue of the quality of the study, the limitations of the research and ethical considerations.

3.2 Research paradigm

A paradigm can be regarded as a lens through which we understand the world. Thuzini (2011) states that there are several different lenses for seeing and understanding the world. Neuman (2006) highlights a paradigm as a general organising framework for theory which includes fundamental assumptions, key issues, models of quality investigation, and methods of seeking answers.

Data collection methods fall under two wide paradigms: qualitative and quantitative approaches (Cohen, 2007; Kincheloe, 2003; Maree, 2007; Neuman, 2006). This study adopted the interpretive paradigm within a qualitative approach to collect data to answer the research question which has been stated in chapter one.

3.2.1 Interpretive paradigm

Cohen et al. (2007) view the interpretive paradigm as based on human behaviour, attitudes, beliefs and perceptions. Human beings always interpret and give meaning to the things they see in the social world, and interpretive researchers understand that the world is changeable and people's behaviour can be influenced by power dynamics (Cohen, 2007; Thuzini, 2011).

The researcher positions this study within the interpretive paradigm because the focus of the study was to explore learners' experiences of learning mathematics using English as a second language in Grade 4 after being taught in their mother tongue (isiZulu) in the Foundation Phase. Thuzini (2011) and Cohen et al. (2007) claim that an interpretive framework allows exploration of the participants' natural setting by exploring the lived experiences of the

participants. Furthermore, interpretivists believe that reality and truth are socially constructed (Cohen, 2007). Therefore, the researcher in this study aims to explore Grade 4 learners' experiences of learning mathematics using English as a second language at their natural setting.

Prasad (2005), cited in Thuzini (2011), states that reality does not exist in some tangible, identifiable 'outside world' but within human consciousness itself. Thus reality is socially constructed through acts of interpretation, and knowledge is socially constructed. This means that the researcher interprets learners' experiences in the context that they are in and attaches meaning to them. Interpretivists are guided by the assumption that knowledge and reality are socially constructed by active people in the process of research, and knowledge in the interpretivist paradigm is concerned with interpretation, illusion and meaning and all human action is meaningful (Cohen, 2007). Hence Grade 4 learners were interpreted within the context of social practices (school). The interpretivist paradigm helps the researcher to describe and understand rather than explain and predict human behaviour. For this reason the researcher found the qualitative approach to be suitable for use in this research.

3.2.2 Qualitative approach

This study used a qualitative approach which employed a case study style. According to Cohen et al. (2007) the qualitative approach is an inquiry-based approach useful for exploring and understanding a central phenomenon. They further state that the phenomenon is an idea that the researcher would like to explore, discover, explain, identify or describe. In qualitative studies the researchers seek in-depth information so as to understand a phenomenon (Thuzini, 2011). Qualitative research is a design that guides the researcher on how to design instruments, collect in-depth data from experiences of small targeted groups of people, and analyse it (Denzin and Lincoln, 2005, p. 3). This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them, the outcomes of this design are descriptive rather than predictive.

The qualitative approach acknowledges that the social and physical world are different and it seeks to understand human interactions by observing and interacting with people in order to construct the social world around them (Cohen, 2007). In this study the researcher aimed to understand the complex world of mathematics learners' experiences from their naturally

occurring settings. The analysis of data was aimed at ‘thick’ description and to understand the learning of mathematics by these learners.

According to Thuzini (2011) a qualitative approach focuses on understanding and meaning of a phenomenon that is being investigated rather than on numbers. Since the study explored learners’ experiences of mathematics using second language, the researcher felt that the aim of this study was similar to that of the qualitative research approach. The qualitative approach was therefore used to capture an in-depth understanding of the phenomenon under study, focusing on describing and interpreting events and actions of participants in their natural environment without any interference.

In order to capture an in-depth understanding of the phenomenon the researcher used the case study approach, and different data collection methods – test and classroom lesson observations – were used.

3.2.3 Case study research method

A case study is descriptive research which involves describing the particular event and/or how events occur (Bergman, 2008; Cohen, 2007; Creswell, 2007; De Vos, 2005; Denscombe, 1998; Knight, 2002; Maree, 2007; Truman, 2000). This study employed a case study style of research, which is often used by researchers in the interpretive paradigm (Cohen, 2007). According to Yin (2009), a case study is an in-depth analysis of one particular case, where the case may involve a person or a group of people and organisations. It aims to describe what is like to be in a particular environment. This study explored the experiences of Grade 4 learners (in the western part of Nkandla) who learn mathematics in a second language, and how they learn in the classroom situation. Case study research aims at gaining greater insight and understanding of the dynamics of a specific situation. Therefore a case study was employed to gain in-depth understanding of Grade 4 within the western part of Nkandla learners’ experiences of learning mathematics in a second language in this study.

The case study design was chosen to gain an in-depth understanding in a related context, rather than a broader population (Cohen, 2007). Hence the study does not generalise, since the researcher focused on 30 learners in three different primary schools. This study is therefore a multi-case study, although all of the schools were from the same community.

3.3 Sampling of participants

According to Maree (2007) sampling refers to the method used to choose a portion of the population for investigation. Cohen et al. (2007) see sampling as the issue of defining the population on which the study will focus. Creswell (2012) claimed that the first step in the process of research is to identify the population and places for study. Qualitative researchers aim at collecting specific cases, events, or actions that can clarify and deepen understanding (Denscombe, 1998; Neuman, 2006). The inclusion of the entire population in the study is restricted by money and time constraints (Maree, 2007). In this study the researcher purposively selected the participants to answer the research question ‘What are Grade 4 learners’ experiences of learning mathematics using English as a second language?’

In simple random sampling the researcher selects participants’ school from the population where all persons have an equal opportunity to be selected, that would be representative or informative about the topic of interest. Thus in simple random sampling each individual case in the population theoretically has an equal opportunity of being selected for the study (Cohen, 2007; Creswell, 2012; De Vos, 2005; Knight, 2002; Maree, 2007; Neuman, 2006). This sampling was relevant to the study since the researcher purposely selected Grade 4 learners who were beginning to learn mathematics using English as their second language. Since most of the schools within the western part of Nkandla are similar in terms of culture, structure and organisation, the researcher simply selected a school that was willing to participate in the study without any further prior criteria and as a result the learners of the grade 4 of the selected school automatically became part of the study.

This type of sampling does not attempt to be representative of the entire western part of Nkandla and its findings would not be generalizable, but the focus was to acquire in-depth information from Grade 4 learners, as the study is concerned with the learning of mathematics in Grade 4. In this case the findings could be transferred to any context where the learning of mathematics in Grade 4 follows a similar policy to that followed in South African rural areas. Therefore 30 Grade 4 mathematics learners were selected from three schools. The selection of participants and schools is discussed below.

3.4 Participating schools and learners

The study was conducted in three primary schools in the rural area of Nkandla circuit in KwaZulu- Natal, South Africa. The names of schools in Nkandla circuit were written on

separate papers, and the researcher randomly drew papers one by one from the lot to select the three schools. These schools were named school A, school B and school C. The same procedure was used to select learners; learners' names were written on small separate papers and the researcher drew names from the lot to select 10 learners from each school. The learners in school A were numbered from 1-10, in school B learners were named from a-j, and in school C Roman numerals were used from I-X for confidentiality purposes.

It will be interesting to note that the western part of Nkandla was purposefully selected because the researcher has been a regular visitor in the area for almost a decade, although she had never been a teacher in any of the school in the selected part of the study. During the visits the researcher realised that there was a problem with learning of mathematics in the rural areas; the main problem was poor performance in mathematics in Matric, compared to schools in urban areas. The researcher knew that during one of the reports presented in a workshop organised by the Department of Basic Education. The researcher's focus was therefore on the Grade 4 class because this is where the change of medium of instruction from isiZulu to English starts. The learners from these schools come from a community where English is a foreign language and only spoken, read and written in school, unlike in the urban schools which have diversified learners.

3.5 School settings and participants

The schools selected for the study are briefly described below. The first section provides a brief description of the participants, while the next describes the schools.

3.5.1 A brief description and distribution of the participants

A total of 30 of participants were selected for the study, and were from Grade 4 only. They were randomly selected from the three selected schools, as earlier stated in Chapter three. Of the 30 learners or participants, 15 were boys and 15 were girls; this was in order to equate or neutralise the impact of gender on data collected. These learners ranged in age from 9-12. The learners who participated in the study are presented in Table 4.1.

Primary schools	Identification of learners for purposes of anonymity	Gender	
		Boys	Girls
School A	Learners: 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10	5 boys	5 girls
School B	Learners: a, b, c, d, e, f, g, h, i and j	5 boys	5 girls

School C	Learners: I, II, III, IV, V, VI, VII, VIII, IX and X	5 boys	5 girls
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Table 3.1: Information about participants from schools A, B and C

The researcher used letters of the alphabet for the schools: school A for the school that was first to write tests, school B for the school that was second and school C for the school that was the last to write the tests. Participants in school A were given numbers from 1-10; participants in school B were given lower case letters of the alphabet; and participants in school C were given Roman numerals from I-X.

3.5.2 A brief description of the schools

All three schools are situated in Nkandla circuit in a deep rural area of KwaZulu-Natal province, and all three schools start from Grades R up to Grade 7. School A has three classrooms and one mobile classroom; the mobile classroom is allocated to Grade R. Schools A and C use mother tongue instruction (isiZulu) in the Foundation Phase while school B has started to use English as the medium of instruction in the Foundation Phase.

➤ School A

School A is located in the rural area of Nkandla in KwaZulu-Natal and has a total of 345 learners and 11 teachers from Grades R-7. There are five classrooms and one mobile classroom. Lack of classrooms means some grades are combined into one classroom. Grade 2 and Grade 3 learners are taught in one classroom by two teachers, which means that the Grade 2 teacher teaches his/her grade and the Grade 3 teacher teaches his/her grade. The Grade 2 learners sit facing the back of the classroom, where their chalkboard is. One of the classrooms was divided into two parts in order to create an office and storeroom. Teachers in this school do subject teaching in multi-grades, which means that the mathematics teacher teaches Grades 5 and 6 mathematics at the same time, with the two grades combined in one classroom. The enrolment in Grade 4 is 35 learners.

➤ School B

School B is also in the rural area of Nkandla in KwaZulu-Natal, with a total number of 154 learners and 8 teachers from Grades R-7. There are three classrooms and two mobile classrooms. This school also suffers from a lack of classrooms. Grades R and 1 are combined in one classroom, with both teachers teaching their grades in one classroom. Multi-grade teaching is done in Grades 2 and 3, meaning that one teacher teaches these two grades at the

same time. Lack of classrooms means Grades 4 and 5 are taught in one classroom as multi-grades, with the mathematics teacher teaching Grades 4 and 5 mathematics at the same time. The enrolment in Grade 4 is 25 learners.

➤ *School C*

School C is in the rural area of Nkandla in KwaZulu-Natal too, with 104 learners and 5 teachers from Grades R-7. There are six mobile classrooms, one of which has been made into the office. At first this school was made of mud, and the government gave the school a mobile classroom while the school was under construction. Multi-grade teaching is carried out in all grades in this school except in Grade R and Grade 1. The enrolment in Grade 4 is 20 learners.

These schools are disadvantaged schools with a shortage of classrooms and of learning and teaching resources. The test scores showed that there is no proper learning and teaching due to the complex challenges. Teachers are expected to teach multi-grades without being trained how to handle this situation.

3.6 Data collection methods

Cohen et al. (2007) state that there is no single prescribed technique for gathering information in qualitative research, rather there is fitness for purpose. In this study multiple layers of data were generated through tests and classroom observations by the researcher. These multiple methods of data collection complement each other and enhance trustworthiness in the findings (Thuzini, 2011). The purpose of using different techniques for data collection was to help the researcher answer the research question presented in Chapter One. Since the experiences of Grade 4 learners during the teaching of mathematics could be assessed from many directions, the researcher used triangulation to validate and qualify the data gathered. Triangulation is used to corroborate evidence from different angles of data collected (Cohen, 2007; Creswell, 2012; Maree, 2007). Data are mapped at different angles, to be put together and analysed by searching common themes to build a text. Cohen et al. (2007) argue that when triangulation is used the researcher is not method bound, and this improves the validity of the study.

The next section describes the two methods which the researcher used in this study.

3.6.1 Tests as a method of data collection

This study used tests as one of the data collections methods. Cohen et al. (2007) list different ways in which tests can be used: to assess performance in school subjects, ability, potential, and language proficiency. The purpose of tests in this study was to check the second-language proficiency in mathematics when solving mathematics problems in each school. The tests were divided into sections: an English version (Appendix A) and an IsiZulu version (Appendix B); the participants wrote tests in English on one day, and then wrote the test in isiZulu on another day. The test was set in English and then translated into isiZulu. These versions helped the researcher to interpret learners' ability to solve mathematics problems using language. The test was aimed at checking the learners' understanding of mathematics using English as a second language.

The questions were translated from English into isiZulu by the researcher. Zuma (2008) states that translation from English into isiZulu is not easy because some English concepts are not commonly used in isiZulu spoken language – and at times do not even exist. For example, the mathematical concept 'product', which means the answer that results from multiplying two or more numbers or items; in isiZulu 'product' is usually used to mean things made by an industry, and does not have a mathematical translation. For this reason, Question 1 (c) was completely changed by the researcher.

3.6.2 Classroom observation

Observation of one lesson per teacher was conducted in the classroom. Notes were taken about what the teacher and the learners were doing during the learning and teaching activity. The researcher felt that classroom observation was relevant in this study because observation is the act of noting a phenomenon with instruments and recording it for scientific and other purposes (Radnor, 2001). Maree (2007) and Cohen et al. (2007) regard observation as the systematic process of recording the behavioural patterns of participants, objects and occurrences in their natural setting without intervention. Observation is the process of gathering first-hand information by observing people and places at research sites (Creswell, 2012)

Observation provides the researcher with first-hand information about what is actually happening in the natural environment. This helps the researcher to describe and understand events as they actually happen in a classroom setting. This lesson observation was a

structured observation where the researcher had to plan in advance and have a clear idea about the issue to be investigated (Thuzini, 2011). In this study observation was used to capture a general understanding of the items shown in Appendix C. It was also used to corroborate and justify the data gathered during the tests.

The researcher used ticks in the relevant spaces provided on the observation schedule to show how the researcher understood the lesson in practice. The researcher spent one day at each of the selected schools carrying out observations. Each lesson was 30 minutes long. From the lesson topics the researcher observed the ‘learning and teaching’, which was how participants carried out the learning and how teachers helped learners to understand the lesson. The researcher used pseudonyms for the schools and participants to ensure confidentiality. The school that was first to be visited is named school ‘A’ and the participating teacher in that school is teacher ‘a’; the school that was second to be visited is named school ‘B’ and the participating teacher in that school is teacher ‘b’; and the third school to be visited is named school ‘C’ and the participating teacher in that school is teacher ‘c’. The observation timetable for mathematics lessons is shown in Table 3.1.

Name of school	Teacher’s name	Date of observation	Lesson topic	No. of lessons	Duration
School ‘A’	Teacher ‘a’	17/09/2012	Time	1	30 min
School ‘B’	Teacher ‘b’	18/09/2012	Grid	1	30 min
School ‘C’	Teacher ‘c’	19/09/2012	Number pattern	1	30 min

Table 3.2: Timetable for observation of mathematics lessons

The researcher was observing, watching, listening and drawing conclusions from what she observed. Cohen et al. (2007) state that observation has contextual relevance in the immediate setting in which behaviour is observed.

The next section outlines the data analysis and procedures which the researcher carried out on the raw data from tests and classroom observations until ready for presentation of the findings.

3.6.3 Data analysis

Cohen et al. (2007) say that qualitative data analysis involves making sense of the data in terms of noting patterns, themes, categories and regularities. However, qualitative data rely

on interpretation and frequently multiple interpretations arise (Thuzini, 2011). The researcher used the content analysis method. Analysing and interpreting the data involves drawing conclusions about it; representing it in tables, figures and pictures to summarise it; and explaining the conclusions in words to provide answers to the research questions (Creswell, 2012). According to Anderson and Burns (1989) analysing data involves connecting the evidence to the conceptual framework; this author further states that analysis is the way in which evidence is linked to the purpose of the study. Researchers in the interpretive paradigm prefer inductive data analysis, which is likely to help them identify the multiple realities presented in the data (Maree, 2007).

Content analysis is an inductive and iterative procedure where the researcher looks for similarities and differences in text that would corroborate with those from other participants and confirm or disconfirm a theory (Cohen, 2007; Maree, 2007). The researcher analysed data by comparing scores from written tests with observations of learning and teaching processes. In the findings the researcher presents patterns of related themes which relate to the research questions, cross-referenced with the literature and the theoretical framework, to limit conclusions that may be influenced by the researcher's own perceptions, experiences and beliefs (Thuzini, 2011).

With respect to this study the researcher examined the learners' understanding of the test questions and related this to the impact of the English language on the understanding of mathematics. According to the researcher this reflected their experiences as to what it means to be a second- language learner (specifically with English as the second language). Furthermore, the observation data were also analysed in relation to how the learners interact in class and how they get themselves engaged with the learning task. The researcher also used the research question as a guide to analyse the data which were gathered.

3.7 Issues of quality in research

The following section discusses the issues of validity and reliability in this study. This section is presented in detail because of the choice of data collection instruments used by the researcher. This will therefore serve as a justification for the instrument used in understanding the learners' experiences as they are being taught in the second language.

3.7.1 Validity and reliability

According to Neuman (2006) reliability and validity are central issues in all measurements, and further argues that reliability is the dependability or consistency, and validity suggests trustworthiness. In this study validity and reliability were addressed by using different methods of data collection. The researcher used two methods of data collection so as to build validity and reliability between the researcher and the participants. Information obtained from the test scores were compared with the classroom observations as a means of corroborating the information. Creswell (2012) sees triangulation as the process of corroborating evidence from different individuals, types of data, methods of data collection and descriptions themes in qualitative research. In this study validity and reliability were ensured by describing in full the process that was undertaken. Cohen et al. (2007) see triangulation as the use of two or more methods of data collation in the study of aspects of human behaviour, and further argued that suitable terms for 'reliability' in qualitative research are credibility, neutrality, conformability, dependability, consistency, applicability, trustworthiness and transferability. This was also confirmed by (Maree, 2007), who says there is no validity without reliability.

Credibility was seen as an important measure in this study. Lincoln and Guba (1985), cited in Thuzini (2011), define credibility as the ability of the researcher to produce findings that are convincing and believable. This is also emphasised by Cohen et al. (2007, p.158), who say "... the notion of trustworthiness replaces more conventional views of reliability and validity ... is developed on issues of credibility, conformability, transferability and dependability". In this study trustworthiness was ensured by describing in full the process that was undertaken. The test scores from the English and isiZulu version were compared to check the understanding of questions in the second language (English) once the same questions were translated into mother tongue (isiZulu). A mathematics lesson was observed in each school to compare test results with the learning and teaching of mathematics.

Thuzini (2011) sees transferability as the degree to which the researcher determines similarity between the study site and receiving context, and further argues that transferability helps the reader to decide whether findings could be used in their own setting and communities, through understanding an in-depth description of the researcher's site. Therefore the researcher clearly interpreted information that was obtained using the two data collection

methods. This will enable the reader to make judgements and other researchers to use the study in their reference literature for their studies.

Durrhein and Wassenaar (2002), as cited in Maree (2007), see dependability as the degree to which the reader can trust that the findings indeed happened in the manner in which the researcher indicates. The researcher promoted the honesty of findings through triangulation of data collection forms, namely tests (English and isiZulu versions) and classroom observations. Moreover, the observation of learning and teaching of mathematics lessons in real-life settings allowed data to arise that were not restricted by written test questions. In this way, the findings that were obtained can be trusted.

3.8 Limitations of the study

This study was conducted on a small population and cannot be generalised; the aim of case study is to get an in-depth understanding of a phenomenon rather than to achieve generalisation of results (Thuzini, 2011). Since this is a case study, one cannot generalise from findings in only 30 learners and three teachers to other schools in the Nkandla circuit where the study was conducted or in the province of KwaZulu-Natal and even in South Africa.

The researcher understood that working with people is not easy, as researching people (in this case, participating teachers) might change their minds and withdraw from the study. One might be absent from school on the day of research. As the study was not about teachers, the researcher could rely on the test results to analyse the data. One teacher did the revision lesson in a manner so as to impress the researcher; this means that the learning and teaching observation was not providing the necessary data. The researcher explained to the teacher that study was not about judging him, but to see if learners are able to understand mathematics using English as second language.

3.9 Ethical considerations

According to Maree (2007) and Cohen et al. (2007) it is crucial to highlight ethical dilemmas when investigating people. The researcher was permitted to carry out this study after applying for ethical clearance from the University of KwaZulu-Natal, and obtaining letters of informed consent from the three principals of the selected schools, parents of learners who participated,

the three participating teachers and the participating learners. The researcher also obtained permission from the Department of Education by filling in the relevant forms.

First the researcher visited the principals of the selected schools to discuss their selection and the purpose of the research as well as the importance of their contribution to this investigation. The formal written letters were issued to the three principals of the selected schools to ask for permission to conduct research in their schools; these were collected after a week. Letters of informed consent from the three principals were signed and stamped and submitted to the University of KwaZulu-Natal. The informed consent from parents of learners who participated and the three participating teachers were kept in arrangement with the supervisor. For more information refer to Appendix C.

Thuzini (2011) sees ethical clearance as moral principles or rules to be considered when studying people. Thuzini (2011) stresses the importance of discussing the matter with the participants, because they are the sources of information, as the study is aiming at improving performance in schools. The researcher visited Grade 4 mathematics teachers of the selected schools to inform them about the selection of their schools, and asked permission to work with them in their classes. The researcher gave them formal written letters, and also formal written letters and informed consent forms for the parents of selected learners. The researcher explained to participants the nature of the study and their right to withdraw from it at any time without any negative result. The participants were told that Grade 4 learners would write a mathematics test, and at the following session there would be lesson observation in mathematics. The researcher gave them the collection date for declaration forms (collected after a week). Furthermore, permission was asked to tape-record the lesson observations; the transcript of the tape-recordings can be found in Appendix D.

3.10 Conclusion

This chapter discussed the research methodology and design used to generate data for the study. The chapter acknowledged the appropriateness of the research paradigm, which was an interpretivist paradigm, and described how the study was located within a qualitative approach and a case study method was employed. The chapter also presented a discussion on the data collection instruments, which were a written test and observation. The data analysis strategies, validity and reliability were all discussed at length. The next chapter presents an analysis and discussion of the data obtained from the study participants.

CHAPTER FOUR

DATA PRESENTATION, DISCUSSION AND ANALYSIS

4.1 Introduction

This chapter presents and discusses the findings of the study, the purpose of which was to explore the experiences of the Grade 4 learners during the teaching of mathematics using English as a second language. The participants in the study were 30 learners from three selected schools in rural areas of Nkandla circuit in KwaZulu-Natal, South Africa. The research findings were obtained from written test scores and classroom observations.

This chapter discusses the themes that emerged from that data. Three themes emerged, as follows: learner experiences through the use of languages; the influence of teaching approaches on learners' experiences; and learning and teaching resources and their influence on learners' experiences.

4.3 Learners' experiences during the teaching of mathematics

This section presents the data collected and the discussion that emerged from the data. The discussion is divided into the three main themes which emerged from the data gathered through the observation schedule and the written test. They are identified below.

4.3.1 Learners' experiences through the use of languages

The learners' experiences of the teaching and learning of mathematics through language was of huge importance to them. The data showed that teachers in Grade 4 used English as the LoLT. The data also revealed that there was a lot of misunderstanding of concepts and terminologies in the course of translation from English to isiZulu. For example the teacher in School C asked the learners in isiZulu, 'Nginikeni izinombolo ezibala ngo fo'. Which translates in English that; 'Give me numbers that count in fours.' To find out that in his translation, he said 'Give me the multiples of four.' This was due to limited English proficiency. This finding is not different from the literature on the use of language among second-language speakers. Setati (2005) reported that mathematics learning needs many aspects, such as fluency in mathematics language (in English as second language in this case), words, phrases, abbreviations, and mathematics communications and writing, and further argued that multilingualism is encouraged for mathematical communications.

The teachers in schools A and B also used code-switching to explain mathematical concepts so as to enhance the learners' understanding. In School A the teacher told the learners that 'time' is 'isikhathi' in isiZulu. However, during code-switching some learning is being lost in the course of translation. This also concurs with the literature, and Thuzini (2011) reports that mathematics language is sometimes different from learners' everyday spoken language and becomes most difficult for English second-language speakers of mathematics. This author further argues that there is a difference between English language in mathematics and English language in other subjects and everyday speaking.

4.3.1.1 English as the LoLT

Data collected from the participants revealed that learners did better in the isiZulu version of the test than in the English version. It was also realised that learners interacted more in the classroom when the teacher spoke in isiZulu than when they spoke exclusively in English.

The data analysis and discussion are based on the tests which appear in Appendices A and B; 40% was set as a minimum pass rate by the researcher. Tests were out of a score of 23, and the minimum pass mark was 9/23. Table 4.2 presents a summary of the test scores analysis.

Schools	School A		School B		School C	
Tests	English	IsiZulu	English	IsiZulu	English	IsiZulu
No. who wrote	10	10	10	10	10	10
Average	13	13	6	6	3	5
Highest mark	19/23	19/23	11/23	13/23	9/23	13/23
Lowest mark	6/23	10/23	3/23	1/23	0/23	0/23
No. passed	9	10	2	3	1	3
No. failed	1	0	8	7	9	7

Table 4.2: Test score analysis of participants

In Question 1, where the answer required a true/false answer, all of the participants did fairly average in both versions.

In Question 2, which required some critical cognition to solve the problems, most participants did poorly in the English version and fairly better in the isiZulu version. This is because learning mathematics is not only about language; there are many other factors pertaining to

mathematics learning. This is supported by the literature – Nel (2010) suggests that it is in Grade 4 that most learners start to experience difficulties, because the medium of instruction is then in English as a second language, and learners' ability to use English is limited. Question 2 required some thinking; some learners were able to divide 16 apples among 3 of Mrs Ndlovu's children and they got 5. The problem was with the remaining apple.

Question 3 was done fairly well in the isiZulu version as opposed to the English version, but school B did comparatively better with the English version. This question asked participants to write number names.

Question 4 was answered badly in the English version and fairly in the isiZulu version. This question needed learners to calculate Father's earnings in six weeks if he gets R20 per month. A few participants were able to get the answer (R30) in the isiZulu version, while some learners left blank spaces in the English version.

Question 5 was done better in both versions. The participants know the basic operations and signs are the same in both languages. The signs are learnt in the Foundation Phase.

Tests scores showed that learners perform better when they understand the language of assessment, as the scores for all of the schools were better for the isiZulu version (their mother tongue) than for the English version (Zuma, 2008). This in line with Botes (2010) findings; this author argues that learners who learn mathematics in their second language can do badly not because they do not know the answers, but because they may have limited language proficiency. This is also acknowledged by Howie (2003), who supported the use of English from early grades to improve Matric results; this is seen in the observation lesson in school B, which uses English as the medium of instruction.

Mathematics and science have their own language (Thuzini, 2011); this was evident in Question 1, which was about squares, rectangles and product. Some participants did not know the properties of the shapes or the meaning of product in mathematics. Random guessing leads to an even spread of available answers (Zuma, 2008); this is evident when learners gave different answers. In school B some learners were doing random guessing, as shown in Table 4.3.

	True	False
(a) A square has five sides	×	
(b) All sides of a rectangle are equal		×
(c) A product is an answer from adding	×	

Table 4.3: Random guessing of answers by participants in school B

In school C some learners did not know how to answer true / false questions. Their response is shown in Table 4.4.

	True	False
(a) A square has five sides	×	×
(b) All sides of a rectangle are equal	×	×
(c) A product is an answer from adding	×	×

Table 4.4: Indicating how learners in school C did not know how to answer true/false questions

From the above table it is evident that these learners do not know how to answer the questions; this is because they do not understand the instruction or they do not understand the concept that was taught. This is reported in the literature by Setati (2009) who states that learners in rural schools sometimes fail because there is limited support for them to understand the use of any medium of instruction which is not their mother tongue. This may have an impact on the learners' final result because of the assessment being used.

4.3.2 Influence of teaching approaches on learners' experiences

The influence of the teacher's approach on how learners experience the teaching of mathematics is not just limited to choice and type of language used in class by both learners and their teacher, as will become apparent below. The teacher's approaches are presented under the following headings according to their respective schools: Introduction, Presentation and Classroom work.

4.3.2.1 Teaching and learning strategies

The data below are on one lesson observed on 'time' in the teaching of mathematics in each of the participating schools. In order to include the concept of time, the teacher began with a discussion of the seasons, as shown below. The discussion is presented according to the

respective sample schools in the study. Translations of what teachers' said in IsiZulu are provided in square brackets.

School A

Introduction

In school A the teacher introduced the lesson by asking learners about the seasons of the year in isiZulu.

Teacher: *Yishoni izinkathi zonyaka enazifunda kwa Grade 3.*

[Name seasons of the year, you learned in Grade 3.]

The learners respond: *Ihlobo, intwasahlobo, ikwindla nobusika.*

[Summer, spring, autumn and winter]

During the lesson the teacher introduced to the learners how to read the time from a watch. However, it was not relevant to introduce how to read a watch to Grade 4 learners, because there is no link between the seasons of the year and time-readings of the day. Grade 4 learners are expected to convert minutes to hours and vice versa. The learners understood the lesson better because the teacher explained her entire lesson in both languages (English and IsiZulu).

Presentation

The teacher wrote: 14:00, 07:15, 2 p. m., and 5 p. m. on the board.

The teacher asked: *Nijwayele ukukubonaphi lokhu?* [Where have you seen these?]

Learners: *Emawashini, emafonini nakwiTV.* [On watches, on phones and on TV.]

The teacher explained to learners that time on an analogue watch is divided into am and pm; 00:01 – 12:00 is morning and 12:00 – 00:00 is afternoon.

Classroom work

Say whether it is in the pm or am:

15:00 =

09:55 =

Code-switching was always used to clarify new concepts. This practice is helpful to promote and achieve understanding, but at the same time is challenging. When learners wrote the English tests no one explained the questions in IsiZulu for the learners. The assessment task was written on the board. This is not different from literature on learners' experiences in the teaching of mathematics. Bayley (2003) states that limited English language proficiency contributes to learner difficulties in understanding questions, and that this could lead to incorrect responses.

School C

This section covers data from a lesson on number patterns in mathematics.

Introduction

Teacher: If I add 1 to 2 and that would be equal to?

Learners: 3

Teacher: If I add 3 to 2 and that gives?

Learners: 5

The teacher told the learners that these are odd numbers.

Presentation

The teacher drew a table on the chalkboard like this:

× 4	1	2	3	-	-	-	-	-	-
	4	8	12	-	-	-	-	-	-

Teacher: 4 multiplied by 1, what is the answer?

Learners: 4

Teacher: 4 multiplied by 2, what is the answer?

Learners: 8

Teacher: 4 multiplied by 3, what is the answer?

Learners: 12

Classroom work

Teacher: *Balani niqedele leli thebuli*. [Count and complete the table.]

In these schools, code-switching was always done. In the tests in this study participants wrote without any translation of questions from English to isiZulu by the researcher. The learners have benefitted from the use of code-switching used frequently by their teachers, and this approach became very helpful in helping the learners to understand and thereby providing them with a rich experience during the teaching of mathematics.

School B

Introduction

In School B the teacher introduced the lesson by asking “Is there anyone who can draw a vertical line for us?” The learners raised their hands to show that they could. The teacher pointed at one learner to come to the chalkboard to draw a vertical line. The learner drew a vertical line.

The teacher then asked “Is there anyone to draw a horizontal line for us?” Learners put their hands up to show that they knew the answer. The teacher pointed to one learner to draw a horizontal line on the board. The learner drew the horizontal line.

Presentation

The teacher drew a sketch on the board like the one below.

1							
2							
3							
4							
5							
6							
	A	B	C	D	E	F	G

The teacher told learners that the sketch on the chalkboard was a grid. The teacher explained to learners that a grid has number on the left-hand side and a letter of the alphabet underneath, as shown above. The teacher drew a triangle in E2 and told learners that the position of the

triangle was E2. The teacher drew a circle in G3 and asked learners what the position of the circle was.

1							
2				△			
3							○
4			△				
5							
6							
	A	B	C	D	E	F	G

The learners were able to say that it was in G3. The lesson was taught through the medium of English. Mathematics is not about knowing English, because mathematics has its own language and involves problem-solving strategies. The overall test scores were not so good in school B, although the school has started on English as the LoLT.

In the classroom observation lesson the teacher used a ‘telling’ method rather than a learner-centred approach. The constructivism and mediated learning theories discussed in Chapter two can help with involvement of learners in learning and teaching activities. These theories can help learners to make meaning of their learning and to mediate their learning among themselves and even construct knowledge through learning aids.

Classroom work

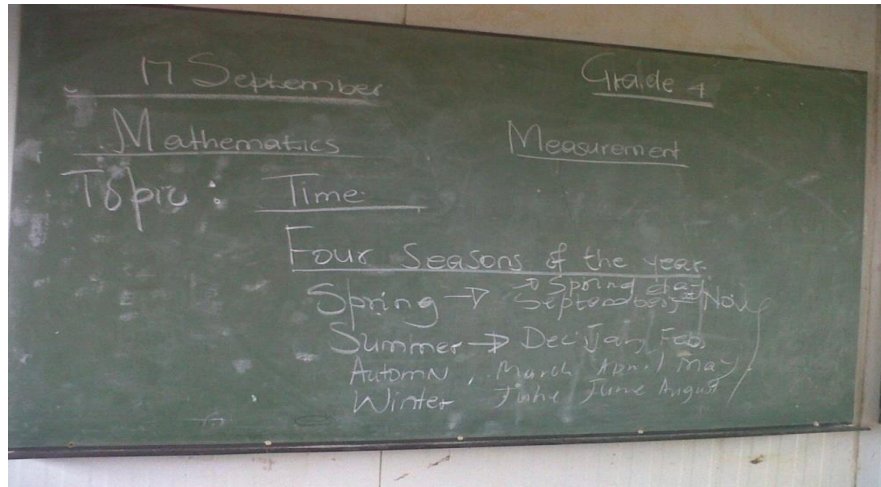
Learners were asked to open their workbooks and do an exercise. The exercise in this workbook was written in English. However, the teacher did some explanation of what was required of them during the exercise. The researcher’s concern was about what these learners would do if they had to learn at home individually, when they cannot understand or read in English. This may result in learners abandoning their study, and expose them to bad experiences in their learning of mathematics

4.3.3 Learning and teaching resources and their influence on learners’ experiences

In all three schools the teachers used the chalkboard as their teaching aid; this was the main teaching aid available at these schools. The unavailability of teaching and other resources at these schools depicted the poor conditions that learners in rural South Africa are exposed to. In these schools teachers are teaching multi-grades in one classroom, with more than one grade in the same classroom and all the grades being taught by the same teacher using different curriculums for the respective grades simultaneously. This is why in some of the

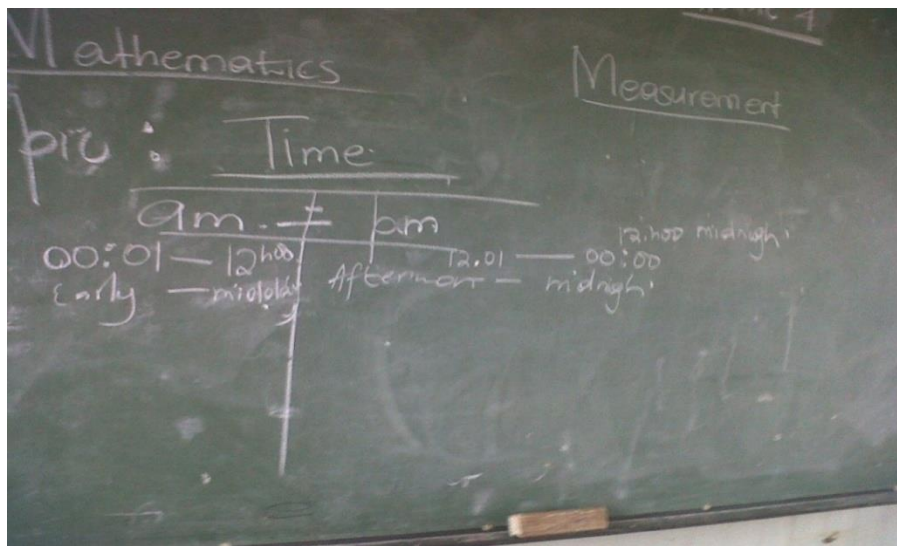
photographs that follow Grade 5 work appeared alongside that for Grade 4. The photographs show work on the chalkboards at the different schools.

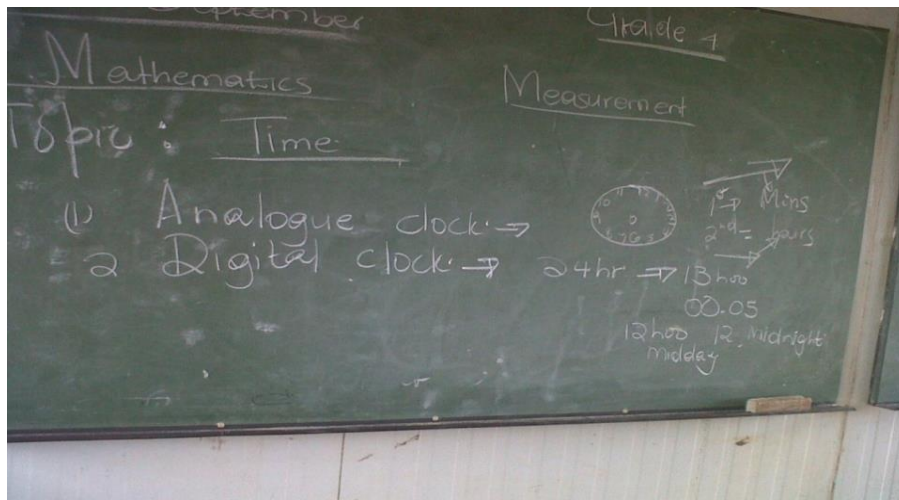
Figure 4.1: School A - lesson introduction in Grade 4 mathematics



The above photograph illustrates the lesson on introduction of the seasons of the year; it can be seen from the chalkboard that the seasons have been written in the English language, whereas the teacher was teaching the learners and code-switching her language between English and IsiZulu.

Figure 4.2, top, middle and bottom: School A – lesson presentation





The three photographs in Figure 4.2 illustrate the stages of the lesson of mathematics presented by the teacher to the Grade 4 learners. In the top photograph the teacher was explaining two types of watches (analogue and digital). The middle photograph shows how she explained the difference in the way the hours of the day were being presented, that is 12 hours a day for the analogue and 24 or 12 hours a day for the digital. She also indicated the difference between a.m. and p.m. The third photograph shows the assessment that was given to the learners.

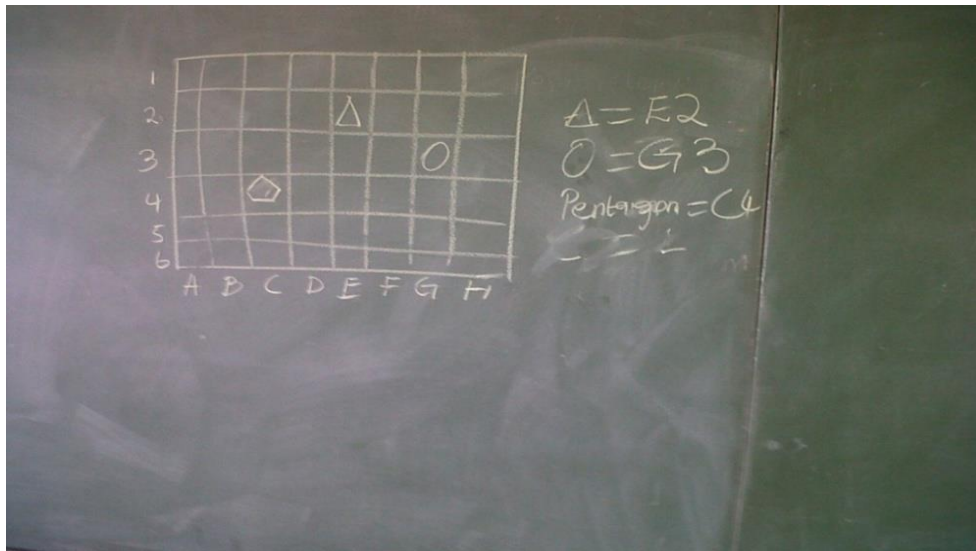
This teacher did her explanation in both English and IsiZulu. This teaching approach made it easy for the learners to understand the lesson better, and hence they could remember what was being taught even after a long period of time. However, Wedekind (2004), as cited in Thuzini (2011), argues that the limitation of smooth learning and teaching of mathematics and science is lack of resources, and continues to argue that most South African schools which were historically advantaged were doing well, while those that were most disadvantaged appeared to be struggling. This notion is expressed in the entire literature on second-language learners.

Figure 4.3: School B - introduction of mathematics to Grade 4 learners; the grid



The above photograph illustrates the introduction of the lesson, where the teacher explains to her learners that the diagram on the board is a grid. This teacher in school B used only the English language as a medium of instruction during the introduction of the lesson.

Figure 4.4: School B - mathematics lesson activity in Grade 4



The above photograph illustrates the mathematics activity that the teacher presented to her learners during the lesson. During this activity the teacher engaged her learners using only the English language as the medium of instruction. Although the learners actively participated during the lesson's activity, they were however not efficient in their writing of English correctly. This is because the learners have an insufficient understanding of the English language.

Figure 4.5: School C – introduction of Grade 4 mathematics lesson



The above photograph illustrates the introduction of a lesson on a number pattern from numbers 1 to 11. From this it would be realised that the number pattern was simply the addition of 2 to an odd number, which was presented in a consistent pattern. The teacher in school C introduced his lesson in IsiZulu; nevertheless he sparingly used the English language as a medium of instruction.

Figure 4.6: School C – lesson activities



The activity on the chalkboard was presented to the learners to engage them actively in the lesson. The learners preferred to engage in the activity using IsiZulu as the language of communication.

4.4 Conclusion

This chapter presented the findings from the data collected from 30 participants, 15 boys and 15 girls⁶, who wrote tests in their respective schools. To reinforce the data collected through the tests, classroom observations were also carried out by the researcher, which served as a correlation of the data which were collected.

The data yielded three main themes. The first theme highlighted that learners in Grade 4 do not understand the English, because even learners from school B where their teacher frequently code switch did not do better in the English version test, and as a result learning and teaching were difficult. The second theme dealt with the approaches and strategies that teachers used in the teaching of mathematics. The teachers used a teacher-centred approach although mathematics needs learner-centred approaches since it is a practical subject. The teachers used the ‘telling’ method and then the question and answer approach, which are not suitable for the learning and teaching of mathematics. Schools A and B used code-switching most of the time, and this affected the learning and teaching in a positive way. The last theme was about the learning and teaching resources. The teachers depended on chalk and the board as the only teaching aid. The use of worksheets for learners to work independently was not evident. The assessment tasks were written on the board.

The next and final chapter of the study concludes the study and provides remarks and recommendations for further research.

⁶ The gender dynamics for this was to make sure that no gender related reason(s) accounted for the disparity of the findings other than that of language. Furthermore, the learners were not to be discriminated upon due to their uneven numbers.

CHAPTER FIVE

CONCLUDING REMARKS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusion of this study on Grade 4 learners' experiences of the learning of mathematics using English as a second language. This was a case study of three schools located in the rural areas of Nkandla circuit in KwaZulu-Natal, South Africa. The three themes discussed in this chapter are derived from the data, and are as follows: challenges experienced when learning mathematics in a second language; suggested teaching strategies to try to overcome problems posed by the language of instruction; and learning and teaching resources. The study reveals that the learning of mathematics in English as a medium of instruction has a number of challenges for learners in Grade 4.

5.2 Challenges regarding language of instruction in learning mathematics

From the data analysed the researcher realised that the Grade 4 learners had a problem understanding the English language when learning mathematics. Data from the test scores revealed that the learners performed better in the isiZulu version than in the English version of the same test. The learners were expected to understand and write in English, and there was no consideration on the part of their teachers or the school administration of when the learners had started learning the English language. For this reason all the teachers' efforts in mediating the lesson were not productive, while the learners themselves struggled to construct the meaning and application of the mathematics concepts being learned. The learners could best construct the meanings of the concept in a language which they could easily understand – which was their mother tongue.

The first challenge was that the learners had to learn mathematics in English. This was revealed in the test scores, where learners had to understand the questions and then solve the problems in English. Due to the learners' poor English proficiency, they could not construct an understanding of the questions being asked.

Code-switching was observed during classroom observations, but in writing of tests there were no translations from English to isiZulu. Learners did better on questions where there were simple calculations. This therefore implies that the use of the English language was the

source of low scores in the English version test. Therefore, irrespective of mediation in facilitating the learners' understanding, the learners were able individually or collectively to still construct meaning in their learning of mathematics, thus providing them with a much richer experience in mathematics.

Learning mathematics using English is problematic, because learners in rural schools are not used to an English language-speaking environment – they only speak the mother tongue at home (Thuzini, 2011). Araromi (2005), as cited in Thuzini (2011), observed that learners' use of English in mathematics classes poses a number of teaching and learning problems, because most of the learners come from homes and environments where English is not frequently used. For this reason the learners easily understand and socialise using their mother tongue in their environment.

Besides speaking isiZulu at home and in their environment, such as in the community and playgrounds, English is a completely new environment for learners in Grade 4, and their first encounter with English as the medium of instruction. Learners are not given the chance to adapt themselves to this now suddenly English-speaking environment while at the same time are expected to learn new concepts. Thuzini (2011) states that people who study in Russia, China, Germany and other non-English-speaking countries are given about a year to learn the new language before they start learning whatever they want to pursue; but for the Grade 4 learners there is a different practice.

The English language acts as a barrier to learners understanding the learning of mathematics. This barrier is promulgated by the teachers, who also took the position of assuming that the learners could understand what they were being taught and make meaning of it, irrespective of the choice of language.

Language usage in the classroom is an important process in the social constructivist setting, and language improves learning and precedes knowledge or thinking. One of the reasons why learners do not understand mathematical concepts when they learn in English is that it is difficult for them to make connections between new concepts learned and terms or concepts already known to them. In this case code-switching is used to clarify new concepts and to promote understanding during the learning and teaching processes. However, when writing

the tests and examination there is no one to translate for them. Sometimes learners do badly in tests because they do not understand the questions (Botes, 2010).

Translations from English into the mother tongue affect learners negatively when they are confronted by the challenges presented by English, such as having to answer tests and examination questions that are written in English after they have been depending on teachers to translate for them instead of being independent (Thuzini, 2011). The ‘lost in translation’ meaning is either as a result of the lack of adequate resources in the rural school for teaching and learning, and this impacts on the mediation process of the teacher, or the learners’ inability to construct meaning either individually or collectively from what they learn.

The teachers used mostly the telling method, and then the question and answer strategy. Teachers did not use learning and teaching resources other than the chalkboard to make mathematics understandable. Observation of lessons showed that the teachers were not using any of the learning theories to make mathematics understandable. The tests scores also revealed that learners had not mastered their work.

5.3 Suggested teaching strategies to try to overcome problems posed by language of instruction

In an attempt to minimise the problem of poor performance in learning of mathematics in Grade 4, teachers need to employ a variety of techniques in their teaching of mathematics.

Mathematics is a practical subject where learners are expected to learn by doing, observing and discovering. Learning and teaching methods should be mostly practically orientated so as to improve understanding. The group work strategy in mathematics learning can help with cooperative learning to promote deeper understanding (Thuzini, 2011). Limited English proficiency contributes to learning difficulties in many ways: being unable to understand questions, which leads to incorrect responses from learners; incorrect spellings; being unable to participate effectively in group discussions; being unable to be active participants in their learning; being unable to read for information and for enjoyment; and many more.

5.4 Learning and teaching resources

Since mathematics involves abstract concepts, teachers need to accompany teaching strategies with the use of materials and objects. Materials and objects are used in helping learners to construct items, and this helps them to develop new concepts. Since mathematics

is a natural subject, teachers need to teach it using a number of objects found naturally and in everyday life situations.

5.5 Recommendations

5.5.1 Language

It is recommended that the South African Government should consider changing the language policy as far as the medium of instruction is concerned. According to the LiEP, learners are taught in their mother tongue from Grade 1 to Grade 3, and the LoLT changes to English at Grade 4. It is therefore recommended that the medium of instruction should be changed to English from Grade 1. This will help learners when they reach Grade 4 and in their further studies, since by then they will have overcome many of their hurdles in dealing with English as medium of instruction.

5.5.2 Support

It is recommended that the Department of Education should support schools with learning and teaching materials and infrastructure such as mathematics rooms, more especially in rural schools. Learners must be given homework regularly.

5.5.3 Teaching approaches

It is recommended that mathematics teachers should be given skills and encouraged to use strategies that go along with learner-centred approaches, since mathematics is a practical subject where learners need to be doing activities.

5.5.4 Assessment strategies

Teachers need to use a variety of assessment strategies: true/false, problem-solving, choose the correct answer. They also need to learn to code-switch all the time, irrespective of whether they are teaching or assessing the learners. This is to improve on the standard of assessment by ensuring that what the learners respond to during assessment is actually what they know to be the answer and not just because they are guessing since they do not understand the questions.

5.6 Conclusion

This study focused on the experiences of Grade 4 learners in learning mathematics using English as a second language. The study was presented in five chapters. The first chapter introduced the study and provided an overview of the entire study. The second chapter

reviewed the related literature around learners' experiences in the learning of mathematics in a second language; this chapter also explained the two theories that framed the study. The third chapter described and explained the research methodology that the researcher used in answering the research question introduced in Chapter one. The fourth chapter discussed and analysed the data gathered through the data collection instruments, which were tests and observations of lessons.

The findings are summarised in this the fifth and final chapter in terms of challenges with the language of learning and techniques to use in minimising these challenges. The challenges include using English as a second language in learning mathematics for the first time, since it is not spoken in their home environments. Learners are expected to learn both the English language and mathematics concepts simultaneously, and this poses a problem to them.

REFERENCES

- Adler, J. (2001). *Teaching mathematics in multilingual classroom*. Dordrecht: Kuwer Academic Publishers.
- Anderson, L. W. B., R. B. (1989). *Research in classrooms the study of teachers, teaching and instruction*. New York: Pergamon Press.
- Auer, P. (Ed.). (1998). *Code-Switching in Conversation* London: Routledge.
- Barbara, A. (1990). Content - based second language instruction: teaching English through mathematics in grades 1 - 4. *unpublished*, 1 -20.
- Bayley, R., & Schecter, S.R. (Ed.). (2003.). *Language Socialization in Bilingual and multilingual Societies*. Clevedon: Multilingual Matters LTD.
- Bergman, M. M. (2008). *Advances in mixed methods research*. London: SAGE.
- Bonk, C. J., & Cunningham, D. J. (1998). Searching for learner-centered, constructivist, and sociocultural components of collaborative educational learning tools. *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse*, 25-50.
- Botes, h., & Mji, A. (2010). Language diversity in the mathematics classroom: does a learner companion make a difference? *South African Journal of Education*, 30, 1-12.
- Botes, H. M., A. (2010). Language diversity in the mathematics classroom: does a learner companion make a difference? *South African Journal of Education*, 30, 123-138.
- Bradbury, J. & Zingel, J. (1998). Learning through peer interaction in a multi-cultural primary school classroom. *South African Journal of Education*, 18(4), 231-240.
- Bunyi, G. (1999). Rethinking the place of African indigenous languages in African education. *International Journal of Educational development*;, 19, 337 -350.
- Cai, J., & Ni, Y. (2011). Investigating curricular effect on the teaching and learning of mathematics in a cultural context: Theoretical and methodological considerations. [December 15, 2011, from <http://www.sciencedirect.com/science/article/pii/S0883035511000383>]. *International Journal of Educational Research* 1-8.
- Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education*. New York: Routledge.

- Creswell, J. W. (2012). *Educational research* (Fourth Edition ed.). Boston: Pearson.
- Creswell, J. W. P. C., V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks: SAGE Publishes.
- De Vos, A. S., Strydom, H., Fouche, C.B. & Delport, C. S.L. . (2005). *Research at grass roots for the social sciences and human service professions*. Pretoria: Van Schaik Publishers.
- Denscombe, M. (1998). *The good research guide* (Second ed.). Maidenhead: Open University Press.
- Denzin, N., & Lincoln, Y. (Eds.)(2011). *Handbook of qualitative research* (4th Ed.). Thousand Oaks, CA: SAGE.
- Denzin, N. & Lincoln, Y. (Eds.). (2005). *Handbook of qualitative research* (3rd Ed.). Thousand Oaks, CA: SAGE.
- Doh Nubia, W. (2013). *An exploration of pedagogic practices in multigrade primary schools within the province of KwaZulu-Natal*. Master degree, University of KwaZulu-Natal, Unpublished.
- Francis, N. (2005). Democratic language policy for multilingual educational systems. *Language Problems & Language Planning*, 29(3), 211 -230.
- Ginsberg, M. B. W. (2000). *Creating Highly Motivating Classrooms for All Students*. San Francisco: Jossey-Bass a Wiley Company.
- Ginsburg, H. P. A., M. . (2008). What is teaching mathematics to young children? Atheoretical perspective and case study. *Journal of applied developmental psychology*, 29(4), 274-285.
- Govender, R. (2010). *IsiZulu-Speaking Foundation Phase Learner' Experiences of English as a second language in English medium schools*. Master of Education Dissetation, University of South Africa, unpublished.
- Howie, S. J. (2003). Language and Other background Factors Affecting Secondary Pupils' Performance on Mathatics in South Africa. *African Journal of Research in SMT Education* 7, 1-20.
- james, M. & Pollard, A. (2006). Improving teaching and learning in schools. *A Teaching and Learning Research Programme Commentary*, London:TLRP.

- Jordaan, H. (2011). Language teaching is no panacea: A theoretical perspective and critical evaluation on language in education within the South African context *South African Journal of Communication Disorders*, 58(2), 1 -11.
- Karlsson, J. M., D. (2004, 6 March 2004). *The language of learning & teaching at schools in KwaZulu-Natal* Paper presented at the KwaZulu-Natal Council's conference, Edgewood Campus, University of KwaZulu-Natal.
- Kincheloe, J. L. (2003). *Teachers as Researchers Qualitative Inquiry as a Path to Empowerment* (Second ed.). London: Routledge Falmer.
- Knight, P. T. (2002). *Small scale research*. London: SAGE.
- Kozulin, A. P., B. Z. (1995). Mediated learning experiences and psychological tools: Vygotsky's and Feuerstein's in a study of student learning. *Educational psychologist*, 30(2), 67 -75.
- Mak, B. C., P. (2011). Differences in perceived approaches to learning and teaching English in Hong Kong secondary schools. *Educational Review*, 63(2), 195 - 218.
- Maree, K. (Ed.). (2007). *First steps in research*. Pretoria: Van Schaik.
- McKinley, K. (2005). Locating the global: culture, language and science education for indigenous students. *International Journal of Science Education*, 27(2), 227 - 241.
- Moodley, V. (2001). *Code-Switching as a Technique in teaching Literature in a Secondary ESL Classroom*. Master of Arts, University of Natal, Durban, Unpublished.
- Moschkovich, J. (2005). Using two languages when learning mathematics. *Educational Studies in Mathematics*, 64, 121 - 144.
- Muijs, D. R., D. (2001). *Effective Teaching* London: Paul Chapman Publishing.
- Muke, C. (2005). *The role of local language in the teaching mathematics in Bridging Class (Grade 3) in Papua New Guinea*. Paper presented at the Paper presented at the 2005 National Curriculum Reform Conference Sustainable Curriculum Development - The PNG Curriculum Reform Experience, Papua New Guinea.
- Nasir, N. S., & Cobb, P. (Ed.). (2007). *Improving access to mathematics diversity and equity in the classroom*. New York: Teacher College Press.
- Nel, M. (2007). *A language enrichment programme for South African grade 4 ESL learners with limited English proficiency*. Paper presented at the Paper presented at the AARE conference, Notre Dame University, Fremantle, Perth, Australia.

- Nel, M. T., L. (2008). Critique of a language enrichment programme for grade 4 ELS learners with limited English proficiency: a pilot study. *South African Journal of Education*, 28, 203-219.
- Nel, N. M., H. (2010). The impact of teachers' limited proficiency on English second language learners in South African schools. *South African Journal of Education*, 30, 635-650.
- Neuman, W. L. (2006). *Social research methods qualitative and quantitative approaches* (sixth ed.). Boston: Pearson.
- Oliver, R., & Herrington, J. (2003). Exploring technology- mediated learning from pedagogical perspective. *Interactive Learning Environments* 11(2), 111 - 126.
- Phillips, D. C. (1995). The good, the bad, and the ugly: the many faces of constructivism. *American Educational Research Association*, 24(7), 5 - 12.
- Pretorius, E. J. (2000). "What can't read will hurt them": reading and academic achievement. *Innovation*(21), 33 - 41.
- Radnor, H. (2001). *Researching your professional practice*. Buckingham: Open University Press.
- Sefa Dei, G. J. (2000). Rethinking the role of indigenous knowledge in the academy. *International Journal of inclusive Education*, 4(2), 111 - 132.
- Setati, M. (1998). Code-switching in a senior primary class of second language learners. *For learning of mathematics*, 18, 114-160.
- Setati, M. (2003). *Language use in multilingual mathematics classroom in South Africa: A different perspective*. Paper presented at the The 27th International Group for the Psychology of Mathematics conference held jointly with the 25th PME-NA Conference, Honolulu.
- Setati, M. (2005). Teaching Mathematics in a Primary multilingual classroom. *Journal for Research in mathematics* 36(5), 447-466.
- Setati, M. (2008). Access to mathematics versus access to the language of power: the struggle in multilingual mathematics classrooms. *South African Journal of Education*, 28, 103-116.
- Setati, M., & Adler, J. (2001). Between languages and discourses: Language practices in primary multilingual mathematics classrooms in South Africa *Educational studies in mathematics*, 43, 243-269.

- Setati, M. A., J. (2001). Between Languages and Discourses: Language Practice in Primary Multilingual Mathematics Classrooms in South Africa *Educational Studies in Mathematics*, 43, 143-269.
- Setati, M. D., B. (2009, 29 June - 3 July 2009). "Mathematics Knowledge for Teaching". Paper presented at the 15th Annual Congress of the Association for mathematics of South Africa, University of the Free State, Bloemfontein.
- Taylor, N., & Vinjevold, P. (1999). 'Getting learning right.' report of the president's education initiative research project.
- Thuzini, M. (2011). *An exploration of teachers' experiences in teaching of standard four mathematics and science curriculum in second language: A case study in three selected Lesotho Primary schools in rural areas* Master of Education Adissertation University of KwaZulu-Natal, unpublished. (HSS/0128/011M)
- Truman, C., Mertens, D. M. & Humphries, B. (Ed.). (2000). *research and inequality*. London: Routledge.
- Uys, D. (2010). *The functions of teachers' code switching in multilingual and multicultural high school classrooms in the Siyanda District of the Northern Cape Province*. MPhil, Stellenbosch University, Unpublished.
- Van der Walt, M., Maree, K., & Ellis, S. (2008). A mathematics vocabulary questionnaire for use in the intermediate phase. *South African Journal of Education*, 28, 489-504.
- Veugelers, W. (Ed.). (2005). *Network learning for Educational Change*. Berkshire: Open University Press.
- Von Glasersfeld, E. (1995). *Radical Constructivism: A Way of Knowing and Learning*. *Studies in Mathematics Series: 6*. Falmer Press, Taylor & Francis Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.
- Vithal, R., Jansen, J. (1997). *Designing your first research proposal*. Lansdowne: Juta & co. ltd.
- Warschauer, M. (2000). The changing global economy and the future of English teaching. *TESOL Quarterly*, 34(3), 511 - 535.
- Woolman, D. C. (2001). Educational reconstruction and post-colonial curriculum development; A comparative study of four African countries. *International Education Journal* 2(5), 27 - 46.

Yin, R.K. (2009). *Case study research: design and methods* (4th Ed.). Los Angeles, CA:SAGE.

Zuma, S. C. D. E. R. (2008). isiZulu as a language of assessment in science. *African Journal of Research in SMT Education*, 12(2), 31-46.

APPENDICES

APPENDIX A: TEST QUESTIONS (ENGLISH VERSION)

Learner's surname :

Learner's name :

Date of birth :

Grade :

Date of test :

INSTRUCTIONS TO LEARNERS: Read instructions carefully before giving answers, spaces for answers are provided.

Question 1

Say whether these statements are true /false by putting a cross in the space provided.

	True	false
(a) A square has five sides		
(b) All sides of a rectangle are equal		
(c) A product is an answer from adding		

(3

marks)

Question 2

Mrs Ndlovu has 3 children and she has 16 apples, help Mrs Ndlovu's children to share these apples equally among themselves.

.....

.....

.....

.....

.....
.....
.....
.....
.....(5marks)

Question 3

Write number names of the following numbers.

(a) 2379=

.....
.....
.....
.....
.....
..... (2 marks)

(b) 647=

.....
.....
.....
.....
..... (2 marks)

Question 4

Father earns R20 per month. How much will father get in 6 weeks? Show calculations.

.....
.....
.....
.....
.....
..... (3 marks)

Question 5

Do the following calculations.

(a) $347 + 18 = \dots\dots\dots$ (2 marks)

(b) $649 - 174 = \dots\dots\dots$ (2 marks)

(c) $48 \times 6 = \dots\dots\dots$ (2 marks)

(d) $75 \div 5 = \dots\dots\dots$ (2 marks)

THANK YOU FOR PARTICIPATING IN THE PROJECT

APPENDIX B: TESTS (ISIZULU VERSION)

Grade 4 Mathematics Test

Marks: 23

Duration: 30

Isibongo :

Igama :

Usuku lokuzalwa :

Ibanga :

**IMIYALELO EBHEKISWE KUBAFUNDI: FUNDA LEMIYALELO NGAPHAMBI
KOKUNIKEZA IMPENDULO EFANELE.**

Umbuzo 1

Yisho ukuthi iqiniso / amanga ngokufaka isiphambano esikhaleni osinikiwe

	iqiniso	amanga
(a) Isikwele sinamacala amahlanu		
(b) Wonke amacala kanxande ayalingana		
(c) Isamba umphumela esiwuthola uma siphindaphinda		

(3

imiklomelo)

Umbuzo 2

Unkosikazi Ndlovu unezingane ezintathu uphethe ama-aphula awu-16, siza unkosikazi Ndlovu ukwabela izingane ama-aphula ngokulinganayo.

.....

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.....
.....
.....
.....
.....(5 imiklomelo)

Umbuzo 3

Bhala lezizinombolo ngamagama

(a) 2379=

.....
.....
.....
.....
.....
.....
.....
.....(2 imiklomelo)

(b) 647=

.....
.....
.....
.....
.....
.....
.....(2 imiklomelo)

Umbuzo 4

Ubaba uholu u R20 ngenyanga. Uzohola malini emasontweni ayisi - 6? Tshengisa indlela obale ngayo.

.....
.....
.....
.....

.....
.....
.....
.....
..... (3 imiklomelo)

Umbuzo 5

Bala lokhu

- (a) $347 + 18 =$ (2imiklomelo)
- (b) $649 - 174 =$ (2 imiklomelo)
- (c) $48 \times 6 =$ (2 imiklomelo)
- (d) $75 \div 5 =$ (2 imiklomelo)

NGIYABONGA UKUBAMBA IQHAZA KWAKHO KULOLU CWANINGO

APPENDIX C: CLASSROOM OBSERVATION SCHEDULE

Grade 4 observation sheet for lesson in practice

The researcher will use ticks to indicate the appropriate information during learning and teaching process in Grade 4 mathematic class.

Concepts	Always	Sometimes	Never
1. Construction of new knowledge using English			
2. Construction of new knowledge using teaching aids			
3. Active learner – involvement			
4. Teacher-learner interactions			
5. Code-switching			
6. Learner-teacher interactions			
7. Learner-learner interactions			
8. Motivation			

APPENDIX E: LETTER REQUESTING INFORMED CONSENT FROM

DEPARTMENT OF EDUCATION

Email address:shezif@vodamail.co.za

Manyane Primary School

P.O. Box 1488

Kranskop

3268

2012-07-11

Head of Department

Private Bag X9137

Pietermaritzburg

3200

Dear Sir/Madam

APPLICATION FOR CONDUCTING RESEARCH IN NKANDLA CIRCUIT

I wish to apply for permission to research in the Department of Education: Nkandla Circuit.

The details of the project have been attached.

This research will form part of my studies in the University of KwaZulu/Natal, Edgewood campus.

Thank you for your attention.

Yours sincerely

F.E. Shezi (MRS)

APPENDIX F: INFORMED CONSENT LETTER FOR PRINCIPALS

Manyane Primary School

P.O. Box 1488

Kranskop

3268

2012 -07 -16

The Principal

Dear Sir/Madam

APPLICATION FOR CONDUCTING RESEARCH IN YOUR SCHOOL

I wish to apply for permission to conduct research at Macala Primary School. The details of the project have been attached.

This research will form part of my studies in Master's degree at the University of KwaZulu-Natal.

Thank you for your attention.

Yours sincerely

F.E. SHEZI (MRS)

APPENDIX G: INFORMED CONSENT NOTES TO PARTICIPANTS

SHEZI FUNANI (200402238)

THE DOCUMENT OF INFORMED CONSENT

- The title /project name: Grade 4 experiences of learning mathematics using English as a second language,
- Project aims: To explore the learning experiences of Grade 4 second-language speakers / learners of mathematics,
- Researcher's name: Funani Esther Shezi, a Master's student at the University of KwaZulu/Natal,
- For further information contact No.: Dr L. Maharaj's office: 031-2607604 / 0724356968,
- Simple random sampling was used to select schools that will be studied, where all schools had equal opportunity of being selected,
- Research project: writing of test that will be 30 minutes and observation of learning and teaching lesson activity that will last for 30 minutes. Ten Grade 4 participants will write the test and then learning and teaching lesson activity will be observed. Each school will be visited for two days, day one for writing of test and day two for lesson observation,
- Potential benefits: to all who will need this information,
- Payment: no payment, it is for the purpose of research,
- Data will be noted down and video-recorded,
- The research data will be kept for 5 years and then data will be destroyed as this is required by University of KwaZulu/Natal; CDs will be shredded and papers will be burnt,
- Schools had equal opportunity to be selected,
- The names of participants are not traceable and names will be kept confidential,
- Participation is voluntary, you may withdraw from the study at any time you feel like this, for any reason, and it will not result in any form of disadvantage.

I.....
..... (full names of participant) hereby confirm that I understand the content of this document and the nature of the research project, and I consent to participating in the project.

DATE

APPENDIX H: INFORMED CONSENT LETTER TO TEACHER PARTICIPANTS

School Manyane Primary
P.O. Box 1488
Kranskop
3268
2012 – 08 -01

The Grade 4 Educator

Dear Colleague

APPLICATION FOR CONDUCTING RESEARCH IN GRADE 4

I wish to apply for permission to conduct research test in Grade 4 mathematics period and also to observe your mathematics lesson of your choice

This research will form part of my studies in Master’s degree at University of KwaZulu/Natal.

Thank you for your attention

Yours sincerely

F.E. SHEZI (MRS)

APPENDIX I: INFORMED CONSENT LETTER TO PARENTS OF PARTICIPATING LEARNERS

(ISIZULU VERSION)

Manyane Primary School

P.O. Box 1488

Kranskop

3268

2012-07-18

Mzali

Mnu/ Nks/ Nkz

ISICELO SOKWENZA UCWANINGO

Bengicela imvume yokuba umntwana wakho abe yingxenye yabafundindi bebangalesine (Grade 4) engizokwenza kubo ucwaningo. Lolucwaningo lumayelana nesifundo sezibalo ebangeni lesine.

Imininingwane yocwaningo ngiyinamathisele ngemuva kwalencwadi.

Ngiyothokoza uma isicelo sami semukelekile.

Ozithobayo

F.E. SHEZI (NKZ)

APPENDIX J: NOTES TO PARENTS OF PARTICIPATING LEARNERS (ISIZULU VERSION)

INCWADI YOCWANINGO NOKUZIBOPHEZELA YOMZALI

- Isihloko socwaningo: Indlela abafundi bebanga lesine abathola ngayo ulwazi lokufunda izibalo ngolimi lwesiNgisi,
- Inhloso yocwaningo: Indlela abafundi abafunda ngayo izibalo besebenzisa ulimi lwesiNgisi,
- Igama lomcwaningi: Funani Esther Shezi, inamba kamakhalekhukhwin: 0729748216, email address: Shezif@vodamail.co.za
- Uma udinga olunye ulwazi thinta: UDokotela L. Maharaj ehhovisi kule nombolo: 031-2607604, ekamakhalekhwini 0724356968
- Indlela estshenzisiwe ukukhetha izikole: indlela enikeze zonke izikole ithuba lokukhethwa (Simple random sampling),
- Ucwanningo: ucwaningo luzothatha izinsuku ezimbili, usuku lokuqala kuzobhalwa isivivinyo sezibalo esizothatha imizuzu engama-30 bese kubukelwa isifundo sezibalo endlini yokufundela okuyokuba imzuzu engama-30,
- Imiphumela iyosiza labo abayodinga lolwazi,
- Lolwazi alukhokhelwa olokufunda,
- Ulwazi luyobhalwa phansi luphinde luqoshwe ngesikhathi socwaningo kusetshenziswa imishini yokwenza lokho,
- Ababambeiqhazabayogcinwabeyimfihlofuthinamagama abo ayokuba imfihlo,
- Ukubambakomfundiiqhazakulolucwaningokuyokubangemvumeyakho, angayekaumaezizwaefisaukwenza kanjalo, noma ngasiphi isizathu, akukho okuyomvelela,

Mina.....

..... (amagamaapheleleomzalinomaumbhekiwomntwana)

ngiyakuqondakonkeokuqukethweyilencwadikanyenomumowocwaningo,

futhingiyavumaukubaumfundiabambeiqhazakulolucwaningo.

Ngiyaqondaukuthiumfundiukhululekile,

ukuthiangayekaukubambaiqhazanomayininiumaefisa ukwenza kanjalo.

.....

...

APPENDIX K: LETTER TO PARENTS OF PARTICIPATING LEARNERS

Manyane Primary School

P.O. Box 1488

Kranskop

3268

The Parent

Dear Sir /Madam

I wish to apply for permission to administer tests to your child / learner in Grade 4. The school has been selected to participate in the research. The research is about learning mathematics using English as a second language.

Details of the study are attached.

Yours faithfully

F.E. SHEZI (MRS)

APPENDIX L: NOTES TO PARENTS OF PARTICIPATING LEARNERS

DOCUMENT OF INFORMED CONSENT FOR PARENT / GUARDIAN

- The title / project name: Grade 4 experiences of learning mathematics using English as a second language,
- Project aims: To explore the learning experiences of Grade 4 second-language speakers / learners of mathematics
- Researcher’s name: Funani Esther Shezi, cell No. 072 974 8216, email address: shezif@vodamail.co.za,
- For more information contact: Doctor L. Maharaj, office no: 031-260 7604, cell no. 072 435 6968,
- Simple random sampling was used to select schools that will be studied, where all learners had the opportunity to be selected,
- Research project: Writing of test and observation of classroom activities,
- Data will be noted down and video-recorded,
- Participation is voluntary, your child may withdraw from the study any time he/she feels like it, for any reason, and this will not result in any form of disadvantage.

I..... (Full names of participant) hereby confirm that I understand the content of this document and the nature of the research project, and I consent to participating in the project.

DATE

DATE

SIGNATURE

EDITOR'S REPORT

L. Gething, M.Phil. (Science & Technology Journalism) (*cum laude*)

[WHIZZ@WORDS](mailto:leverage@eject.co.za)

PO Box 1155, Milnerton 7435 Cape Town, South Africa; cell 072 212 5417

leverage@eject.co.za

10 March 2013

DECLARATION OF EDITING OF DISSERTATION:

GRADE 4 LEARNERS' EXPERIENCES OF LEARNING MATHEMATICS USING ENGLISH AS A SECOND LANGUAGE: A CASE STUDY OF THREE SCHOOLS IN NKANDLA, KZN

By Funani Shezi

I hereby declare that I carried out language editing of the above dissertation by Funani Shezi.

I am a professional writer and editor with many years of experience (e.g. 5 years on *SA Medical Journal*, 10 years heading the corporate communication division at the SA Medical Research Council), who specialises in Science and Technology editing - but am adept at editing in many different subject areas. I am a full member of the South African Freelancers' Association as well as of the Professional Editors' Association.

Yours sincerely

LEVERNE GETHING

leverage@eject.co.za

APPENDIX M: ETHICAL CLEARANCE CERTIFICATE



12 September 2012

Mrs Funani Esther Shezi 200402238
School of Education

Dear Mrs Shezi

Protocol reference number: HSS/0642/012M
Project title: Grade 4 experiences of learning mathematics using English as a second language.

EXPEDITED APPROVAL

This letter serves to notify you that your application in connection with the above has now been granted full approval following your response to queries raised by the Humanities and Social Sciences Research Ethics Committee.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach/Methods must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Best wishes for the successful completion of your research protocol.

Yours faithfully

.....
Professor Steven Collings (Chair)

/px

cc Supervisor Dr HLR Maharaj
cc Academic Leader Dr D Davids
cc School Admin. Mrs S Naicker

Professor S Collings (Chair)
Humanities & Social Sc Research Ethics Committee
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 3587/8350 Facsimile: +27 (0)31 260 4609 Email: ximbap@ukzn.ac.za / snymanm@ukzn.ac.za
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