Cape Peninsula
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Code Switching in the Learning of Mathematics Word Problems in Grade 10

By

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ABSTRACT

This study investigates the effects of code switching in the learning of mathematics word problems in Grade 10. The research used Cummins' language acquisition theory to inform the study. The study employed ethnographic qualitative research design whereby classroom observations and semi-structured interviews were used as data collection techniques. The use of multiple data collection techniques was to ensure validity and credibility of the study. The sample consisted of sixty learners and two mathematics teachers. The sample was drawn from a population of one thousand two hundred and thirty five learners and forty nine teachers.The study has shown that even though code switching could be beneficial in the learning and teaching of mathematics, it was difficult for learners and teachers to use it in a way that enhances the learning of mathematics word problems because of the barriers in the use of mathematical language. It is recommended that teachers should exercise care when using code switching, especially with the topics that involve word problems; as such topics are more aligned to certain mathematical language that could not be translated to IsiXhosa.

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DEDICATION

This thesis is dedicated to my wife, Georgina; my son, Einstein; daughter, Einstentine; father, Cleophas, mother, Raina and my siblings. Thank you for your continuous support during my studies.

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ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Explanation
CPUT	**Cape Peninsula University of Technology**
DoE	**Department of Education**
WCED	**Western Cape Education Department**
LoLT	**Language of Learning Teaching**
AA	**Name of School**
L	**Learner**
L1	**Learner 1**
L2	**Learner 2**
L3	**Learner 3**
L4	**Learner 4**
L5	**Learner 5**
L6	**Learner 6**
TA	**Teacher A**
TB	**Teacher B**
C	**Class**
LiEP	**Language in Education Policy**
NCTM	**National Council of Teachers of Mathematics**

CHAPTER 1
INTRODUCTION TO THE RESEARCH

1.1 Introduction

I have taught at different schools during my teaching career. During this experience there has always been one thing that I have paid attention to and noticed in every school. This phenomenon is very common among learners in schools and also occurs among people who regularly use more than one language. This phenomenon is called code-switching, something that I, as the researcher in the current study, am quite familiar with since I teach in a foreign language. I have experienced code-switching in every class; therefore, found this phenomenon to be very interesting. Thus, I decided to investigate and write about the effects of code switching in learning of mathematical word problems.

1.2 Statement of research problem

In spite of the frantic effort by the Government and the Department of Education (DoE) to make use of the English language as the medium of instruction in the teaching and learning of mathematics in some schools, teachers and learners seem to continue to use or revert to their mother language. Jekwa (2011:23) concurs that, "some mathematics teachers could be forced to rely heavily on code switching as a way of presenting instructional materials and activities in mathematics classrooms". It has been observed by previous researchers such as Cummins (1981), Setati and Adler (2000), Webb and Webb (2008) and Barwell (2011) that some teachers and learners code switch mother language and English in the teaching and learning of mathematics at high school when having difficulties with the language of learning and teaching (LoLT). Angateeah (2013:8) points out that "many learners and teachers are confronted with a range of linguistic difficulties when learning mathematics, for instance, difficulties when their mother language does not have the vocabulary to express the mathematical ideas that they learn in the classroom and therefore resort to using code switching". Consequently, mathematics teachers and learners face tremendous problems related to the use of the LoLT in learning mathematics because they are not proficient enough in the English language.

1.3 Background to the research problem

In the past decades the use of English as a medium of instruction has been advocated in many countries, including South Africa. As mentioned by De Wet (2009:119), "English language has become the dominant medium of instruction in Southern Africa". Due to modifications in the educational policies, code switching has received much attention in the learning and teaching of Mathematics both internationally and locally. This study was conducted to gain more insight into the effects of code switching in the learning of mathematical word problems in Grade 10.

1.4 Significance of the research

Global research has been conducted on code switching in the learning of mathematics; however, no research appears to have been done on the effects of code switching on Grade 10 mathematical learners located in Khayelitsha (South African township located in the Western Cape). The significance of the study relates to the analysis of the effects of code switching in the learning of word problems in mathematics in Grade 10 and how it might impact on enhancing and solving of mathematical word problems. This research study aims to investigate different ways in which language can be used as a tool for improving the teaching and learning of mathematical word problems. The study may assist policy makers, as well as teachers, in formulating strategies that may improve performance in mathematics by noting the use of LoLT. In addition, the findings may be used by the Department of Education (DoE) to develop strategies to improve the quality of teachers by offering in-service training, as a teacher development plan in the use of the recommended LoLT in the teaching and learning of mathematics.

1.5 Purpose of the study

The purpose of this study was to explore the effects of code switching in the learning of mathematical word problems in Township schools in order to determine whether teachers and learners use code switching in learning mathematical word problems. The findings and recommendations of the research could be used to assist learners and teachers in the teaching and learning of mathematical word problems. The findings could also be beneficial to teachers in terms of considering topics that need the entire use of English rather than code switching.

1.6 Research Aim

The aim of the research is geared at ascertaining the effects of code switching in the learning of word problems in Mathematics. The study aims at identifying the effects of code switching in the learning of mathematical word problems. This study will examine the effects of code switching on learning of word problems.

1.7 Research question

How does code switching affect the learning of word problems in mathematics in Grade 10?

1.8 Summary of the theoretical framework

Cummins' (1981) theoretical framework was used to inform the study in finding out the effects of code switching in the learning of mathematical word problems in mathematics classrooms. The literature review deals mainly with information about code switching, reasons for code switching, a national and school language policy and mathematical languages and communication in mathematics classes. More detail will be provided in chapter two.

1.9 Research methodology

An ethnographic research approach was employed since it promoted the use of both observations and interview techniques in collection of data. The data collected was compiled in an interpretive and descriptive manner. Video recordings were used to capture data from participants in their natural settings to depict what took place during mathematics lessons. A convenience sampling method was used to select participants in this study as participants were easily accessible. More detail will be discussed in Chapter 3.

1.10 Limitations

The convenience sampling method used was not well trusted because participants were not randomly selected. However, participants were selected because of their accessibility to the researcher. The sample of the research was too small and the time spent to conduct the study was very short. The study was limited to one secondary school in Khayelitsha Township in the Western Cape Province only. It was also limited to learners in Grade 10 and a few teachers teaching Mathematics whose learners' mother language was IsiXhosa. The research used only one racial group of learners and teachers and one learning area to analyse the effects of code

switching in learning mathematical word problems. Consequently, the findings of this research may have low external validity and could not be used for generalization because of the differences in social contexts. Nevertheless, the research clearly shows that learners and teachers have difficulties in dealing with mathematical word problems.

1.11 Structure of thesis

The thesis consists of five chapters. Every chapter will be summarized as follows:

1.11.1 Chapter One

This section will consist of background, problem statement, purpose and aim of the study, research question as well as a brief discussion of the theoretical framework, research methodology and summaries of all chapters. The chapter also provides a summary of what will be discussed in the other chapters of the thesis.

1.11.2 Chapter Two

The section provides discussion and background to the theories related to code switching in the learning of word problems in mathematics. The literature review is presented and the framework discussed in more detail about code switching in education and in general. Moreover, the literature review and the theoretical framework are incorporated.

1.11.3 Chapter Three

This section describes the research paradigm, research design and research methodology to be used. A detailed discussion on data collection techniques is also provided as well as the roles of the researcher and the validity of the data and sampling methods. Finally, the chapter discusses the ethical issues considered in conducting the research to enable the answering of the research question.

1.11.4 Chapter Four

This section discusses the findings and data analysis of the research from the data collected in the previous chapter. The results of the data collected are presented and discussed in depth. The views of participants are outlined as well as analysed to make meaning from the collected data.

1.11.5 Chapter Five

This is the final chapter of the thesis, which deals with the conclusion and recommendations from the findings of the research. The chapter discusses the conclusion and recommendations about the effects of code switching in the learning of word problems in mathematics in Grade 10.

1.12 Conclusion

This chapter discussed the research background, the purpose of the research, the research question, a summary of the theoretical framework and the research methodology. It also provided some outlines of all the chapters of the thesis.

The next chapter discusses the theoretical framework underpinning the study and presents the literature review about code switching in the mathematics classroom. In addition, I will look at reasons for code switching in the learning and teaching of mathematics and provide a brief summary of the South African Education language policy in terms of the recommended language of learning and teaching.

CHAPTER TWO
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

The previous chapter discussed the research background, research questions, and the purpose of the research as well as gave a brief outline of all the chapters of the thesis. In this chapter I discuss the theoretical framework underpinning the study and present the literature review about code switching in the mathematics classroom. I first look at the definitions of code switching, then explain some suggested reasons for using code switching in the learning and teaching of mathematics. A brief summary of the South African Education language policy and that of AA secondary school will also be presented, which highlights the recommended language of learning and teaching (LoLT).

2.2 Theoretical underpinning of the study

This study adopted the work of Cummins (1981) as a theoretical framework to inform the research on code switching in the learning of word problems in mathematics. The research considers language as a means of communicating concepts and skills. The manner in which learners acquire knowledge is through communication with others due to the use of language. Learners in mathematics classes communicate with each other and the teacher through informal and formal language (mathematics language). During interaction, learners use different words that mean different things in everyday situations and in mathematics settings.

Cummins' (1981) language proficiency theory, which views the acquisition of language and cognition, is influential in this regard. Learning and teaching processes do not take place in isolation. Learners need to communicate with teachers or with each other formally or informally. Cummins' (1981) theory stipulated that the first language will assist the acquisition of concepts expressed in a second language. LoLT is used to convey the mathematical language through the use of mother tongue. Mathematics is a complex language that needs higher order thinking, as was postulated by Cummins (1981) when arguing that cognitive academic language proficiency is acquired formally and is academically demanding. Sfard (2009) stresses communication in learning of mathematics by learners as individuals or as groups. Her idea is in line with

Cummins' (1981) language acquisition theory. It gives the impression that, through communication, concepts may be shared among learners with the aid of common language. Sfard (2009:571) concurs that "communication goes hand in hand with cognition". Teaching and learning processes occur in a social setting, whereby the teacher communicates to learners, learners to the teacher and learners to other learners, through the use of language. The language used is either the medium of instruction or the native language. Communication in the mathematics classroom should be meaningful, for the main purpose of communication is for understanding. Learners should be able to comprehend information from the known to the unknown through teacher assistance. Shelly (2006:394) points out that Vygotsky believed that learning was influenced significantly by social development. Learning takes place in the social setting of learners. Learners interact with each other, with parents, community members and with teachers. Learners learn from more advanced peers or experts, and in this case the teacher is the expert who is teaching them. The language used by the teacher is the one that is imitated by learners. If the teacher frequently uses English during mathematics lessons, learners will imitate this, resulting in the acquisition of the required concepts through practice.

Cummins' (1981) work is relevant for this study because he considers language as a useful tool for communication in the learning and teaching of mathematics. Marji (2009:5) supports the idea that language plays an important role in the learning of mathematics, since teachers use language as a tool to explain mathematical concepts and carry out mathematical procedures. The emphasis is on communication with others in formal and informal situations. This idea of the importance of language in learning of mathematics is also supported by Kotsopoulos (2007:303) who explains that learners struggle with differentiating everyday language and mathematical register because mathematical language is in contrast to everyday language in that mathematical language consists of highly formalized rules and consists of symbols, pictures, words and numbers. Cummins (1979) suggested that first language and second language academic proficiencies were developmentally interdependent. For example, in educational contexts the development of second language proficiency was partially dependent upon the prior level of development of first language proficiency. Cuevas (1984:137) argued that "learners require considerable proficiency in both their first and second languages if they are to cope with the range of linguistic activities required for learning mathematics". The language in the Education

Policy of South Africa (2010) emphasizes the utilization of mother languages to assist learning and teaching of mathematics, as this may assist learners to communicate, interpret and interact with others in sharing information and promote easy transfer of mathematical knowledge and skills to learners.

2.3 Language proficiency as it relates to the learning of mathematics

Bonenfant (2010) stresses that second language competence is partly depended on first language competence, the well-developed the first language, the better it will be for the second language acquisition. Cummins (1986) echoes these sentiments by saying that the same skills and concepts that children learn in their mother language will be carried over to the second language, and that good proficiency in mother language results in better transfer of skills to the LoLT (English). Yew and Nathan (2008:15) found that learners learn mathematics in English better as they master mathematics concepts more easily in their mother language. Talking about mathematics in their mother language would help them to understand mathematics better and then learning mathematics in English would be smoother for them. The main language of learners should be fully utilized in the learning and teaching of mathematics, so that learners will be fully competent in the LoLT, with the aid of their mother language, as it will assist them to understand the mathematics concepts. Learners need to be competent in mathematics language and in the social English used in social settings.

Bonenfant (2010:155) specifies that learning English as a second language requires learners to develop listening, speaking, reading and writing skills in the target subject. The researcher continues to explain that if listening, writing, reading and speaking are integrated into lessons these processes assist English language learners to master mathematics concepts as well as the LoLT simultaneously. O'Keeffe and NiRiardain (2012) argue that communicative proficiency in the language of instruction is important in a learning environment to help learners acquire academic proficiency in the language of instruction used in the learning of mathematics, rather than the use of learners' language. Learners who use English as LoLT should use this language during interaction in mathematics classes.

Marji (2009:3) states that many Sub-Saharan countries such as Zambia, Zimbabwe, Malawi, Botswana and Namibia offer bilingual education in learners' mother language as well as in English. There is allowance for learners to continue their conceptual growth and literacy skills in the mother language while transitioning to English. The knowledge and skills that learners develop in the mother language assist them to develop proficiency in LoLT. Cummins (1981) agrees that the languages, skills, ideas and concepts that learners learn in their mother language will be transferred to the target language (LoLT). Sfard (2009:518) proposed that mathematical thinking can be communicated among learners themselves, while Yew and Nathan (2008:7) are of the opinion that learning mathematics is seen as participating in a community where learners rely on language as a tool to think and communicate mathematical ideas. Mati (2002:2) also makes the observation that learners will be enriched by learning more than one language, provided the process assumes an additive rather than subtractive form. The additive form allows learning of the LoLT in addition to the mother language, as opposed to the subtractive form where the mother language is lost during acquisition of the LoLT (English). The additive form was promoted by the South African Education Policy (2010) as it assists learners to gain LoLT with the help of their mother language, and without losing their mother language, as opposed to the subtractive form where the LoLT is gained at the expense of the mother language. Macgregory and Price (2002:109) found that learners learning a second language without a foundation of first-language (mother language) competence may not develop sufficient proficiency in either language to support their learning. The current study aligns itself with the above findings because for learners to be able to use a second language they need to be able to communicate in their first language as this is the language they are taught first at home.

2.4 Literature Review

The literature review deals mainly with information about code switching in the learning of word problems in mathematics. The literature considered previous findings by other researchers, with specific reference to the use of Cummins' (1981) Language proficiency theory. In this section I discuss language policy, code switching, mathematical language and communication in the learning process as well as reasons for code switching. These issues are examined in order to gain more insight into previous research findings that may assist in the construction of arguments to answer the research question.

2.4.1 Language policy in South Africa

The Language Policy of the South African Department of Education was considered as an important aspect in the study as I wanted to gather more information about what this policy stipulates in terms of the use of code switching in the learning and teaching process and what is expected of teachers and learners. According to the Department of Education (2010:6), the Language in Education Policy (LiEP) is aimed at maintaining the use of mother language as the LoLT, while providing access to additional language(s). All learners are offered at least one approved language as a subject in Grades 1 and 2. From Grade 3 onwards, all learners are offered their LoLT and at least one additional approved language as a subject. Mother tongue language is to be used up to Grade 4, after which learning and teaching is changed to the LoLT. Coleman (2005:44) maintained that "the use of mother language during early years provides cognitive and a literacy foundation for education as a whole and it is an essential foundation for second language learning". Teacher code switching was encouraged in the post-apartheid South African Education, which may be a reason why most teachers and learners continuously use code switching (DoE, 2010:25). Setati and Adler (2000:243) also mention how "code switching is encouraged in the post-apartheid South African education". Language in Education Policy (1997) recommends school language policies that will promote additive bilingualism and the use of mother languages as languages of learning and teaching.

The New Language in Education Policy (DOE, 1997) obliges in terms of the language of learning and teaching (LoLT) to be taught as subjects. Learners have to learn at least two official languages as subjects and one of the subjects is decided upon by their own language policy, which should promote additive bilingualism. Maluleka (2008:8) observes that the role of language policy as LoLT in schools conveys relevance on question of if and how children utilize the languages they speak. The National Language Policy Framework (2003:6) strongly encourages the utilization of the mother languages as official languages in order to foster and promote national unity. The WCED also requested schools to reduce code switching in the classroom and encouraged teachers and learners to stick to and promote the LoLT in the teaching process, which contradicts with the LiEP (1997) which promotes code switching. The WCED emphasized that learners must be taught to comprehend and answer questions in the language of assessment and that learners be trained and encourage to communicate in their LoLT at all times.

2.4.2 Language policy for AA secondary school

The language policy at AA secondary school states that all learning and teaching processes will be undertaken in English, as it is the LoLT at the school, except in IsiXhosa lessons. All communications at the school should be conducted in English. As such, the school is encouraging the use of English in all subjects. Cummins, Mirza and Stille (2012:6) argues that, "English language learners' opportunities to broaden their vocabulary knowledge and develop strong reading compression skills are achieved when learners actively engage with abundant texts". The discussion about the school policy was meant to determine whether this policy is aligned with the national policy. Marc (2005:512) "found out that although the LiEP (1997) insists that the LoLT in the first four years of schooling is the mother language, teachers continuously use learners' native language (not English) even after the first four years of schooling". Therefore, the WCED have encouraged all schools to implement a school language policy that promotes integration of subjects and the teaching of content subjects in LoLT across the school curriculum.

2.4.3 Language of Learning and Teaching in mathematics at AA school

The language of learning and teaching of mathematics at AA secondary school is English. According to the National Council of Teachers of Mathematics (2009:60), "learners should be able to use the language of mathematics to express mathematical ideas precisely". Therefore, learners and teachers need to use the mathematical language in the learning and teaching process by means of the recommended LoLT. Winsor (2007:377) reiterates that, "for learners to be able to learn Mathematics as well as English, they must have the chance to communicate mathematically". Furthermore, Winsor (2007:378) asserts that learners' mathematical ability in mother language affects their ability to learn mathematics in their second language. Some of the researchers have argued that the use of English only helps learners to perform better in Mathematics. Howie (2003:9), for instance, reports that "there is evidence that learner proficiency in English, the language the learner spoke at home and the language of learning in the classroom have a direct on learner effect performance in mathematics".

Yushau (2009:917) asserts that it seems clear that lack of proficiency in the language of instruction effects learners' classroom interaction, cognitive activities, understanding of as well

as performance in mathematics. From these ideas it may mean that the use of LoLT with the assistance of the mother language in the teaching and learning of mathematics needs to be emphasized clearly. Cuevas (1998:140) propounded that language plays an important part in the learning of mathematics, and a second language learner's underachievement in mathematics is likely to be due in part to language factors. Truong (2012:8) highlights that, "the role of language policy on medium of instruction in schools bears relevance on if and how children utilize the languages they speak".

2.4.4 English usage at AA secondary school

The School Governing Board and the School Management Team of AA secondary school chose English as the LoLT, by which is meant that all learning areas other than IsiXhosa are taught solemnly in English. This means that teaching and learning materials such as textbooks, workbooks and examination question papers are set and will be answered in English. All information communicated to teachers, management, non-teaching staff and all school communication is supposed to be in English. Morning briefings, school rules and announcements are done in English as well. But in some cases, teachers or even the School Management Team uses the learner's mother language in communicating or emphasizing important information, for example on disciplinary issues, and when conveying important messages to parents.

The National School Policy is supported by Pillay (2003:4) who notes that, "schools should create a school language policy in line with the National School Policy where a positive environment towards English (LoLT) is promoted". Even though the LoLT at AA school is English it is not adhered to, instead teachers and learners resort to code switching. Truong (2012:11) pointed out that "South Africa has adopted a laissez-faire attitude by allowing schools and parents to choose one of the official languages to be used as the LoLT for the first three years with the learners' mother language being taught as subject afterwards". This laissez-faire attitude prompted many schools to teach the way they feel is appropriate for their learners, whereby some resorted to code switching. Since teacher code switching was encouraged in the post-apartheid South African Education, it results in most teachers and learners continually using code switching in learning and teaching processes. The WCED states that it is crucial that all learners gain sufficient competence in the language of assessment (LoLT) in order to be able to understand it and to write and speak it effectively. Similarly, Setati and Adler (2000:255)

observes that "teachers should induct their learners into mathematical English and hence it is important to use English in the mathematics classroom as much as possible".

2.4.5 Reasons for using English in South African schools

English as a language assists learners to keep abreast with scientific and technological developments that are mostly recorded in English; it also provides opportunities for learners to use English language and therefore increase their proficiency in the language. The other reason is for trade and commerce, travelling and tourism, enabling communication with people from abroad. Using English will be useful when having workshops with other schools, having interschool competitions and travelling during excursions. Mouhanna (2010) shows how English enables learners to be internationally competitive, especially in the workforce as it is regarded as a universal language for business and science. The use of English assists learners when they matriculate and study abroad, since most universities around the world use English as the medium of instruction, especially in online programs. Yew and Nathan (2008:7) state that "learners who are learning mathematics with a language background other than the language of instruction such as English will face tremendous difficulty in comprehending the textbooks, teaching aids and discussions in English". That is why English is regarded as an important language when it comes to assessment issues in most schools, as it assists learners in acquiring skills needed in examinations and school based assessments (Setati, Chitera & Essien, 2009:79).

English is used as a neutral language, especially when learners and the teacher possess different languages. Brice (2011:15) reveals that, "even if the special teacher is bilingual, there is no guarantee that she or he will be able to accommodate all languages presented by learners in the classroom; therefore, the teachers will use the language that caters for all". For example, foreign teachers from other countries have to stick to LoLT (English) because they cannot speak the learners' mother language. Setati et al. (2009:67) explains that fluency in English is considered by many to have benefits for the learners because it is spoken widely across many countries in the world. Many learners and teachers prefer to use English in the teaching of mathematics as they can gain access to social goods, tertiary education, possibility of employment abroad and being able to communicate with other people from other nations that use English for communication. Durano (2009:32) purport that "English language aids effortless international communication and significant for academic and professional success". Furthermore, learners

use English when there is less mathematical vocabulary in their mother language. This is in agreement with Warren, de Vries and Young's (2007:781) findings with Indigenous Australian learners who used English language because they lacked the specific vocabulary that was needed to describe mathematical concepts in their mother language.

2.5 Mathematical language

Mathematics is taught through the use of language to ensure proper communication between the sender and the receiver. The language used in mathematics plays a significant role in transferring mathematical skills. DoE (2011:8) defined mathematics as:

> [A] language that makes use of symbols and notations to describe numerical, geometric and graphical relationships; it is a human activity that involves observing, representing and investigating patterns and quantitative relationships in physical and social phenomena and between mathematical objects themselves.

Mathematics helps to develop mental processes that enhance logical and critical thinking, accuracy and problem solving that will contribute in decision-making. Marcs (2005:513) agrees that "mathematics is a language that has its own syntax, symbols, grammar and a variety of representations". The DoE (2011) went on to articulate that:

> [A] learner needs to acquire mathematical skills that will enable him or her to develop correct use of the mathematical language, be able to listen, pass along, apply mathematical knowledge as well as discover how to solve problems.

Mathematical knowledge refers to the mathematical theory, whereas mathematical skills refer to the application of mathematical knowledge into practice for the achievement of expected goals (DoE, 2011:9). Mathematical knowledge, skills and language are related in that, for the learner to take the mathematical skills he or she has to be able to transfer mathematical knowledge into practice through the utilization of mathematical words.

Kaphesi (2003:267) states that:

> [I]t is important that the teachers become more effective in oral work in mathematics to assist children in the development of general language skills. In

> the learning and teaching process teachers and learners should communicate using mathematical language so that learners can gain mathematical skills, concepts and knowledge.

Ndaba (1997) found that secondary school learners were not consistent in the use of language to describe mathematical concepts and principles, suggesting that deficiency of terminology to distinguish the concepts implies lack of understanding of mathematical concepts. Knowledge construction should go beyond interaction between the teachers and learners to include the interaction of learners themselves, other sources like books, internet and the community at large (Kaphesi, 2003:269). Therefore, it is of great value to understand clearly that mathematics learning is related to language, social interaction and cultural context that may assist learners to communicate mathematically. Veloo and Haroo (2004:12) maintain that, "it is important for mathematical instruction to be conducted with proper mathematical language and this gives learners opportunity to talk whereby practicing to be good mathematics communicators". Extra support is needed in terms of learners who use English as LoLT in the learning of mathematics. The support will assist learners understand and distinguish the formal and informal words used in mathematics through learner-centered learning approaches.

Müller and Neil (2010:7) assert that, "language acts as the basic communication channel for knowledge transfer and learning from the teacher to the learner". If the knowledge, communication channel is obscured and hindered by limited English proficiency both on the side of the learner and of the teacher, then knowledge transfer cannot be effective. Learners can deepen their understanding of mathematics by using language to communicate and reflect their ideas and cement their understanding. Kotsiopoulos (2007:303), from her research conducted about multiplying polynomials, discovered that learners were unable to perform the operations because of minimal language proficiency in the mathematical language; this prevented learners from being able to explain and solve mathematics problems. The results indicate that learners need to be familiar with mathematical language for them to be able to apply mathematical knowledge to acquire the stated objectives. Yew and Nathan (2008:7) stress that, "learning mathematics is seen as participating in a community where students rely on language as a tool to think and communicate mathematical ideas". In such instances, mathematics teachers should be cognizant with the role of helping learners to develop mathematics proficiency to assist these

learners in dealing with mathematics problems to achieve planned goals. Cuevas (1984:137) points out that, "learners require considerable proficiency in both their mother and second languages if they are to cope with the range of linguistic activities required for learning mathematics".

According to Garegae (2007:234), "mathematical language does not only consist of ordinary English, it also consists of symbols and highly specialized language". Setati (2005:448) agrees that learning mathematics is acquiring fluency in the language of mathematics, which includes words, phrases, symbols, abbreviations, and ways of speaking, reading, writing and arguing that are specific to mathematics. In addition, Haryanto (2013:49) observes that, "a teacher has a significant role in the teaching and learning process, particularly delivering and explaining the new concepts of knowledge to learners through effective mathematical language for mathematical communication". Kranda (2008:38) concurs in observing that effective communication will be achieved between learners only if each knows and understands the terms being used during the interaction process. The Department of Basic Education (2011:8) advocates active participation and the ability to use mathematics as a language to analyze and communicate information and ideas. Teachers are encouraged to use the appropriate language for a particular subject, such as the use of proper mathematical language during mathematics lessons.

Mathematics promotes learners to think critically, develop the capability to solve problems and have good interpersonal and study skills. Boulet (2007:4) emphasizes that, "teachers should engage learners in meaningful mathematical activities through the use of clear mathematical language". Furthermore, NCTM (2000:107) stipulates that teachers must present classroom activities in which children read, write, draw and explain mathematical ideas. NCTM (2000:108) proceed by saying that teachers might use a variety of approaches to enhance their support of children's mathematics language learning. A major premise of all strategies is to connect new terms or phrases to ideas children already know. To improve mathematics understanding, NCTM (2000:109) describes that mathematics teachers may use a mathematics word-wall to stress new concepts in mathematics, or charts to help learners to make meaning of new words. Teachers are encouraged to create a text-rich classroom environment to promote language acquisition by

utilizing resources such as word-walls, charts, books and journal articles which assists learners with the acquisition of the LoLT.

O'Keeffe and NiRiordain (2012:12) point out that communicative proficiency in the language of instruction is important in a learning context. Setati (2008:103) draws our attention to the fact that it is widely accepted that language is important for learning and thinking and that the ability to communicate mathematically is central to learning and teaching school mathematics. Marji (2009:1) add that every part of the learning is language dependent, from the arousal of curiosity, the teacher's explanation of a concept, the formation of an understanding of that concept, to the verbalization or written expression of that understanding. Anthony and Walshaw (2009:154) also mention that the use of mathematical language is shaped when the teacher models appropriate terms and communicates their meaning in a way that learners understand. This study is aligned with Anthony and Walshaw's (2009:154) findings, that teachers should foster the learners' use of mathematical terminology for better understanding of mathematics in the target language in such a way that learners will grasp concepts easily.

Martiniello (2008:335) stresses that mathematized language can be used to build up mathematical language which assists learners to understand and grasp concepts properly. Angateeah (2013:18) concur that learners should be able to use mathematical language as it is important for conceptual understanding of mathematics and prevents learners from relying on informal language. The Principles and Standards for School Mathematics (NCTM, 2000:60) states that students should be able to:

- Organize and consolidate their mathematical thinking through communication;
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- Analyse and evaluate the mathematical thinking and strategies of others; and
- Use the language of mathematics to express mathematical ideas precisely.

2.5.1 Mathematical skills

DoE (2011:9) states that to develop mathematical skills the learner should:

- Develop the correct use of the language of Mathematics;
- Develop number vocabulary, number concept and calculation and application skills;
- Learn to listen, communicate, think, reason logically and apply the mathematical knowledge gained;
- Learn to investigate, analyze, represent and interpret information;
- Learn to pose and solve problems; and
- Build an awareness of the important role that Mathematics plays in real life situations including the personal development of the learner.

2.6 Communication in mathematics classrooms

Communication, as it occurs in the mathematics classroom, is a means of transferring messages from one point to another, so that the receiver will understand the message sent. Communication enables the sharing of ideas and clarification of mathematical understanding (Viseu, 2012:288). Effective communication allows learners to share ideas, thoughts and ways to solve mathematical problems through teachers encouraging learners to talk constructively during the lesson. Wati (2011:83) argues that, "teachers must be able to demonstrate the communicative command rather than knowledge of instruction, and teachers must be fluent and confident in the classroom". Haryanto (2013:52) maintains that the teacher has a significant role in the learning process, particularly delivering and explaining the new concepts of knowledge to learners that effective language for communication is needed. De Wet (2009:120) also alerts us that "mathematics teachers should use simple and clear language of communication that can be easily understood by every learner when learning mathematics".

Learner should be able to understand what the teacher is saying during mathematics lessons. Language plays a great role in communication and is used as a tool for sharing ideas among learners and teachers in a schooling environment. Boulet (2007:10) recommends that, "teachers must be aware of the language they use when teaching mathematics as the teachers' own use of language in the mathematics classroom serves as an important example of effective communication". Moursund and Albrecht (2011:65) also raise the point that, "communication is

an act of conveying information, where a sender and receiver can exchange ideas in order to be able to develop new concepts and ways of understanding". Teachers need to teach learners to communicate mathematically, give sound mathematical explanations and justifying their solutions (Anthony & Walshaw, 2009:151).

According to Kyenyune (2003:173), "the efficiency of the learning process at any level depends on whether or not effective communication has taken place between the teacher and the learner". This is because the teaching and learning process occurs in a social setting, whereby the teacher communicates to learners, learners communicate with the teacher and with other learners through the use of language. Hence, effective communication in mathematical classrooms needs to be meaningful to all parties involved in the conversation. There is need for learners to learn mathematical language as well as communicate mathematically. Marji (2009:4) mentioned that:

> [T]eachers need to use strategies that give them access to the content in mathematics and other curriculum areas and help them learn the sophisticated vocabulary and language structures required in those academic settings.

In other words, when teachers teach mathematics to English language learners, they are also teaching Mathematics, not just teaching in English. As such, the teacher needs to communicate in the proper way to allow free flow of messages between the teacher and the learners that may result in the generation of meaning, knowledge and understanding. Yushau (2009:915) is of the opinion that the development of mathematics is through language, and language is the means by which mathematics is communicated and learnt from the formation of concepts to the development of new forms of thought. In addition, Muke (2005:1) states that learners' language is certainly a vital resource teachers use to communicate important concepts such as mathematics in schooling environments, but it is not being utilized, especially in classes that use English as LoLT.

2.7 Word problems

Mathematics classrooms are mostly associated with problem-solving and mathematical thinking where language is used as a tool for communicating mathematics concepts. Sajadi, Amiripour and Rostamy-Malkhalifeh (2013:7) suggest that, "word problem solving is one of the important elements of mathematical problem solving which incorporates real life problems and applications, but is not properly taught by many teachers because of language problems". Due to the difficulties experienced by learners in solving mathematical problems, teachers have ignored teaching word problems, as mentioned by Voster (2008:35) that, "some teachers avoid topics such as word problems because they circumvent language by using a minimum of words and concentrate on symbolic language and also they are uncomfortable with the LoLT". However, O'Keeffe and Ni'Riordain (2012:2) have suggested that using proper language (LoLT) and continual exposure of learners to mathematical word problems will encourage learners to apply mathematical language, knowledge and skills to reason, decide and solve mathematical problems effectively. Thus, if teachers could give or provide proper assistance or guidance in dealing with word problems, learners may tackle word problems without difficulties through proper modeling.

Setati (2005:458) argues that giving learners an opportunity to read the word problem before they solve it is important, because solving a problem is not only about mathematics but also about reading and fluency in the language of the task (English). Moreover, Kranda (2008:3) indicates that, "teachers need to offer opportunities for scholarly people to personalize word problems by using content and linguistic process that is familiar to the learners". Therefore, there is great need for teachers to promote learners' awareness of language issues in the learning and teaching of mathematics. Barton and Barton (2005:22) have observed that, "language difficulties also seem to limit learners' mathematical solving techniques". Major problems are that textbooks and examination question papers are written in English; therefore, word problems will be a difficult aspect to learners if they lack language ability (LoLT). Yamat (2011:21) recommends "fostering a deep understanding by encouraging higher order thinking whereby learners identify and analyze information, pose and solve mathematical problems, make informed decisions, and reflect on the reasonableness of their solutions".

Problems faced by learners in solving word problems, as stated by Sajadi et al. (2013), are:

- Some learners are not able to adequately define mathematical word problems;
- Learners lack motivation, that is, the reluctance of learners to solve word problems;
- Learners do not have sufficient experience in mathematical word problem-solving; and
- Some learners cannot make use of fixation. They do not know which mathematical operations to use for particular word problems.

Morton and Qu (2013:88) propound that, "learners are mostly challenged by mathematical word problem-solving not because of their mathematical skills but because of text comprehension". Sajadi et al. (2013:2) concur that, "learners normally find difficulty in solving word problems from translating the word representations into mathematical representation". Macpherson (2007:23) opined that most learners tend to skip over word problems in favour of questions that does not include word problems. Irujo (2007:317), in the same vain, states that the language used in the problem is often so complex that learners will be unable to fully understand the language used to describe the situation in word problems. Learners also have difficulties in connecting the mathematical operations to the given situation. Irujo (2007:317) agrees that learners that have difficulty in solving word problems adopt strategies that do not work, they pay more attention to the mathematical content of the problem than to the verbal content, and they guess what operation to use resulting in wrong solutions. Barwell (2001:4) supports this view by saying that the major mistake made by learners is that they often combine the numbers in the mathematical word problem in an apparently nonsensical way or give unrealistic solutions without reasoning. Bose and Choudhury (2010:93) report that it is also the use of language that leads to a conflict between learners' negotiations with the mathematical meanings of the word problems and the required mathematical operations therein. There could be an assumption that teachers perceive word problems as a difficult section of mathematics due to the language used which could make it impossible for teachers to teach learners, resulting in learners being incompetent when they encounter mathematical word problems at a higher level.

To minimize some of the problems faced by learners, teachers should teach accurate generalization for word problems and promote collaborative learning. Vygotsky (1962) points out that, "learners should work collaboratively to share their different perspectives with each

other, so that they could negotiate a solution and come to a much deeper understanding of a problem or tasks (word problems)". Barwell (2011:1) explains that, "to be successful in solving word problems, learners need to learn how to read mathematics word problems by learning to read between the lines and understanding what they are expected to do mathematically and to be given opportunities to practice mathematizing word problems". Barwell (2011) continues by observing that, "an open approach to mathematical word problems should be adopted to engage learners in understanding, mathematizing, analyzing and communicating in the context of meaningful situations and problems". This is in agreement with Sajadi's et al. (2013:2) view that; "successful problem solving is possible with first representing the problem appropriately". For these researchers, it is clear that learners may need to be guided and to be exposed to interact so that they may share information to manipulate word problems.

Gooding (2009:32) also expressed the sentiment that, "reading and understanding the language used with a word problem may assist learners to understand the mathematical word problems and encourage learners to read the word problems thoroughly with understanding". Irujo (2007:310) makes the contribution that, in order for learners to manipulate mathematical word problems, they need to understand the language in the problem, interpret the language so that they can identify the mathematical relations and understand what the problem is asking and convert the language and the mathematical relations to abstract symbols. Kagwesage (2013:31) suggests that, "teachers may promote peer interaction in mathematics classrooms because of its effectiveness in the context of problem solving".

2.7.1 Three dimensions of word problems

Barwell (2011:3) suggests three dimensions of word problems as depicted in the figure 1 below.

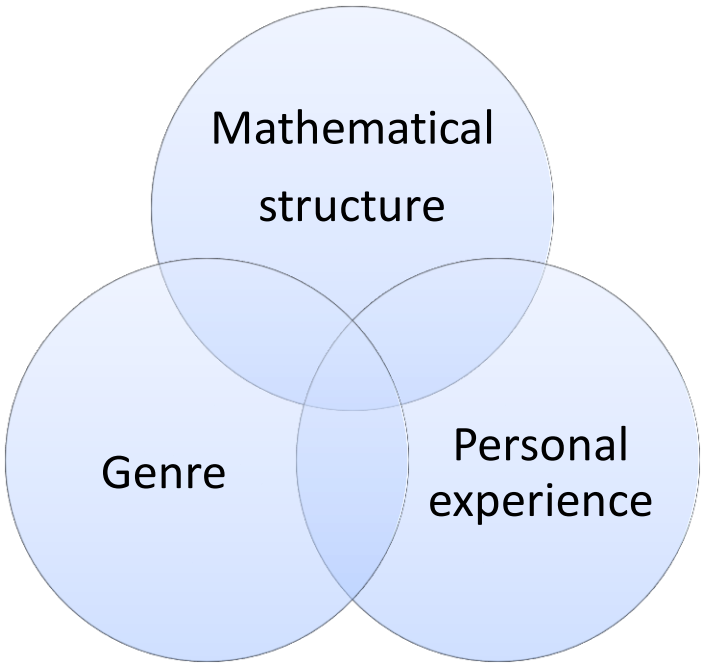

Figure 1

Dimension of word problems

Adapted from Barwell (2011:3)

From the diagram above a number of deductions can be made, as follows:

- Learners pay attention to personal experience, the teacher need to provide word problems that are related to learners' experience such as prices of goods in local shops or pocket money they get from their guardians and transport fares.
- Learners pay attention to mathematical structure. Learners will discuss the mathematical structure of their problem quite carefully, including operation and what numbers to use and how the numbers relate to each other. Learners will be engaged in meaningful mathematical thinking which assists them to relate the words to mathematical symbols.
- Learners pay attention to genre.

These three aspects of learners' attention are interrelated. Personal experience is used to make the underlying mathematical structure meaningful and to interpret the scenario of the word problem. Understanding the structure of word problems is necessary to mathematize the scenario successfully. In Barwell's (2011:3) words:

> Learners are quite able to mathematize situations based on real-world considerations when writing word problems of their own, the challenge is to draw on this ability, and so that learners can respond appropriately to word problems they have not seen before.

This leads us to a consideration of what the appropriate quality materials are for teachers to facilitate effective LoLT amongst learners. I look at this issue next below.

2.8 Teacher quality and LoLT materials

In the learning and teaching process, the teacher is an important element as he or she is in charge of selecting and transmitting information to learners. The teacher selects teaching and learning material as well as the type of language to be used when teaching learners. Therefore, a teacher may use learners' mother language entirely, can use the LoLT only or can use code switching, depending on his or her discretion. That is why I decided to discuss teacher quality and the learning and teaching materials in code switching in this sub-section.

According to Uys, Van der Walt, Van den Berg and Botha (2007:77), teachers have been often unaware of their inability to meet the language-related needs of their learners. In their study, they found that teachers lacked language proficiency in the learning of mathematics to assist their learners in acquiring mathematics concepts. Teachers relied entirely on code switching without placing emphasis on LoLT, which is used for examinations and assessment purposes. Haryanto (2013:52), from his study in Indonesia, found out that the teachers there relied mostly on the use of code switching because they were not proficient in English. Teachers should be encouraged to participate in professional training to develop their English proficiency in the teaching of mathematics to reduce too much dependency on code switching (Haryanto, 2013:53). Pillay (2003:4) concurs that schools should start language classes for teachers who are interested in improving their command of the English language. These teachers could then be used as resource persons to extend the use of English in the school environment. Teachers' English

competence needs to be assessed before they are employed by the school in order to recruit teachers with good qualities in terms of proficiency in English (LoLT), rather than someone who relies on code switching. Teachers with mathematical and language problems can be provided with courses to improve their teaching and mathematical skills to promote self confidence in the use of English (LoLT), as well as being involved in professional development. Yamat (2011:19) suggests that teachers should be competent to teach mathematics using English, since mathematics is examined in English (LoLT). NCTM (2009:2) assumes that in mathematics classrooms, children will also speak as they are spoken to, depending on the language ability and choice of the person addressing them. Therefore, it may not be enough to be just proficient in the English language; teachers should also be competent to teach mathematics using English as learners might imitate what their teacher says or does during mathematics classrooms.

African schools in South Africa are characterized by a lack of suitable textbooks and materials for the specialized languages, unmet needs of children and teachers who are not well trained and qualified enough as teachers, and whose competency in English as LoLT is severely limited (Mati, 2002:15). This may be a reason why some teachers prefer to use code switching rather than using English entirely in the teaching of mathematics, and also why there are no mathematics teaching and learning materials written in a learner's mother language, in this case IsiXhosa, that may be used for assessment purposes. Rose and Dulm (2006:2) echo these sentiments by saying that, "there is a lack of teaching and learning materials written in other African languages other than English and Afrikaans in South Africa which makes it difficult for teachers to understand concepts because the LoLT is a second language". Smith (2011:55) agrees by observing that, "the lack of adequate bilingual mathematics textbooks and materials catalyzes the continual use of code switching by teachers as they try to assist the transmission of information to learners".

Contrary to the above, Yamat (2011:19) reports that it is not enough to be just proficient in the English language, teachers should also be competent to teach mathematics using English. Yamat (2011:20) further suggests the idea of testing the competence of mathematics teachers, so as to identify problems they face when using English to teach mathematics. Anthony and Walshaw (2009:154) recommend that, "teachers need ongoing professional development so that they can

use new technologies and skills in ways that advance the mathematical thinking of their learners". Yew and Nathan (2008:10), likewise, argue that, "even though teachers find the professional training they received as helpful, they are still striving in helping learners to overcome difficulties to learn mathematics in English, instead they rely on code switching which is not used for assessment purposes". Anthony and Walshaw (2009:155) suggest that teachers need to be effective through developing and using a sound knowledge as a basis for initiating learning and responding to the mathematical needs of all their learners, as well as having in-depth knowledge in deciding class tasks, resources and being well-equipped academically. By doing so, teachers might be at par with the changes in the education system, rather than relying on the use of traditional teaching methods.

Teachers; therefore, should be able to select the relevant content and know how to teach it in the best way possible to promote understanding. Chamot (1995:391) points out that, "all teachers need help in methods for teaching and learning strategies explicitly". Anthony and Walshaw (2009:159) also argue that:

> [S]chools, communities and nations have a part to play in ensuring that their teachers have the knowledge, skills, resources and incentives to provide learners with the very best possible learning opportunities. By doing so, learners will be able to enhance their mathematical proficiency and view themselves as powerful mathematical learners.

2.9 Learner interaction through group work

Learner interaction helps learners to share ideas and promote a learner-centered approach. Latu (2005:485) found that, from classroom observations undertaken, learners were interacting in their mother language during mathematics discussions and personal conversations. Mouhonna (2010:14), with regard to this issue, states that, "teachers supported some use of the mother language to maximize learning in group-work to help learners understand difficult mathematics content". Viseu (2012:288) observes that, "mathematics communication is essential to enabling learners to understand about process, discussions and decisions that are made". He maintained that, by regulating the social interactions in the classroom, it enables the sharing of ideas and clarification of mathematical understanding among learners.

Group-work and class participation foster an enduring culture within the classroom and need to be encouraged. Garrison (2009:42) expresses the opinion that:

> [G]roup-work provides opportunities for learners to develop both listening and speaking skills in English and increase mathematical understanding. Group-work promotes free sharing of ideas without fearing the whole class. It also affords learners the chance to express their ideas freely and confidently.

Chamot (1995:384) explains that in mathematics, learners develop mathematical concepts through group activities and solve problems by working in groups to understand the problems and find solutions.

Mercer and Sams (2006:516) have reported that learners need to be helped to gain relevant knowledge of mathematical operations, procedures, terms and concepts. Moreover, learners need to be assisted to learn how to use language to work effectively together, to jointly inquire, reason, share and negotiate their ideas, and to make appropriate mathematical decisions. From the discussion, it is clear that learner interaction should be promoted and discussion encouraged in order to promote dialogue between learners and teachers. Mercer and Sams (2006:526) showed how the quality of dialogue between teachers and learners, and amongst learners, is of crucial importance and leads to better learning and conceptual understanding of mathematics. Kagwesage (2013:33), in the same vain, observes that, "through the use of the tool of language, people think and work together to transform given information into new understanding and solve problems clearly as a result of their combined intellectual efforts". Mercer and Sams (2006:513), likewise, state that:

> [P]eer group interaction results in learner collaboration that can focus on solving problems or practical investigations which also have potential value for helping children to relate their developing understanding of mathematical ideas to the everyday world.

Group-work results in cooperative learning that increase potential for better in-depth learning of learners. Mabrouk (2007:34) defines cooperative learning as an approach to group-work that maximizes the occurrence of unpleasant situations and maximizes the learning and satisfaction

that results from working on a high-performance team. Macpherson (2007:12) also defines cooperative learning as, "part of the group of teaching and learning techniques where learners interact with each other to acquire and practice the elements of subject matter and to meet common learning goals". In cooperative learning, the teacher acts as a facilitator, guides learners to explore ideas with their peers and allows them to work together and reach an agreement to their solutions.

Benefits of cooperative learning, according to Johnson, Johnson and Smith (2006:57) are that it promotes face-to-face interaction whereby group members interact by providing feedback to each other. Team building, leadership and management skills, decision-making as well as better communication are thus achieved. Individual accountability is achieved when learners work and share information collectively. Positive interdependence results as group members rely on each other in accomplishing their goal through members assisting, encouraging and caring about each other. "Cooperative learning, if applied or practiced, may result in higher achievement, better reasoning and critical skills, deeper understanding of taught material and greater intrinsic motivation" (Mabrouk, 2007:34).

When learners work in groups they benefit through exploratory talk. Mercer and Sams (2006:516) reveal how, "exploratory talk is directly involved with the teachers' role in shaping children's use of language for solving mathematics problems". Anthony and Walshaw (2009:10) state that, in groups learners learn how to make conjectures and engage in mathematical argumentation and validation, whereby teachers encourage them to explain and justify their solutions. Mercer and Sams (2006:525) continue to say that, "exploratory talk involves sharing of relevant information, group members are invited to contribute to the discussion and opinions of members are respected and considered, as well as making conclusions after reaching a consensus". Rollnick and Rutherford (1996) found that, "the use of learners' mother languages is a powerful means for learners to explore their ideas". Setati and Adler (2002:134) agree that exploratory talk is important for learners to discuss ideas and concepts in a comfortable environment through the use of code switching.

2.10 Teachers as role models in teaching mathematics

Learners may copy what their teachers say and do. That means they may imitate their teachers' behaviour towards mathematics as these teachers are role models in the learning and teaching environment. Mercer and Sams (2006:525), in their study, have shown that teachers can act as important models for children's own use of language for constructing knowledge. Gyasi (2013:21) points out that, "teachers are, invariably, role models whose behaviours are easily copied by learners, for example, what teachers like, dislike, and appreciate, how they feel about their teaching or studies could have a significant effect on their learners". If teachers code switch or strictly use one language during the teaching and learning of mathematics learners will imitate them. To facilitate learners' proficiency in mathematical language the mathematics teachers should model mathematical language, and provide learners with guidance and lead the way in the use of connecting mathematical terminology (Townsend & Lapp, 2010:79). There is the need for teachers to be careful with the type of language they use when teaching mathematics in classrooms. Through proper listening, speaking, writing and reasoning teachers can model good practice for learners, resulting in better performance in mathematics. Anthony and Walshaw (2009:152) assert that, "teachers should encourage the use of oral, written and concrete representation by learners; and teachers should model the process of explaining and justifying, guiding learners into mathematical conversations". Muke (2005:6) argues that the teacher understands her role as including the modelling of mathematical talk for learners who are struggling simultaneously with concepts and their appropriate naming in English, if this is the language of learning and teaching. Consequently, teachers should be careful with the way they do their teaching and try to be good examples for learners by teaching them what is required of them by the education system.

Mercer (2006:511) also found from his research that teachers can act as important models for learners' own use of language for constructing knowledge. Alabi and Adegbile (2005:35) state that teachers serve as models for learners to learn from, in some instances, when such models make mistakes wittingly or unwittingly the learner imbibes the same mistakes. From the study carried out by Alabi and Adegbile (2005:37), it was urged that teachers should help learners to reach a stage of English proficiency so that they may be able to verbalize and write quality work through modelling in such a way that learners may be able to follow suit. Rubenstein and

Thompson (2002:107) inform us that terms, phrases and symbols such as a simplify, differentiate, subtracted from, consecutive numbers, multiplied by, + and √ are essential in communicating mathematical ideas, and becoming fluent with them is vital for learners' mathematical learning. Teachers must present classroom activities in which children read, write, draw and explain mathematical ideas and get exposure to all concepts that are supposed to be learned.

Mercer and Sams (2006:526) found that, "providing learners with guidance and practice in how to use language for reasoning would enable them to use language more effectively as a tool for working on mathematical problems together". Teachers need to encourage and promote reasoning. Improving the quality of children's use of language for reasoning together would improve their individual learning and understanding of mathematics. Mercer and Sams (2006:535) further report that, "the development of mathematical understanding is best assisted by a careful combination of peer group interaction and expert guidance". Anthony and Walshaw (2009:154) bring forward the idea that teachers can guide learners in using technology to support independent inquiry and shared knowledge building; technological tools can link the learner with the real world, making mathematics more accessible and relevant. Presenting a similar view, Townsend and Lapp (2010:74) states that teachers must assume the role of a 'cheerleader' by encouraging, supporting and modelling language to expand better learning behaviours for every learner.

2.11 Code switching

Code switching is when teachers alternate between the mother language and the LoLT during the learning process (Web & Web, 2008:29). Moschkovich (2005:125) define code switching as, "the practice of using more than one language in the course of a single communicative episode or using two languages during conversations". Ibrahim (2001:124) also defines code switching as the introduction of items from another language into the base language, which occurs within sentences or between sentences within the course of a single conversation. NCTM (2009:10) defined code-switching as a practice of using two languages during one conversation or within one sentence. Setati and Adler's (2002:144) definition explains "code-switching as switching by the teachers and learners between the LoLT and the learners' mother language". The definitions

above emphasize that code switching is used by teachers and learners through the use of learners' mother language in conjunction with the LoLT during the learning and teaching process. Pollard (2002:5) explains that people who believe code switching to be harmful claim that learners will not be able to communicate effectively in either language. Navehebraim and Jamshidi (2013:189) promote the use of code-switching in English classrooms since "it is inevitable and necessary for learner understanding and is not only a part of communicative resources of bilingual classes but also an active part in the learning experience".

Presenting a contrary view to the above Durano (2009:34) argues that, "code switching impedes communication and may increase the probability of misunderstanding due to the use of two languages in classroom conversations and could signify a waste of time and effort". Alenezi (2010:16) is of the view that, "code switching is an influential teaching tool that facilitates learning and teaching because it encourages learner involvement in the teaching and learning process". Uys (2010:16) found that code switching could support classroom communication as well as exploratory talk, which are important for the learning and teaching process. Web and Web (2008:30), likewise, found that, "when learners were engaged in talk using only English they had difficulty in expressing their ideas and reasoning and they ended up resorting to code switching which assisted them to understand and explore ideas". Clegg and Afitska (2010:12) observe that:

> [T]eachers feel the need to facilitate understanding by encouraging more informal mother language use through teacher and learner code switching in the classroom. On the other hand, however, they are compelled to move lessons in the opposite direction towards more formal second language use so that they induct their learners into the genres of academic talk and writing in which the subject is expressed, textbooks are written and ultimately examinations are conducted.

Al-Azami (2008:123), from their study about the use of both mother tongues (Bengali) and English, showed that there was a greater engagement of tasks by learners when using code switching rather than the use of the LoLT only. The understanding of a concept in one language aided understanding in another, for example, by discussing how a mathematical concept operated

in each language. Code switching promotes learner interaction, understanding and ultimately assists the development of the LoLT. However, care should be taken as overuse or too much reliance on code switching may deprive learners of the needed input and may act as a barrier in mastering good communication skills. That way it may also delay development of the LoLT (Clegg & Afitska, 2010:18).

2.11.1 Reasons for code switching

Ndayipfukanye (1994) indicates that teachers code switched from English to the learners' mother language for a range of purposes: to explain new concepts, to clarify statements of questions, to emphasize points, to make connections with learners' own context and experience, to maintain the learners' attention, for classroom management and discipline. Probyn (2006) found that teachers were first teaching in the mother language and then translating to English (LoLT) or vice-versa. Teachers also switched to mother language when learners had problems in understanding the concepts. Truong (2012:11) argues that learners and teachers need to be able to interact verbally and express themselves clearly in order for learners to understand the concepts being taught in the LoLT. O'Keeffe and NiRiordain (2012:3) point out that, "learners should be afforded a chance to discuss in their mother language so that they can develop mathematical thinking". Therefore, learners and teachers code switch for different purposes, which include: classroom management, clarity, explanation, solidarity, repetition and for trying to make learners understand the concepts not clearly explained in the LoLT.

It is believed that code switching helps learners to interact more meaningfully with the teacher. Zabrodskaja (2007:127) propounded that the main reasons for the use of code switching by teachers is to enable them to conduct the lessons in the target language even if the second language proficiency of learners is low. According to the Benson (2004:18), learning in one's own language holds various advantages for the learner, including increased access, improved learning outcomes, reduced chances of repetition and drop-out rates, and socio-cultural benefits. In South Africa, Howie (2003:19) suggested that, "code switching is a valuable communication strategy for learning mathematics contents". Studies done in other nations showed that code switching promotes better learning and understanding of mathematics. For example, Ferro

(1983:60) showed that teaching in Cape Verdean and English gave better results in Mathematics achievement than teaching entirely in English.

However, the study carried out by Webb and Webb (2008:28) in the Eastern Cape showed that many teachers expressed that they felt guilty when they code switched as they considered that they were depriving learners the exposure to the use of English. Therefore, too much use of code switching may result in low learner moral, it is better for learners to use the LoLT since the learning and teaching resources are presented in English. Mati (2002:21) pointed out that continuous use of code switching may encourage learners to be reluctant to use the target (English) language, even though code switching is praised for its benefits of classroom management and enabling a comfortable learning environment.

Bacherman (2007:99) is of the opinion that the use of mother language instruction has to be limited and selective in nature, as consistent reliance on translation will not only affect the learners' language development but also discourage the learners from using the target language (LoLT). Salami (2008:2) commented that, "the language in which education is conducted is important as the selected language may enhance or impede the quality of education". Teachers need to be careful with the type of language they use in a mathematics classroom as it may affect learning ability. Yushau (2009:916) argues that, "learners have to cope with the double tasks of learning a new language and that of learning to understand the special terminology and syntax of mathematics in the new language if they use English only in their classrooms". Yushau (2009:918) goes on to say that, "there is the double task for learners, the acquisition of two conceptually difficult and different skills at once, one being related to language and the other to mathematical content". Marji (2009:925) supported the idea by saying that learners using English as the LoLT have the dual task of learning a second language and mathematical context at the same time. Yushau (2009:924) lamented that for learners who are acquiring a language of instruction as well as learning mathematics in the new language, the language of mathematics is another source of difficulty and confusion. This is in agreement with Noren's (2007:32) study which found that it was a complicated task for learners to learn mathematics in a second language which they were not academically proficient in, and difficult for them to develop mathematical skills and mathematical communicative competence at the same time, which added

more burden on their work. Marc (2005:511) states that for most South African teachers and learners of mathematics the LoLT is English, an additional language which for many is difficult to understand and use. Therefore, the use of English only could be seen as a burden since learners have to learn both English and mathematics at the same time, as both are new subjects to learners. It is suggested that mathematics be taught in learners' mother language as this may reduce the burden of learning different content simultaneously.

Yahaya, Noor, Mokhtar, Rawian, Othman and Jusoff (2009:142) point out that mathematics teachers are not language specialists, they have to cope with the double demand of transmitting content as well as language. This may be some of the reasons why other researchers support code switching, such as Botes and Mji (2010:11) who echo the sentiment that learning and teaching mathematics in classrooms where the medium of instruction is not the learners' mother language is a complicated matter because learners have to deal with the new terminology of mathematics as well as the new language of instruction in which mathematics is taught (English). Research carried out by Garegae (2007:236) agrees with the idea that second language learners experience challenges brought about by the medium of instruction, and thus to be successful in mathematics achievement, they have to focus on learning the language of instruction first before they could learn mathematics content. This suggests that learners' mother language needs to be incorporated in the teaching and learning of mathematics so as to assist learners' understanding of the mathematical concepts, since these learners may have difficulty in learning mathematics as well as English which is their second language.

Winsor (2007:377) suggests that making the effort to help learners feel comfortable by speaking in their mother language will inspire them to make an effort to learn mathematics in classrooms. Haryanto (2013:49) is of the opinion that learners maintain their self-confidence if they are allowed to use a language of their choice to demonstrate their expertise in the chosen language. Cuevas (1984:137), in a similar way, argues that:

> [D]ifferent linguistic activities serve different purposes when mathematical concepts and skills are being acquired; learners require considerable proficiency

> in both their mother and second languages if they are to cope with the range of linguistic activities required for learning mathematics.

In the opinion of Sajadi et al. (2013:6), the major issues that learners face in learning mathematics are related to an inadequate grasp of the language of instruction. This plays such an important role in the learners' development of conceptual understanding because they use another language which is not the LoLT. Yew and Nathan (2008:15) support the idea that learners learn mathematics in English more effectively as they master mathematics concepts better in the mother language. Hence, talking about mathematics in their mother language would help them to understand the subject better, after which learning mathematics in English will be smoother for them.

From the study carried by Alenezi (2010:10) he found that learners had a strong preference for using code switching in the learning and teaching process, as they felt secure in the knowledge that they are able to communicate exactly what they think and feel without fear of making mistakes should they use English only. Moreover, learners said that code switching was more desirable and believed that it made the course easier to understand when code switching was used. Pollard (2002:12) found out that learners were able to communicate their knowledge of the subject matter clearly to a teacher or peer through the use of two languages. However, Moodley and Kamwangamalu (2004:198) argue that if teachers make frequent use of the mother language or code switch; learners will become unfamiliar with the language (LoLT) used in examinations which will affect their understanding of the target language.

2.11.1.1 Functions of code switching

According to Clegg and Afitska (2010: 18) teachers use code switching for:

- Explanation and elaborating concepts;
- Increasing classroom participation;
- Affective and social purposes;
- Maintaining the class solidarity which underpins affective learning;
- Classroom management purpose to ensure the smooth running of the lesson;
- Maintaining and sustaining pace and interest; and

- Making connections between new conceptual material and the local context and culture of learners.

2.11.2 Scaffolding as a tool for code switching

Scaffolding is the assistance given to learners by more knowledgeable persons and it comes in various forms and at various points of learning (Yamat, 2011:17). Yamat explains that the goal of the teacher when using scaffolding strategy is for the learner to become an independent and self-regulating learner and problem-solver. Therefore, as the learners' knowledge and competency increases, the teacher gradually reduces the assistance (code switching). Vygotsky's (1962) theory of the Zone of Proximal Development sees scaffolding as a ladder that connects the current level of the learner with the next level of learning or acquisition, thus forming deeper connections between new material and existing knowledge.

Code-switching is used as a scaffolding tool to assist learners to achieve or reach a required level. The learner is assisted by a more knowledgeable person. This can be the teacher or a peer. Yamat (2011:18) points out that teachers may use scaffolding to assist learners in understanding word problems in the learning of mathematics. Therefore, scaffolding may help the facilitation of learners' capabilities to incorporate previous knowledge and the acquisition of new concepts. The study by Prediger, Clarkson and Bose (2012:6213) has shown that teachers started teaching in English and repeated the same information in Malay to benefit learners with low English proficiency as a form of scaffolding. There were transitions between the use of LoLT and the mother languages (Prediger et al., 2012:6213). There was great improvement in learner participation as a result of this approach, even though more time was spent conveying the same concepts in both English and Malay (mother language). Moreover, the studies carried out by Yamat (2011:19) and Bonenfant (2010:155) showed that scaffolding is a strategy that may improve learners' understanding of concepts taught when incorporated with code switching, and that scaffolding may be provided through activities that build on one another in a meaningful and consistent manner. Mercer and Sams' (2006) findings indicated that if teachers provide children with an explicit, practical introduction to the use of language for collective reasoning, then children learn better ways of thinking collectively and better ways of thinking alone through scaffolding.

2.11.3 Incompetence in the use of English by teachers and learners

Incompetence in the use of English by teachers and learners mainly happens when they are unable to use the LoLT (English) comfortably or accurately and end up resorting to the use of their mother language or code switching. Most of the time teachers and learners use the avoidance tactics because of their reluctance to use English during the communication of certain concepts. Youkhana (2010:37) found that, "learners and teachers… switched back to their mother language when they lacked competence in the target language and when they wanted to clarify a message to the classmates". Moghadam, Samad and Shahraki (2012:2223) stress the point that, "code switching assists when learners and teachers lack the right vocabulary to communicate in the target language. Sert (2005:4) suggests that during conversations in the target language, the learners fill the stop-gap with mother language use, to avoid gaps in communication".

Kagwesage (2013:40) propounds that some "learners prefer to keep quiet for fear of making mistakes in English or simply because they lack the required English competence to express themselves, considering that their active participation is of paramount importance as regards negotiation of meaning and knowledge building". Therefore, incompetency in the use of the LoLT may also contribute to the reluctance by learners to use English in the learning of mathematics word problems. This was confirmed by Warren, de Vries and Young's (2007:781) findings that, "many indigenous Australian learners did not like to be asked questions in front of the whole class and did not want their incorrect answers to be pursued because they were not comfortable with English". In addition, Probyn (2006:394) stated that for many townships and rural learners, the oral language of the school and classroom is their mother language, whereas the language of reading, writing and assessment is English. So they sometimes code switch as a result of an inability to communicate.

When teaching mathematics in a foreign language this may result in misconceptions in understanding of mathematical concepts by learners, which may result in learners and teachers resorting to code switching because of their incompetence in the use of the LoLT. Angateeah (2013:8) concurs that:

> [M]any learners were confronted with a range of linguistic difficulties when learning mathematics, one of the difficulties arose when their language did not have the vocabulary to express the mathematical ideas that they learned in the classroom and they ended up using code switching to convey meaning.

Marji (2009:1) stated that, "when a learner is carrying out all of his or her cognitive work in a second language, limitations in language can lead to limitations in learning that may lead learners to rely on code switching to be able to understand the taught concepts". However, Bose and Choudhury (2010:95) supported "code switching in that it assists the learners to understand and comprehend information better". Research carried out by Yamat (2011:19) in Malaysia showed that teachers were code switching in order to compensate for learners' weakness in the class first by using English and then repeating the explanation in Malay for the benefit of those who had low English proficiency. Compensating learners' weaknesses adds more burden to teachers, as Setati et al (2009:65) observed. Setati explains that teachers in multilingual classrooms face a major task of having to teach mathematics and English at the same time, while learners have to cope with learning mathematics in English, a language that they are still learning. It places additional demands on mathematics teachers and their learners who are learning a language that is not their mother language. Therefore, teachers face the major demand of continually needing to teach both mathematics and English at the same time.

Research carried out by Alabi and Abegbile (2005:35) showed that most of the time second language learners encountered difficulty in expressing their communicative intentions, attributable to the gaps in their linguistic repertoire. A learner who is able to anticipate such difficulties may avoid communication or try to modify what he or she intends to say. Even when the learner is already engaged in communication (oral or written) and such difficulty is experienced, he or she may resort to code switching. Sometimes learners may refuse to talk or use their mother language, or use a literal translation of the word to the mother language to put their ideas across.

Ahmad (2009:49) states that in Malaysia teachers consequently have been employing code switching as a means of providing learners with the opportunities to communicate and enhancing

learners' understanding. Ahamd (2009) in his study found that code switching was successful because Malay language was understood by the learners of varying backgrounds; through code switching teachers were able to ensure the transfer of intended skills to the learners effectively. Code switching is more successful if learners are having the same mother language as the teacher. Setati (2008:107) explains that "for the facilitation of learner participation and success in mathematics, teachers need to use learners' mother language as a legitimate language of mathematical communication". The study carried out by Zabrodskaja (2007) with Estonian and Russian students showed that oral Estonian-Russian code switching can be used in the classroom to help students overcome communication problems. Warren et al. (2007:778) pointed out that code switching is acquiring the facet to transition from one language variety to a different one as a strategy to negotiate meaning when learners are incompetent in the use of English. Research suggests that foreign language study enhances children's understanding of how language itself works and their ability to manipulate language in the services of thinking and problem solving. Zabrodskaja (2007:131), for instance, observes how "the main goal of code switching is to enable the teacher to conduct the course in the target language even if the second language proficiency of students is low". Zabrodskaja (2007:134) further argues that a switch to mother language, whether initiated by the teacher or the learner, increases attention to the context of second language messages and facilitates understanding.

2.11.4 Classroom management

Teachers use code switching for classroom management in order to maintain learners' discipline (Sheeraz, 2011:418). Sometimes teachers use the learners' mother language so that learners can hear and understand important disciplinary messages. Learners, on their part, code switch when they want to complain or to alert the teacher of a problem. Brice (2011:13) observes that, "the use of code switching allowed for more spontaneous language use, which prompted increased English use whereby maintaining a flexible learning environment that allowed the calling out of responses and increased speaking opportunities". The study by Bose and Choudhury (2010:99) showed that teachers made use of code switching to enforce authority and discipline in the classroom; they continued to say that teachers used Hindi utterances rather than English only when managing their classes. Moddley and Kamwangamalu (2004:194) agreed that teachers

used code switching for management control as well as to elicit specific behavioural responses from learners, as these aspects were important for learners to behave in a desirable manner.

2.11.5 Solidarity needs

Code switching allows creation of a good relationship between teachers and learners that promote a conducive and non-threatening learning environment, because learners and teachers share the same mother language. Clegg and Afitsa (2010:11) state that, "teaching in second language creates distance between teachers and their learners than teaching in mother language". Teachers try to use code switching for motivating learners to be interested in learning mathematics. Afitsa and Clegg (2010:18) furthermore reveal that, "teachers need code switching for explaining and elaborating concepts; code switching may also increase classroom participation". Code switching is useful for affective and social purposes, as teachers need to establish good classroom relationships. For most teachers the mother language is the best medium to maintain class solidarity, which underpins effective learning and is useful for classroom management purposes to ensure the smooth running of the lesson and for maintaining peace and interest. Teachers need to use the mother language to make connections between new conceptual material and the local context and culture of learners. Afitsa and Clegg (2010:18) suggest that learners need to code switch in their interactions with teachers in the classroom in order to express knowledge which they cannot express in LoLT. Van der Walt and Mabule (2001:296) likewise claim that one of the reasons for code switching by teachers could be an attempt to lessen the social distance brought about by the status of the teacher through the use of English. Teachers code switch to initiate and invite negotiation of meaning, thereby improving comprehension of the subject material.

Prediger et al (2012:6220), Bensen (2013:72) and Mujiono (2013:49) all agree that, "code switching can be used as a mark of solidarity thus empowering the learners in the classroom, attracting attention from learners, and to close the gap and establish goodwill and rapport between learners and teachers". Therefore, teachers use code switching as a mark of solidarity, empowering learners in the classroom by providing flexible and comfortable modes of communication. Noren (2007:46) is of the opinion that:

> [T]o be able to communicate in a mathematical learning situation, students need to use their language(s) of thinking and their cultural and social backgrounds as tools for mediation, in order to be able to develop new concepts and ways of understanding. In other words, code switching is used by teachers to negotiate meaning as well as managing learners' activities.

Mujiono (2013:50), echoing the same sentiments, observes that code switching is used by the teacher in order to build solidarity and intimate relations with learners. Sert (2005:2) and Sheeraz (2011:423) both claim that code switching may be used as a tool for creating linguistic solidarity and intimacy, especially among individuals who share the same ethno-cultural identity such as mother language. Therefore, code switching may be seen as creating a supportive and accommodating classroom environment whereby learners and teachers build trust in each other (Teik & Lain, 2013:7).

2.11.6 Code switching as learning and teaching resource

Mati (2002:19) states that code switching can be regarded as a diverse linguistic resource for learning. Code switching happens mostly when the teacher or the learner is unable to find an appropriate word, expression or phrase for carrying out the discussion smoothly. Yahaya et al (2009:142) explains that, "teachers may resort to the teaching of mathematics in a mixture of both the mother language and the target language". Code-switching enables learners to harness their mother language as a learning resource which may increase their participation in the classroom, as they will be willing to contribute and share ideas with others.

Muke (2005:1) reports how, in Paupa New Guinea, policy promoted the language practice of code-switching, but the emphasis is that teachers switch to the mother languages of the students only as a resource to teach subjects, including mathematics, while English is formerly introduced. Setati and Adler (2001:252) concur by noting that:

> [T]eachers' work was to encourage code switching as a means for enabling learners to talk more freely in class, and use their mother language as a learning resource for talking, in order to learn in the South African educational situation.

Garegae (2007:233) claims that language is a communication tool through which cultural values, beliefs and knowledge are conceived, negotiated and conveyed from one generation to the other. Research done in Botswana by Garegae (2007) showed that teachers believed that when learners use their mother language they will express themselves with ease, and thus would understand mathematics better when Setswana was interchanged with English (LoLT), thereby using code switching as a learning and teaching resource. Previous research argues that the learners' mother language acts as a resource tool for the learning and teaching process (Setati, 2008). Marji (2009:1) states that when a learner is carrying out all of his or her cognitive work in a second language, limitations in language can lead to limitations in learning. Noren (2007:44) observes that:

> [I]n situations where teachers had the same language and similar cultural background as their learners, they were able to draw on their own and the learners' earlier experiences, and to use code switching as tools for teaching and learning mathematics.

Pollard (2002:12), in his study about code switching, found that both teachers and learners code switched without hesitation between English and Spanish in order to convey meaning in the best way possible, and were also able to convey their knowledge of subject matter to their classmates and teachers effectively. Sert (2005:5), in a similar manner, explains how:

> [C]ode switching serves for communicative purpose in the way that, it is used as a tool for transference of meaning and it builds a bridge between known to unknown and may be considered as an important element in teaching when used effectively.

Therefore, if learners are allowed to use their mother language as a learning resource, it may result in better comprehension of concepts being taught.

2.11.7 Repetition

Learners cannot master mathematics skills effectively, therefore the need to repeat every activity in their mother language. Chimbganda and Mokgwathi (2012:27) explain that by repeating the explanations in the mother language the learner is likely to understand more easily the meaning of the main message. Sert (2005:5) disagrees with this position, arguing that, "the tendency to repeat the instruction in mother language may lead to some undesired learner behaviour". Learners may be bored since they know that the teacher will repeat the same information in mother language from foreign language. Yamat (2011:19), from a study carried out in Malaysia, reported that in order to compensate for learners' weaknesses in the English language, a teacher may begin teaching in the class first using English and then repeats the explanation in Malay for the benefit of those learners who have low English proficiency. When repeating the information in two languages, it means that more time will be needed to convey the same concepts. The purpose of repetition therefore is to clarify meaning of some difficult content. Sert (2005:3) contends that teachers might code switch in order to transfer the necessary knowledge for clarity.

2.11.8 Understanding

Code switching helps learners to understand. By adjusting the degree of formality of their English, teachers translate from LoLT to mother language and vice versa to clarify mathematics concepts and to help weak learners. Van der Walt and Mabule (2001:288) report that the Department of Education in South Africa encourages learners to use code switching so as to facilitate learning. Van der Walt and Mabule (2001:299) point out the reasons for code switching as being to initiate and invite negotiation of meaning, thereby improving comprehension of the subject material. However, code switching is not used during examinations, only the LoLT (English) is the language of assessment resulting in contradictions in the use of code switching as a strategy. Alenezi (2010:5) explains that code switching is used to emphasize and reinforce a message that has been transmitted firstly in the target language. Zabrodskaja's (2007:135) findings showed that a switch to mother language, whether initiated by the teacher or learner, increases attention to the content of LoLT messages and facilitates understanding. This kind of code switching helps to bridge a gap in communication and plays the role of a compensatory strategy.

Mujiono (2013:50) notes how switching from one language to another is an effective way to continuously establish learner understanding. It will be easier for learners to ask questions or answer them in their mother language as well as make them free to explain their ideas fully. However, there is no code switching during assessment, which may make it difficult for learners to understand the content expressed in LoLT. The use of code switching may thus disadvantage learners because they may not understand information written in LoLT, or may find it difficult to answer tasks using English. Halai (2006:27) maintains that for understanding the mathematical ideas and concepts one has to be able to understand the instruction-language, which means that, if the instruction-language is foreign to the learner then effort should be made by the teacher to teach learners in the LoLT. Teachers need to encourage learners to stick to the LoLT since it is the official language of learning and teaching, as was pointed out by Chetty and Mwepu (2008:334). English is the language of the state and government documentation appears mostly in English in South Africa. Therefore, learners are supposed to communicate and use LoLT (English) because all the information communicated to them will be in English, including their assessment tasks such as assignments and examinations.

2.11.9 Translation and clarification

When learners are assisted by the teacher to translate LoLT to mother language or vice versa, they may be able to understand concepts under discussion. If concepts are clearly clarified by both the teacher and learner in LoLT as well as learners' mother language it may result in meaningful learning.

Muthuuri-Gitonga (2006:36) points out that code switching is used to stress a point and to enhance greater clarity and acts as a means for conveying information as accurately as possible. Lan and Tan (2008:148) found that, with weaker classes in Malaysia, teachers used much more Malay language in class by way of translation. As a result, instead of teaching mathematics in English, many teachers ended up teaching in English and Malay. There is a disadvantage here in that teachers were taking the role of translators in class for the benefit of learners with low English proficiency. Teachers ended up wasting learners' time instead of finishing the planned work in the stipulated time.

Most teachers want to code switch but encounter problems such as lack of learning and teaching materials, especially in African languages (Muthuuri-Gitonga, 2006:36). Ajmal (2010:32) indicates that teachers use code switching to translate or elaborate important information, for example explaining new vocabulary or concepts. Code switching reduces the burden on learners and makes it easier for them to understand the new concepts.

The use of code switching seems to pose a danger to most South African schools because, as was stated above, learners need to read or write mathematics in English (LoLT). Despite this, Zazkis (2010:42) explains that teachers code switch in order to translate or clarify instructions and also to reformulate and model appropriate mathematical language use. Learners switch codes to seek clarification and to express their ideas or arguments precisely. Clegg and Afitsa (2010:10) support the idea that teachers code switch between the LoLT and the mother language in order to make clearer what they would have said in a second language. Garegae (2007) found how teachers believed that when learners use their mother language they will express themselves with ease and thus would understand mathematics. Iqbal (2011:192) makes a similar observation that the use of code switching when learners are not clear about a point or when participation is needed, not only makes instruction effective, but also develops students' rapport with teachers and develops confidence to interact.

Mwinsheikhe (2009), in a study in Tanzania, found that most of the teachers interviewed used code switching for clarification of concepts and to improve understanding of the concepts being taught. Mujiono (2013:56) made similar findings that code switching is attributed to the need for clarification of the message and occurs when a speaker wants to make clear what he or she is talking about. Moghadam (2012:2221) state how code switching can be used for translating and elaborating the significant messages while explaining new vocabulary or instruction, instead of proceeding in the foreign language, emphasise that this strategy may make comprehension easier. Modupeola (2013:93) reiterate that teachers employ the code switching strategy as a means of providing learners with opportunities to communicate and enhance learners' understanding**.** Samad (2012:2224) found that code switching may be considered as a useful technique in classroom interaction, especially if the goal is to clarify and convey the information

to learners in an efficient way. Code switching is used for drawing learners' attention to new information (concepts).

2.11.10 Informal and formal language

Setati et al. (2002:135) report that most learners come into the school with informal ways of talking, and the challenge that teachers face is to encourage movement in their learners from predominantly informal spoken language to formal language, both spoken and written. Setati and Adler (2002:135) explain that mathematics informal language can be referred to as the kind that learners use in their everyday lives to express their mathematical understanding. The researchers further disclose that formal mathematical language refers to the standard use of terminology, which is usually developed within formal settings such as schools. In mathematics classrooms, both formal and informal languages are used either in the written or spoken form; teachers need to assist learners to develop formal spoken and written mathematics and language competence in English. Teachers believe that when learners use their mother language they will express themselves with greater ease, and thus would understand mathematics better when the mother language is interchanged with English as the language of teaching and learning.

Instead of simply using code switching, however, teachers need to use hands on activities whereby learners are involved also in using the LoLT when learning mathematics, since LoLT serves as the academic mathematics language or vocabulary. Escamilla and Grassi (2000:4) stress that, "to ensure the success of second language learners, it is important for content area teachers to directly instruct second language learners in the academic vocabulary necessary to comprehend the content area lessons". For example, learners can find the perimeter of a classroom by first measuring the sides and then calculating the area as well. Pimm (1991:21) iterated that the difficulty facing all teachers, however, is how to encourage movement in their learners from the predominantly informal spoken language with which they are all pretty fluent, to the formal language that is frequently perceived to be the benchmark of mathematical activities.

2.12. Conclusion

From the literature discussed it has been shown that there is a gap between the LoLT (English) recommended in the learning and teaching of mathematics by the DoE and what is actually happening in mathematics classrooms. The literature review has highlighted important ideas on the non-compliance of teachers on the use of LoLT in the learning and teaching of mathematics. It is important for both teachers and learners to be proficient in the language of learning and teaching. Learning mathematics in a second language creates challenges to learners and teachers, as learners will be learning mathematics and English simultaneously. The salient ideas from the literature review are that teachers need to be careful with the type of language they use when teaching mathematics because learners may imitate what their teachers do or say. Appropriate mathematical language should be modelled to learners so that they may understand the concepts under discussion. Moreover, teachers avoid the teaching of word problems because of their inability to communicate and use mathematical language in the learning of mathematics.

Chapter Three will discuss the research paradigm, research design, and research methodology and data collection instruments. Other aspects to be discussed include the procedures followed in the selection of participants, ethical considerations, issues of validity and data analysis procedures.

CHAPTER THREE
METHODOLOGY AND RESEARCH DESIGN

3.1 Introduction

In Chapter Two the researcher discussed the theoretical framework which underpins the study as well as reviewed related literature from both international and national sources. The literature discussed dealt mainly with code switching in the mathematics classroom situation. The South African language of teaching and learning policy as well as issues relating to teacher qualities were also discussed.

The main aim of Chapter Three is to outline the research paradigm, describe the research design and explain the research methodology and methods used for data collection and data analysis. The chapter discusses aspects of data collection through observations, interviews and video recordings, ethical issues, data analysis and issues of validity in order to answer the research question.

3.2 Research Aim

The aim of the research is to explore the effects of code switching in the learning of word problems in Mathematics. The focus is to gain more understanding of learners and teachers regarding the learning of mathematical word problems in Grade 10.

3.3 Research question

How does code switching affect the learning of word problems in mathematics in Grade 10?

3.4 Role of researcher

I am a mathematics teacher and my role in conducting this research involved selecting participants, taking field notes, interviewing learners and teachers, conducting classroom observations as well as analysing and interpreting data. In addition, I was responsible for selecting a suitable venue for interviewing participants. My role as researcher was therefore pivotal in facilitating and implementing data collection, gaining entry to the research site as well as the consideration of ethical issues.

3.5 Research Paradigm

Wahyuni (2012:69) defines a research paradigm as, "a set of fundamental assumptions and beliefs as to how the world is perceived which then serves as a thinking framework that guides the behaviour of the researcher". Thus, the assumption which underpins this study is that the real information about the effects of code switching in the learning of mathematical word problems is found from the way teachers and learners interact in their classrooms in a natural manner. Joubish (2011:2083) reports that a research paradigm is "essentially a worldview, a whole framework of beliefs, values and methods with which research takes place". Terre Blanche and Durrkein (2006:40) echo this view by observing that, the research paradigm "acts as perspectives that provide a rationale for the research and commit the researcher to particular methods of data collection, observation and interpretation". The main three dimensions of paradigms are positivism, critical postmodernism and interpretivism. An interpretive paradigm was used in this study because it seeks to gain deeper insight into the nature of code switching of teachers and learners in mathematics classrooms and also because the researcher tries to make sense of the situation by observing and interviewing a set of particular instances (Terre Blanche & Durrkein, 2006:7).

In the interpretivist paradigm, "it is believed that reality is constructed by social actors and people's perceptions" (Wahyuni, 2012:72). The interpretive paradigm attempts to understand the situation through interpreting meaning assigned by participants. Therefore, a research paradigm is a "belief that guides the way certain acts are undertaken in a natural setting whereby the researcher tries to make sense of the feelings, experiences as they occur in the real world" (Terre Blanche & Durrkein, 2006:287). An interpretivist researcher is interested in the meaning that people give to phenomena and requires a detailed and thorough analysis of social situations and also requires first-hand knowledge (Willis, Daly & Kealy, 2007). Therefore, in the interpretive paradigm the researchers make interpretations of what is seen, heard and understood.

3.6 Ethnographic research approach

The research approach was of an ethnographic nature since it promoted the use of both observations and interview techniques to collect data in a natural setting, which leads to social interpretation. Fraenkel (2012:507) points out that, "the emphasis in ethnographic research is on

documenting or portraying the everyday experiences of the individuals by observing and interviewing". Dufon (2002:42) also mentions that, "ethnographic research focuses on the behaviours of the members of a particular community by studying them in naturally occurring settings, typically while they participate in mundane day-to-day events". The researcher consequently conducted the research with learners and teachers to investigate the effects of code switching in learning mathematical word problems in their classrooms (real settings). Moreover, there was in depth collection of data, the ethnographic research approach was interpretive and descriptive because it relied on text data (words), as opposed to numeric data, and took place in the natural setting of participants (classrooms). This research was conducted by recording details of activities in mathematics classrooms. In addition, the research dealt with behaviours and beliefs of teachers and learners about effects of code switching in the learning of word problems in mathematics, which concurs with Williams' (2007:72) observation that ethnographic research is conducted by recording many details about a specific culture or social system as much as possible. Creswell (2008:323) also defines ethnographic research as, "a strategy of inquiry in which the researcher studies an intact cultural group in a natural setting by collecting, primarily, observational and interview data". Marilyn (2011:13) contends that, "the aim of ethnographic research is to learn from members of a cultural group to understand their worldview as they define it". Descombe (1998:69), Reid and Gough (2000:60) echo the same views, explaining that in ethnographic research there is great emphasis on the understanding of information from the point of view of people involved in the setting. Therefore, the researcher collected data from learners' and teachers' interactions through observations and interviews in their classrooms about the effects of code switching in learning mathematical word problems.

Furthermore, ethnographic approach was used because "the research was concerned with understanding behaviour from the participants' own subjective frames of reference" (Neville, 2007:6). Ethnographic approach also helped the researcher to extract data deeply about the effects of code switching in the learning of mathematics. "The methodology provided rich narrative descriptions of the participants' perspectives on the construction of the reality of their social world" (MacMillan & Schumacher, 2001:74). An ethnographic approach is descriptive in nature; it tries to understand how and why teachers and the learners code switch in the learning of mathematics word problems, whereby the researcher gathers data personally through visiting

participants' classrooms. An ethnographic approach, according to Maluleka (2008:47), "always involves some kind of direct encounter with the world, whether it takes the form of on-going daily life or interaction with a select group" Therefore, the researcher chose an ethnographic approach in conducting observations and interviews with participants in their natural settings through visits to mathematics lessons to gather relevant information about the effects of code switching in the learning of mathematical word problems. In this research, the researcher collected data through interaction with participants. An ethnographic research approach was selected because it contained features which enabled the researcher to obtain thick descriptions in the form of words, and to attain depth of information for a better understanding of the effects of code switching in the learning of mathematics word problems, through interaction with participants in their classes.

3.7 Research methodology

Wahyuni (2012:73) alerts us to the fact that, "research methodology and research method are distinctive concepts". Methodology refers to a model to conduct research within the context of a particular research paradigm, whereas a method denotes a procedure, tool or technique used by the researcher to generate and analyse data. Methodology refers to how one goes about finding out knowledge and conducting the research. It is the strategic approach as distinct from techniques and data analysis (Wainright, 1997). In other words the research methodology is a way used to find solutions to research questions. Rajasekar (2006:5) explains that, "essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology".

3.8 Research method

Rajasekar (2006:5) notes that research methods are the various procedures used in research; they assist the researchers to collect data samples and find solutions to research questions. Therefore, research methods deal with how the research should be carried out by giving a work plan of a study that consists of a set of specific procedures, tools and techniques to gather and analyse data (Wahyuni, 2012:73). In other words, a method is a practical application of doing research, whereas a methodology is the theoretical and ideological foundation of a method. Seale (2004:457) and Schwandt (2007:190) agree that research method is a technique or a strategy for

collecting data in a certain setting. Consequently, the research method is used to collect data from different participants in the settings in a natural way.

3.9 Research design

According to Terre Blanche and Durrkein (2006:34), qualitative research design is a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research in such a way that it answers the research question. Yin (2009:7) defines the qualitative research design as "the logical sequence that connects the empirical data to the study's initial research questions and ultimately to its conclusions". Therefore, the research design employed in this study articulated what data was required and what methods were used to collect and analyse these data, and how to answer the research question. A qualitative research design, then, becomes important to connect a methodology and an appropriate set of research methods in order to address research questions that are established to examine a social setting (Rajasekar, 2006:6).

The qualitative research design "indicates the approach to be used in solving the research problem, sources and information related to the problem" (Rajasekar (2006:10). In this instance the research design is a plan and a way of obtaining answers to a research question. The ethnographical research approach was used in this study, whereby classroom observations and interviews were used as data collection methods. According to Leininger (1985:35), ethnography can be defined as, "the systemic process of observing, detailing, documenting, and analysing the life-ways or particular patterns of a culture (or subculture) in order to grasp the life-ways or pattern of the people in their familiar environment". The ethnographic research approach provided the foundation of the entire research work to help in making the performance of the research easy in order to answer the question about the effects of code switching in learning mathematical word problems. The first phase was the selection of participants, followed by data collection through classroom observations and interviews and, finally, data analysis, interpretation and writing of the report.

3.10 Data collection techniques.

The first stage of the study was ethnographic classroom observations that were conducted to record instances of code switching in the learning of word problems in mathematics. An ethnographic observation is whereby the researcher observes how participants communicated with each other in their settings. As Agar (1986:12) describes, ethnography involves "encountering alien worlds and making sense of them and to show how actions in one world make sense from the point of view of another world". An in-depth discussion of ethnography was made in previous sections. The researcher used non-participant observations followed by interviews to increase rigour, trustworthiness and validity of data collected. According to McPake (1999:3), "lesson observations should be done in conjunction with interviews with both learners and teachers so as to tap the thinking behind actions and the perceptions of each part".

Narrative data were collected through lesson observations and interviews. Lessons were observed and video recorded for two consecutive days. Interviews focused on learners' and teachers' reflections and views about the effects of code switching in the learning of word problems in mathematics lessons. Interviews were conducted and video recorded after school, outside the learning and teaching activities. Observations and semi-structured interviews assisted in giving the researcher first-hand information in terms of code switching in the teaching and learning process. By using these techniques the researcher was able to obtain rich and in-depth information about code switching in the learning of word problems in mathematics.

3.10.1 Observations

The researcher made use of classroom observations in collecting data. The reasons for using observations will be discussed later. MacMillan and Schumacher (2000:42) defined observation as "an active process, which includes muted cues, facial expressions, gestures, tone of voice and other non-verbalized social interactions, which suggest the subtle meaning of language". According to William (2006:286), "observation is the systematic noting and recording of events, behaviours in the social setting chosen for study". Marilyn (2011:36) adds the angle that "the goal of observation is to immerse the researcher in the setting, so he or she can see, hear, feel, experience and participants' daily life". Therefore, classroom observations allowed the researcher to hear and see directly the language used by participants when they interact during

mathematics lessons. The aim of the lesson observation was to determine the effects of code switching, as well as how and when in the presentation of the lesson code switching was being used.

Observations thus enabled the researcher to identify the language used by teachers and learners during mathematics lessons (real classroom teaching). Patton and Cochran (2002:22) assert that:

> [O]bservational data is also very useful in overcoming discrepancies between what people say and what they actually do and might help the researcher uncover behaviour of which the participants themselves may not be aware.

Basit (2010:120) extends this view by stating that, "in observation the researcher is able to observe behaviour directly and gather data in situ, rather than relying on second-hand accounts of participants' perceptions of their own or other peoples' behaviour". The researcher actively observed and recorded the findings of the learning and teaching process; and carefully listened to the languages that were used by the teachers and learners, with the aim of identifying the effects of code switching in learning of word problems in mathematics.

The researcher continually tried to systematize classroom observations by using video recordings, observation checklists and field notes to record and focus on the communication that took place between learners themselves and also between learners and teachers. Conversations were carefully observed with a focus of noting what languages the learners and their teachers used most, who they talked to; times they used English, code-switched and when and why they chose to use their mother language. Finally, classroom observations made the researcher explore how learners learned, how they interpreted and made sense of the taught concepts, where they stumbled, what they did when they misunderstood the concepts.

3.10.1.1 Reasons for using observations:

Classroom observations were used to determine the language used by both teachers and learners in mathematics classrooms. Through observing I was able to investigate how learners respond to

questions posed by teachers while teaching. Classroom observations were also used to find out the type of languages used by learners and teachers when they interacted.

Jacobson (2009:5) articulated some of the reasons for observing participants as being that:

> [Observation] allows the collection of data where and when an event or activity is occurring, it does not rely on participants' willingness to provide information and it directly sees what participants do rather than relying on what participants say they do.

Mulhall (2003:307) echoes these sentiments by saying that, "the primary reasons for using observational methods are to check whether what people say they do is the same as what they actually do". Classroom observations provided more insight into interactions between participants by capturing the whole classroom setting in which learners and teachers function as well as provisiding a valuable opportunity to learn more about the practices and the context of the teaching and learning of mathematical word problems. Moreover, classroom observations were conducted to assist in learning more about the learning and teaching that happen in mathematics classes.

Observations were used because they assisted the observer to witness, experience and record what learners and teachers said during the learning process. Classroom observations were an excellent method for discovering behaviours of learners and teachers in terms of how they communicated to each other, language type and usage, and people they talked to at different times in a natural setting. Neo and Heng (2002) also cite that, "the method of observation is employed, because it enables the researcher to see and hear directly the natural language used and the interaction of the participants in mathematics classrooms".

3.10.1.2 Advantages of observing participants

Finn and Jacobson (2008:54-55) articulated some of the advantages of observing participants in stating that:

> [D]ata is collected where and when an event or activity is occurring. The observer will directly see what participants do rather than relying on what they say they do. Therefore, classroom observations provide the researcher with first-hand experience with participants by recording information as it occurs as well as noticing unusual aspects.

3.10.1.3 Disadvantages of observing participants

Participants may see the researcher as intrusive. Sometimes private information may be observed that the researcher cannot report. The researcher may not have good interviewing and observing skills, which may result in unreliable conclusions (Finn & Jacobson, 2008:56). The researcher countered some of the disadvantages by explaining the purpose of the research to participants and adhering to confidentiality protocols. Moreover, the researcher asked for assistance from the design teacher to assist in taking video recordings during classroom observations and interview sessions. The design teacher is a qualified and experienced photographer and so was well-placed to assist with the video recordings.

3.10.1.4 Non-participant observation

Mulhall (2003:308) states that, "Non-participant observation involves watching and recording what will be happening without taking part in the activities of the participants". To reduce limitations of observation as a method the research employed non-participant observation whereby I sat at the back of the classroom during mathematics lessons to avoid disturbances and to record as much data as possible. Through the use of non-participant observations participants felt comfortable even though they were being observed because the researcher did not interact with them. Muke (2005:6) explaines that, "non-participant observation method is normally used to give meaning to certain behaviours and beliefs by observing activities and interactions of a social setting".

Sitting at the back of the classroom allowed me to focus on the interactions between teachers and learners or between learners themselves. I sat at the back of the classroom to avoid contact with participants and to take field notes. Sometimes I walked around the classroom unobtrusively to listen to the conversations between participants. Fraenkel (2012:446) points out that, "in a non-participant observation study researchers do not participate in the activity being observed but,

rather, sit on the side-lines and watch without being directly involved in the situation they are observing".

3.10.1.5. Purpose of non-participant observation

Firstly, the purpose of using non-participant observation was to record what was happening and to hear the language used by both teachers and learners in mathematics classrooms without interacting directly with participants. Secondly, it was to investigate how learners responded to questions posed by the teachers while teaching and to capture the interaction between learners and teachers during mathematics lessons, so as to get some ideas about the perceptions about code switching. Non-participant observations were also used to find out if learners and teachers code switched in mathematics lessons and to record events that may be left out during interviews (Fraenkel, 2012:447).

3.10.2 Observation checklists and field notes

Observation checklists and field notes were used to record times when, and how often or frequently, code switching was used; the type of language used, the people involved in the discussion as well as recording of behaviours, actions, and beliefs observed. I developed the observation checklists to be used during classroom observations. The observation checklists are provided in Appendix D. These checklists assisted the researcher to quickly record the observed actions. Creswell (2008:325) defines an observation checklist as "a structure for observing, that allows observers to record behaviours during sessions quickly, accurately, and with minimal interviewer effect on behaviour". I recorded field notes and used observation checklists which were detailed, in capturing what happened in the mathematics classroom. Creswell (2008:330) points out that, "observations may be successful through field notes from an observer's point of view". Field notes recorded expressions of what was heard, seen and experienced during lesson observations. Bogdan and Biklen (2003:110) note that, "field-notes are the account of what the researcher hears, sees, experiences and thinks in the course of collecting and reflecting on the data in a qualitative study". Field-notes helped to fill in the missing acts during data collection, for example non-verbal actions where video-recording did not focus. Each teacher was observed twice to give a total of four observations and four video recordings. Each observation took place

in the participating teachers' classroom. Each observation lasted for 30 minutes, resulting in 60 minutes per teacher.

3.10.3 Interviews

Interviews were used as methods of collecting data from participants by recording their responses from questions asked by the researcher. There are different types of interviews such as focus group interviews, structured and unstructured interviews. Fraenkel (2012:451) articulate that, "interviewing is a way of trying to understand what people think through their speech as well as capturing of direct quotations from participants". Fox (2009:4) also describes an interview as "an important data collection technique involving verbal communication between the researcher and the participant". Semi-structured interviews were used for clarification of actions that were not clear to the researcher during observations. Only two teachers and six learners were interviewed separately after school, as previously stated. The semi-structured interviews focused on learners' reflections, views and gathering of quotations from learners and teachers about the effects of code switching in learning of word problems in mathematics, and for analysis purposes. The semi-structued interviews were video-recorded for the purpose of analysis and interpretation. As Blom (2006:319) states, "[V]ideo-recordings are methods for recording interviews, for documentation and later analysis". Consequently, interviews were used to elicit views and opinions of teachers and learners about effects of code switching on the learning of mathematics word problems.

3.10.3.1 Reasons for using interviews

Interviews were conducted to collect information in participants' own words. Interviews assisted in getting the direct words and phrases uttered by learners during the interview sessions, and these data were captured in a natural and descriptive (words) form. Interviews helped in gaining more insight from learners about what they thought and knew about the effects of code switching in learning mathematics word problems. Interviews also encouraged participants to talk openly and freely and were used as a follow up to observations in order to obtain more detail about effects of code switching in the learning of word problems in mathematics, as well as acquire information which could not be collected readily through observations. Interviews were used because they "are quick, relatively easy to set up and useful for gathering quotes and stories" (Jacobson, 2009:13).

3.10.3.2 Advantages of using interviews

In Patton and Cochran's (2002:16) words, "interviews generate much information that can be used to provide insight of participants' responses and they encourage respondents to talk freely". Interviews promoted the generation of information through interaction between researcher and participants. Data was captured in its natural form and much data was obtained within a short period of time. There was also a high response and opportunity for the examination and explanation of data through clarification of statements by probing for additional information. The interview method had potential to elicit rich and thick descriptions. Denscombe (1998:136) concurs with Patton and Cochran (2002:16) by stating that, "interviews produce data rich in depth and detail and is a flexible data collection technique". There was direct contact at the point of the interview, which meant that data could be checked for accuracy and relevance immediately from participants, resulting in high validity. A relatively high interview response was achieved because interviews were generally prearranged and scheduled for a convenient time and location. Even though interviews are expensive in terms of travel costs, the researcher conducted the interview at his work place and met participants without any costs incurred.

3.10.3.3 Disadvantages of interviews

Interviews may take a much longer time to undertake because of translating, transcribing, interpreting and analysing the data. There may be external distractions such as knocking on the door, asking sensitive questions without knowing, as well as closing the interview before the stipulated time expires. In this research, I tried to reduce distractions during interviews through the use of a quiet venue and made participants feel at home by explaining the ethical issues before the interview session commenced.

3.10.3.4 Semi-structured interviews

Semi-structured interviews refer to verbal communication which takes place between the researcher and participants, whereby participants present their ideas. Bernard (1998:9) is of the opinion that, " [A] semi-structured interview uses interview guidelines to keep some control of the interview, but also allows some flexibility in terms of the interviewee's responses" In this study semi-structured, face-to-face interviews were used. The semi-structured interviews allowed me to ask open-ended questions and to obtain clarification where necessary (Gill ham, 2000).

Semi-structured interviews were employed to gather data on the effects of code switching in the learning of word problems for learners and teachers. Basit (2010:100) propounded that, "interviews seek the participants' perceptions of the social world as it is experienced and lived by them and those around them". Semi-structured interviews are the best way of collecting data from participants by use of open-ended questions and "it assists researchers formulate questions to be asked and may pose supplementary questions as the interview session proceeds" (Basit, 2010:104). The interview questions were directed directly to participants' experiences, feelings, beliefs and perceptions in the learning of mathematics word problems.

3.10.3.5 Reasons for using semi-structured interviews

Fraenkel (2012:115) point out that, "semi-structured interviews are used by the researcher to check the accuracy or to verify the data collected during observation". Semi-structured interviews were used here to find out what was in learners' and teachers' minds about code switching in learning about mathematics word problems. According to Fraenkel (2012:120), "the researcher can clarify any questions that are obscure and also can ask the respondent to expand on answers that are particularly important or revealing". As questions are flexible and not fixed to those on the interview guide; there was room to probe or ask participants to elaborate more on the issue under discussion. Finally, the semi-structured interviews were properly planned well in advance which avoided wastage of participants' time as well as allowed collection of information from participants even if they were not able to write or read.

3.10.3.6 The role of the researcher during interviews

I took participants to my classroom, which was quiet and had privacy as well as being free from noise, for participants to articulate their ideas without fear of being heard by outsiders. Before commencement of the interview, I obtained consent from the participants to video-record the interview. I started by introducing myself to the participants and informed them about the purpose of the research, duration of the session and what would be the use of the data to be collected. Ethical issues were discussed and participants were asked to treat the interview with confidentiality. I listened and wrote notes during the interview and video-recorded the events with the assistance of the design teacher. I asked the design teacher to assist because he is an expert in terms of photographing and video-recording, which would ensure that I gathered accurate data. Interviews were conducted individually for 30 to 40 minutes per participant. The

researcher asked all participants to switch off their cell phones during the session and allowed them to drink water which was in a jar if they felt thirsty. I also asked participants if they had questions as well, and thanked them for participating and for their time and contribution to the research.

3.11. Video-recording

Video-recordings were used to record data (behaviours, beliefs) during observations and interviews. Video-recordings were stored in DVD format and on a USB for future use. Rochelle (2000:709) describes video recording as "a data collection tool that makes recording of data more viable and effective". Rajasekar (2006:5) also argues that, "video recording clearly communicates who and what we see, whom we choose to listen to and to reach our conclusions". Derry (2007:2) states that, "video recordings offer a means of close documentation and presents unprecedented analytical, collaborative and archival possibilities, that is, video-recording is an easy way of storing and retrieving data for future use". Therefore, video recordings were adopted to keep a record of what happened, of why and where ideas evolved and of the research process itself. Reflections of personal communication were safely kept for future use. Bowman (1994:2) notes that, "video recordings serve to provide context, together with the opportunity to research for meaning in the dialogue and the actions before and after any specific utterances".

3.11.1 Reasons for using video-recordings

I used video-recordings because I wanted to capture both verbal and non-verbal actions so that I could get a picture of the larger context of the interaction between teachers and learners. I was interested in video-recording events with the aim of making sense of what transpired during mathematics classroom observations and interviews without manipulating what participants said. I also used the video-recordings to provide me with non-verbal information that was useful for future data interpretation and analysis of the interactions between learners and teachers and amongst the learners themselves.

3.11.2 Advantages of using video recordings

Rajes (2011:5) observes that, "the advantages of video recordings [are] that video-recording is good at collecting nonverbal behaviours". Visual images taken are far better at capturing the context as well as the action of an event. Video-recordings are very useful when it comes to collecting accurate information on learners' participation and attitudes, since these video-recordings can capture their voices, movements and mannerisms.

Jewitt (2012:6) believes that, "video-recordings support an exploratory research design and extended data discovery, videos can be re-opened for later analysis and they capture actions not noticed at the time of being present". Jewitt (2012:7) further states that the "recorded images can also be shown to multiple viewers to interpret or analyse and are sharable among researchers and participants". Iino (1999:67) concurs with Jewitt (2012:16) by advising that researchers and participants may use video-recording for further discussions and reflections of past experiences. This allows the researcher to observe an activity afterwards by watching the video, without the disruptions of the classroom or time constraints. Video-recordings also provide a more permanent record of incidents which occurred in the classroom during observations as well as during interviews, which can be reviewed by playing them back. DuFon (2002:43) agrees with this observation, noting that video-recordings prevent information loss. Therefore, video-recordings may generate a good deal of discussion between individuals by storing and retrieval of information for further studies or uses.

In this study video recordings served as a backup to observe lessons and interviews, since not all information can be captured during lesson observations and semi-structured interviews without the help of video-recordings. DuFon (2002:44) contributes to these observations by stating that, "video recordings accurately identify who is speaking, but also provide information about posture, gestures, clothing and proxemics". Video recording allows the interviewer to concentrate on listening to what the interviewee is saying and is not distracted by trying to write anything. It allows the capturing of the complete interview. Derry (2007:8) notes that, "video recordings can provide dense, close-to-reality information about on-going human activity". Therefore, video-recording assisted the recording of what the researcher did not see or hear during classroom observations and interviews.

3.11.3 Disadvantages of video-recordings

Video recordings are limited because they can capture only what is observable. The unspoken thoughts and feelings of participants cannot be seen or heard on the videotape (Derry, 2007:9). This may be another drawback. However, the researcher was careful by noting down the occasions during which non-verbal gestures were made, and by writing some field notes as a backup.

3.12 Analysis and recording of data

Narrative data were analysed according to the techniques used to collect it (classroom observations and interviews). The first task was to code and categorize the data collected to generate themes. Secondly, the data collected from learners' and teachers' interviews through the use of interview guidelines was analysed. The third task involved the analysis of data collected during classroom observation through the use of field notes and the observation schedule.

Wahyuni (2012:77) points out that, "data analysis in qualitative research involves the drawing of inferences from raw data". Narrative data analysis was used to analyse the data collected. According to Seale (2004:303):

> Narrative data analysis involves collecting data that will inform the study, breaking down the data into various categories and making connections between these categories in terms of relationships among them, then visually displaying the interpretation and writing it up for dissemination.

Bodgan and Biklen (2003:145) agree with the above, stating that, "data analysis is working with data, organizing it, breaking it into manageable units, synthesizing it, searching for patterns, discovering what is important and what is to be learned and deciding what one will tell others". Therefore, the data collected was analysed by the researcher so that sense could be made for the presentation of findings. Below I discuss the different aspects related to how I approached the analysis of the data generated from interviews and classroom observations.

3.12.1 Coding

I organized the data into specialized groups called codes to make meaning of the data collected. Seale (2004:303) explains that, "Coding is a technique used in research that applies to those actions that involve organizing and reorganizing the data into categories that enable the researcher to identify relationships between and among categories" I, therefore, coded phrases, lines, sentences and paragraphs that had important information. Terre Blanche and Durrkein (2006:189) state that, "coding involves applying a set of rules of the data to transform information from one form to another". I kept this in mind while carrying out the process of analysing the data.

Coding of transcribed data from interviews and field notes involved organizing the notes according to related quotations, so as to write down a report in a narrative manner. Olsen (2012:39) states that, "the creation of a transcript involves writing down or typing out the text of an interview or other sound file". I, therefore, read the interviews to identify main ideas so as to categorize data, a process which is discussed next below.

3.12.2 Categorisation

Categorisation involves the organization of data in search of meaning. It helps the researcher to make comparisons as well as contrasts between patterns of data to try and make sense of the data collected. After categorisation I wrote descriptive paragraphs and looked for relationships among main ideas.

In this research, narrative analysis was used to interpret the data collected. Terre Blanche and Durrkein (2006:321) explains that, "the key to doing a good narrative analysis is to stay close to the data, to interpret it from a position of empathic understanding". Therefore, narrative data analysis was used as a process of reducing large amounts of data collected to make sense of all the data at hand. Furthermore, narrative data analysis was used to determine what learners and teachers talked about and what they did, in order to find out the effects of code switching in the learning of word problems in mathematics.

3.12.3 Analysis of field notes and observation schedule

Narrative data were transcribed from field notes and from the observation schedule (classroom observations) and categorized into different categories through the use of coding. Main points from the notes were arranged into different categories for further analysis and interpretation mannually.

3.12.4 Analysis of interviews

Regarding this, I analysed as much data collected as possible after each interview and classroom observation. Data from interview guidelines was translated from IsiXhosa to English during the transcription process. The main points were coded to check for relationships (comparison or contrasting points). Quotations and phrases as well as transcribed excerpts were analysed to make sense of the ideas found. After coding and categorizing the main ideas, the data were interpreted, and the findings will be discussed in Chapter 4.

3.12.5 Analysis of video recordings

Data from video recordings was translated from IsiXhosa to English during the transcription process. I listened to the video-recordings and made notes. I then translated and transcribed the video recorded interviews and observations, then viewed and reviewed the video to make sense of the actions observed. The video recordings were transcribed word-for-word, including pauses. I also replayed the video-recordings after interviews and class observations to listen to the voice, tone, pauses and responses as well as the entire content, in line with the advice form Burns and Grove (2003:38). The analysis of quotations, transcriptions and phrases from video-recordings, field notes and observation checklists was used to determine what type of language(s) learners and teachers used, and the reasons for using such languages in mathematics lessons.

3.13 Sampling

The target population of the study was Grade 10 learners in Township schools in the Western Cape Metropolitan area. A purposive sampling method was used in the form of convenience sampling for the selection of participants in the study.I used purposive sampling by making a precise decision about selecting the participants and site that would provide the required information (Burns & Grove, 2003:45). The reason for using convenience sampling ties in with

Wegner's (2007:214) statement that, "convenience sampling is ideal since sampling units are selected to suit the convenience of the researcher". This sampling method is less expensive and less time consuming, it saves money and effort to undertake the research within the stipulated time. In addition, I used participants that were easy to reach. In this research, teachers and learners were always available and willing to participate in the research, therefore, participants were easily accessible to me. In addition, the participants were purposefully selected because this assisted me to gather data that could answer the research questions. The trustworthiness of the sampling method will be discussed under the section on validity below. This was achieved through member checking, peer reviews and triangulation.

The population of AA secondary school comprised of one thousand two hundred and thirty five learners and forty nine teachers where the sample was selected. The participants comprised sixty learners doing Mathematics in Grade Ten and two teachers teaching mathematics in that grade. This sample was chosen in order to have a better representation of participants and for the promotion of validity of the study. One of the male teachers had seven years teaching experience (which was the least experience) while the other one had twenty years teaching experience (the most experience). The ages of learners participating ranged from fifteen to eighteen years. The study focused on teachers and learners because they are major stakeholders in the learning process. I decided to use Grade Ten learners in the research because they had spent some time at secondary school level and were starting a new path, hence were more focused in terms of career choices.

3.14 Ethical Considerations

The research adhered to the ethical guidelines of the Ethics Research Committee of Cape Peninsula University of Technology and respected the rights of participants. I obtained informed consent from research participants based on adequate information on the research. According to Robson (1995:32), "good research is possible only if there is respect and confidence between the investigator and participants". Participants were assured of anonymity and confidentiality, and they were allowed to take part freely or to withdraw from participating in the study. Basit (2010:60) notes that, "researchers also need to inform the participants that participants have the right to withdraw at any point in the research if they wish". Williams (2007:72) agrees that the

"research participants have full autonomy and confidentiality, they have the right to understand the research so that they can decide whether to participate in the research or not".

Learners were issued with consent forms to be signed by their parent/guardian and by themselves. Permission for conducting the research with learners was sought from the school principal as well as from parents of participating learners through the permission letter issued by the Western Cape Education Department (WCED). I got permission before conducting the research from the Department of Education based on the consent letter from Cape Peninsula University of Technology. All participants were promised that the findings of the research would be made available to the WCED and AA secondary school after completion of the thesis.

The research did not include sensitive questions that might have caused emotional discomfort to participants. Participants were assured privacy through the use of pseudonyms to protect their identity. Patton and Cochran (2002:5) state that, "the researcher should respect the rights of the participants, do well, and not harm the participants". Fraenkel (2012:438) also stress that, "participants should always be treated with respect and researchers should do their best to ensure that no physical or psychological harm will come to anyone who participates in the study".

3.14.1 Informed Consent form

I wrote a consent letter to guardians of participating learners in simple English (translated to IsiXhosa) so that the guardians would understand easily the purpose of the research, the potential, benefits and risk of participating in the research. Derry (2007:5) notes that:

> [I]nformed consent forms should act as a contract between a participant and a researcher that attempts to fully inform the subject about the value and purpose of the research and the use of the data, as well as protect the interest of both researcher and participant.

Therefore, participants were given consent forms to sign; minors were assisted by their guardians. The consent forms stated that participants would voluntarily participate in the research or withdraw if they so wished.

Participants were told at the beginning of the interviews and classroom observations that video-recording techniques were going to be used and were given the opportunity to view the video recordings at the end of the session for validity purposes.

3.14.2. Confidentiality

Participants' identities were protected at all times through the use of pseudonyms. Permission was sought prior to video-recording of participants by stating reasons for using video recordings. Basit (2010:60) suggests that, "in order to keep the data confidential, researchers ought to ensure that they do not name the participants' place of study and names. Data collected or analysed (must be) kept in a safe place for example in a locked safe and with protected password for data in electronic form". Silverman (2011:201) reminds researchers that "they should always remember that while they are doing their research, they are in actual fact entering the private spaces of their participants; therefore, extra care is needed when handling issues of confidentiality and anonymity". Blom (2006:315) supports this view by stating that, "recorded data should be carefully guarded and generally destroyed after transcription or once analysis is complete to protect participants' identity".

3.15 The site

The study took place at AA secondary school in Khayelitsha Township in the Western Cape Province. The observations took place in the participating teachers' classrooms while the interviews took place in a classroom that was readily available because it was a favourable environment which stimulated honesty in sharing information.

3.16 Validity

For ensuring trustworthiness of the study, appropriate methods were used that included member checking, triangulation and external audit (peer reviews). According to Terre Blanche and Durrkein (2006:147), "validity is the degree to which a measure does what it is intended to do". Therefore, different methods of ensuring validity are discussed in detail in the next section.

3.16.1 Methods for validity

3.16.1.1 Member checking

Guba and Lincoln (1994:314) considered "member checking into the findings as the most critical techniques for establishing credibility". Patton and Cochran (2002:26) echo this sentiment, stating that, "member checking is a validity strategy that involves feeding findings of the analysis back to participants and assessing how far they consider them to reflect the issues from their perspective". In this regard I used video-recordings taken during observations and interviews; transcribed the data and then presented the transcriptions to participants as a means of checking the accuracy of the observations and interviews. I asked participants to check if the quotations taken were correct to validate the authenticity of the data collected. Care was taken not to lose the data by having a backup system, for instance, having extra copies and saving on a removable disk.

After completing each classroom observation a preliminary data review with participants was conducted before the data were transferred or transcribed and interpreted for further analysis by preparing a narrative account of each classroom observation. In addition, after each lesson observation and interview with participants, I compared and contrasted their responses with what actually took place in the classroom to make the research feasible, viable and trustworthy.

Validity was ensured through direct contact at the point of the interview with participants, meaning that data was checked for accuracy and relevance as it was collected. For ensuring validity of data, the researcher observed, video-recorded and took field notes of the classroom practices in connection with language usage among learners and teachers. Playing-back the videos to participants was a means of checking for validity. Transcriptions were also checked against the voice recordings for accuracy purposes. In an informal post interview session, each participant was given the chance to discuss the findings. I went back to participants to check if the essence of the interview had been correctly captured. Careful attention was paid to all detail during data collection and analysis to ensure trustworthiness of the research process. Moreover, I asked teachers and learners to assess the findings, interpretation, discussions and conclusions to pave the way for corrections.

3.16.1.2 Triangulation

Triangulation was used to validate data through the use of various data collection techniques. Basit (2010:67) defines triangulation as, "a strategy which is used to establish concurrent validity in research by looking at the same issue from different perspectives". Denzin (2006:91) contends that, "triangulation involves using more than one method to gather data, such as interviews, observations, questionnaires and documents". In this study video-recordings were transcribed and interpreted in conjunction with the observation schedules, interview guidelines and field notes to ensure validity and reliability. Fraenkel (2012:517) state that, "When a conclusion is supported by data collected from a number of different instruments, its validity is thereby enhanced". Thus, using multiple data collection methods increased the validity of the findings, which resulted in justification and consensus of the data collected.

3.16.1.3 External audit

External audit was achieved by obtaining individuals outside of the study to review and evaluate the report. I asked several outside experts to audit and crosscheck the data collected as well as to read and critique the findings before compilation. I also used an external auditor to review the entire project as well as made use of the assistance offered by my supervisor, resulting in the validity of the study. Experts such as editors and other academics assessed the quality of the research.

3.16.1.4 Peer review.

As part of quality assurance I asked colleagues to review the findings, interpretations, discussions and conclusions. In addition, I discussed with peers with knowledge about research and provided suggestions about and insights into the findings.

3.17 Conclusion

In this chapter I discussed and described the research design, data collection techniques and ethical considerations. Classroom observations and interviews were the data collection techniques used in the study. The aim of the research was to find out the effects of code switching in the learning of word problems in Mathematics from participants.

The next chapter, Chapter 4, will deal with the analysis and interpretation of data. The chapter presents an interpretation and in-depth analysis of the data. It describes how data was translated, transcribed, coded, and categorized in the process of looking for meaning (making comparisons and identifying contrasts). In addition, Chapter 4 will attempt to make meaning of the data collected.

CHAPTER 4

DATA COLLECTION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

In the previous chapter I discussed the research paradigm, research design and data collection methods. In addition, I discussed the ethical and validity issues linked to the data collection and analysis processes as these relate to answering the research questions.

The present chapter deals with data collection and analysis procedures and presents a discussion of the findings, in order to answer the research question: How does code switching affect the learning of word problems in mathematics in Grade 10? The main purpose of the research was to investigate the effects of code switching in the learning of mathematics word problems in Grade 10. The data collected from classroom observations, interviews and video recordings are presented and discussed in detail.

The data to be analysed was collected through classroom observations and semi-structured interviews through the use of video-recordings. More information about data collection was provided in Chapter 3. Pseudonyms were used for teachers and learners. Teachers were given code names, TA and TB while participating learners are referred to as L1, L2, L3, L4, L5 and L6. Pseudonyms are used to protect participants' identities and are in line with the confidentiality requirements of CPUT Research Ethics.

The data analysis process started with transcribing data from observations, interviews and video recordings. After transcribing the conversations I returned to the video recordings to compare the transcripts with what actually transpired during classroom observations and interviews. This involved replaying the video-recordings many times so as to capture as much data as possible. The process of transcribing data was strenuous because it was time-consuming to work through all the narrative data. Although the teachers and learners used IsiXhosa there was a great deal of English used during interviews as compared to classroom observations.

4.2 Data analysis procedure

Semi-structured interviews and classroom observation field-notes were transcribed, analysed and coded using Tesch's (1990) procedure of analysing data. The data collected was categorized according to the participants' responses during the interviews and class observations. These responses were read and reread to make meaning about the effects of code switching on the learning of word problems in mathematics. The following procedures were followed:

- Data was collected and organized for analysis purposes through transcription of interviews and description of classroom observations;
- All the transcribed data was read and reread to make meaning of the data. Rereading the data was done to make sure that the important information was captured for further analysis; and
- The transcribed data was coded into different categories to identify relationships and differences in the data collected for interpretation purposes. Data was analysed in different phases: first phase was the analysis of learners' and teachers' interview responses and the next phase involved the analysis of classroom observations. Interviews and classroom observations were interpreted in a narrative manner.

4.2.1 Narrative analysis

I used narrative data analysis to describe and analyse data collected about the effects of code switching on the learning of mathematical word problems. Riesman (2008:218) notes that, "narrative analysis focuses on how respondents impose order on the flow of experience in their lives and thus make sense of events and actions in which they have participated". Thus, I used the teachers' and learners' responses to analyse the data as they were describing their experiences about the learning of mathematical word problems in their classrooms. In addition, the narrative data analysis was chosen because the researcher observed the way in which teachers and learners learnt mathematical word problems in their natural settings.

Data were placed into different categories as explained in Chapter 3. Different categories were found and merged into different themes, namely:

- Translation
- Clarity
- Explanation and understanding
- Classroom management
- LoLT deficiency
- Role modelling

4.3 Findings from learner interviews

4.3.1 Learners' responses

Question 1

In which language is your mathematics classes supposed to be taught?

All learners said that their mathematics lessons were supposed to be conducted in English. Therefore, all learners knew their medium of instruction in the learning of mathematics which is English. They were aware that all communication should be done in English as was evidenced by this response from one of the learners:

L1: *It is English because mathematics is written in English, so we should use English and our principal told us that we should use English when learning mathematics.*

Question 2: What languages do you usually use during mathematics lessons?

Understanding and explanation of difficult mathematics concepts

L1: *Sisebenzisa English and IsiXhosa because asiwa understand amanye amagama.* (We use English and IsiXhosa because we do not understand some of the words).

L2: *AmaXesha amanintsi we use English but if we do not understand utitshala ucacisa ngesiXhosa for ukuba si understand*. (Mostly we use English, but if we do not understand, our teacher explains to us in IsiXhosa for us to understand better).

L3: *English and IsiXhosa but difficult words are translated by our teacher to IsiXhosa, we even ask the teacher to explain in IsiXhosa so that we can understand the words. English words are a problem to us.*
L6: *We use English because our teacher talks in English every time and explains and simplify in English when we have problems with big words*.

The extracts above show that teachers and learners used code switching for explanation and understanding of difficult concepts. Learners reported that they asked their teacher to explain the concepts in isiXhosa if it was difficult to understand in English. This finding concurs with findings made by Van der Walt and Mabule (2001:299) in observing that code switching is used by teachers to explain the meaning of difficult concepts to improve learner understanding of the matter under discussion. However, L6 disagreed with this and said that their teacher used English and they were able to understand mathematical concepts expressed in English, which was in contrast with the responses of the other learners. Maybe the disagreement reflects the fact that the teacher's mother language was different from the learners' mother language; hence, the teacher used English as the common language for communication. The majority of learners appeared to be benefiting from the use of code switching through teacher explanation of difficult concepts, as stated by one of the learners, *"Amagama esilungu anzima utitshala ayawacacisa ngesiXhosa"* (Difficult words are explained in IsiXhosa by the teacher for understanding).

Furthermore, from the findings, it could be seen that teachers and learners used code switching for explanation and understanding of difficult mathematics concepts. Therefore, code switching was used as a learning and teaching resource to aid the learning process. The responses are in line with Rose and Dulm's (2006:2) findings that the lack of learning and teaching materials in mathematics may promote the use of code switching by teachers as they try to explain to learners so that learners may understand difficult mathematical concepts. Hence, teachers used code switching as a strategy for assisting learners to understand difficult mathematical concepts.

Question 3: Do you use both IsiXhosa and English in the learning of mathematics? Provide reasons for your response

Translation

L1: *Our teacher always uses both IsiXhosa and English when teaching us.*

On the contrary, L5 said that their teacher used a lot of IsiXhosa because maybe he could not speak English. Only four of the learners said that they used both English and IsiXhosa when learning mathematics. They said that the teacher used the two languages so that they could understand the concepts being taught. However, the other two learners said that their teacher used English only with a little IsiXhosa because he was not able to speak IsiXhosa. The findings are elaborated upon by the extracts below:

L3: *We use English and IsiXhosa. Difficult English words are translated to IsiXhosa by our teacher, we ask the teacher to explain so that we can understand the words. Words are a problem to us most times.*

These findings are consistent with those made by Ajmal (2010:32) who reports that teachers use code switching to translate or explain difficult concepts to learners so that they could understand better. In contrast to this finding, learners taught by TB disagreed and said that their teacher used English and they were able to understand English. Maybe the reason for this contrast is that teacher TB's mother language is different from that of the learners, therefore the teacher uses English. Maybe he could have used the learners' mother language if it was common between the two parties. This observation is supported by Noren (2007:29) who maintains that if teachers had similar language and cultural backgrounds as their learners, they could use code switching as a learning and teaching resource in the teaching and learning of mathematics.

Furthermore, L1 said that: *It is better for the teacher to use IsiXhosa and English so that we can understand better. Our teacher teaches first in English and explains in IsiXhosa if we are stuck so that we can get the words that we do not understand in English*.

The extract shows that teachers use English and then IsiXhosa to transfer the meaning of a word problem. Code switching is used to assist learners in understanding or explaining of difficult statements. Translation may enhance understanding because the concepts would be explained in learners' mother language. Similar findings were recorded by Alenezi (2010:12) who reports that, "It is better to use mainly English because this makes us understand future references about

the subjects, however, difficult concepts should be explained in Arabic first then transcribed to English".

L5: *We mix because our teacher also mixes so we copy him*. Sixuba isilungu nesixhosa kuba notitshala uyezixuba nathi ke sibona kuye). (Our teacher cannot speak English properly so we imitate him and use IsiXhosa during mathematics lessons and some learners are shy to speak English in front of the class).

The results show that some learners were shy to speak English because they could not express themselves clearly or adequately and were afraid of being laughed at by others so they resorted to remaining quiet. The findings are in agreement with Moghadam et al. (2012:2223) who found that code switching is used when there is a lack of the language of learning and teaching (English). Moreover, it seems if the teacher uses IsiXhosa and learners do not see the significance of using English, learners end up imitating their teacher since he is their role model. It is clear that learners imitate their teachers as these teachers act as their role models in the learning and teaching process. Therefore, learners take it for granted that it is allowed for them to use both languages since their teacher is also doing so. Perhaps the teacher used code switching so as to try to impart the message properly to learners as propounded by Pollard (2002:12) in saying that teachers and learners may use code switching to reduce hesitation and to promote effective transfer of knowledge. Hence, teachers act as role models to their learners in the learning and teaching of mathematics word problems, as learners imitate their teachers.

Question 4: What do you think are the effects of mixing the two languages in learning mathematics in the classroom?

Clarity

Code switching may assist learners to have clarity in terms of difficult concepts. It makes their work easier and clearer to manoeuvre. From the findings it shows that learners will get the concepts clearly when their teachers use code switching. The findings are supported by Modupeola (2013) who found that code switching is used to assist learners to communicate and understand concepts. Some of the learners' comments regarding mixing IsiXhosa and English are as follows:

L1: Siyakwazi ukuthetha nabanye abafundi eklasini kweye sifunda ngcono. (We are able to communicate with other learners in class and learn better).
L2: Xa igama lesilungu licaciswe ngeSixhosa libalula naxa udibana nalo kuvavanyo. (If the word is in English and was explained in IsiXhosa then it is easy to answer the exams because these are the same words repeated in examinations.)
L3: Singancedisana kuba siyakwazi ukuthetha ngokululekileyo sabelane ngezimvo zethu. (We can assist each other because we can talk freely and share ideas).
L5: *It is good to use code switching for understanding, but we face difficulties when it comes to examinations because we do not know the meaning of other concepts and the teacher will not be around to explain to us in IsiXhosa.*

These responses show that learners will have difficulties when doing formal assessment tasks because the tasks demand some knowledge of the LoLT (English), which may limit their ability to comprehend mathematical word problems. Similar findings were recorded by Barton and Barton (2005:22) who found that, difficulties in language (English) may limit the ability of learners to solve mathematical word problems because the information is expressed in English. Code switching gives an opportunity to talk and share ideas because if it is English only, learners will not be able to communicate because of incompetence in English. Therefore, code switching may create problems to learners as they encounter formal assessments in English where no one will translate English concepts to IsiXhosa to them.

With regard to the above, L6 said that: *Code switching does not improve my English because I will not be able to pass my examinations because the question papers are written in English and I will not be able to communicate with people from other countries*.

This extract indicates that the use of English will allow learners to communicate with people from other places and assist them to answer assessment tasks expressed in English. The findings are in agreement with Mouhanna's (2010) observation that, "English is used as an international language, especially in areas of Science and Business".

Question 5: Did you have any problems in answering questions during mathematics lessons?

LoLT deficiency

L1: *Yes, it is because in word problems there are a lot of words, therefore, one has to listen carefully and understand the question and the words used. If you do not understand the words you will fail because you do not know what to do. So, we are encountering a lot of problems due to language barrier. In word problems there are a lot of difficult words that need some explanations so that we can do the mathematical computations.*

L2: *I had problems when answering questions alone, especially with English words English andiwathandi amagama esilungu ngoba ayandisokolisa.* (I do not like English words because it gives me problems).

L3: *I did not have problems, because mixing English and IsiXhosa makes questions easier to answer, but only difficult when the teacher did not explain to me in IsiXhosa.*

L5: *I did not have any problems in answering questions, but I had few problems with big words but the teacher had explained earlier now I know what they mean.*

L6: *I did not have any problems in answering questions because I am good in English. I always speak in English and our teacher teaches in English only. I like English because I would like to use it when I am working with other people from abroad. I understand mathematics when taught in English because the words I learn are ones that are used in the examinations. English increases my pass mark so that I will get a better job after matric*.

The findings show that some learners had problems when given tasks to do alone because there was no one to assist them in translating mathematical word problems. This is in line with the results from Sajadi's et al. (2013:2) findings that, "learners encounter mathematical word problems due to the lack of translating word representations to mathematical representations". The other problem is that some learners lacked experience with word problems, they were not ready to deal with many and new mathematical English words. Furthermore, the findings are supported by Sajadi et al. (2013:4) who notes that learners do not have enough experience of

dealing with mathematical problems which is compounded by lack of motivation to solve word problems.

Therefore, learners are incompetent in English language; they cannot comprehend the mathematical words. It is clear that most learners encountered problems with new words and relied heavily on teacher support through code switching. The findings concurred with those of Morton and Qu (2013:88) that, "learners are mostly challenged by mathematical word problem solving not because of their mathematical skills but because of text comprehension". The findings showed that most learners are having problems with word problems due mainly to their limited mathematical vocabulary. Irujo (2007:317) also shares similar views that the language used in word problems is difficult because of specialized mathematics vocabulary that learners will not be able to understand, resulting in them guessing the solutions.

On the contrary, the other learner did not have problems with mathematical word problems because he said that he was good in English and was taught entirely in English, which may have given him the advantage of finding solutions. This may be in line with Gooding (2009:32) who found that, "reading and understanding the language used with word problems may assist learners to understand the mathematical word problems and encourage learners to read the word problem thoroughly with understanding".

Question 6: If your answer to question 5 is "yes" state the problems and give some solutions to these problems.

Role modeling

L4: *Our teacher should speak more English than IsiXhosa because he is killing us. Utitshala akayazi iEnglish.* (The teacher does not know English).

L5: *Problems with amagama amakhulu, utitshala amafundise ngeEnglish because ayasibhida amagama.* (The teacher should use English because we have problems with words).

I think we should use one language (English) and practice to be confident

L6: *I did not have problems in mathematics because I can speak English better than other learners. Our teacher is my celebrity because he encourages us to use English and he always teaches in English. We should try to speak English most of the times because it is a universal language and our mathematics is written in English.*

These responses show that learners had mathematical vocabulary deficiency, may be they enjoyed limited exposure to English since their teacher used IsiXhosa most of the time. Learners suggested that the teacher should only use English as the medium of instruction so that they could improve their English, since examinations and tasks are all written in English. Teachers should be role models in speaking English during mathematical lessons because learners may catch onto what they do. Barwell (2011:1) shares similar views, namely that:

> [F]or learners to be successful in solving word problems, [they] need to learn how to read mathematics word problems by learning to read between the lines and understand what they are expected to do mathematically and to be given opportunities to practice mathematizing word problems.

In other words, learners should be provided with opportunities to deal with mathematical word problems through the use of the LoLT (English) so that they could understand and manipulate any mathematical word problems they encounter. Irujo (2007:310) concurs by stating that:

> [I]n order for learners to manipulate mathematical word problems, they need to understand the language in the problem, interpret the language so that they can identify the mathematical relations and understand what the problem is asking and convert the language and the mathematical relations of abstract symbols.

Therefore, the findings revealed the reluctance of the teacher to use English in the teaching of mathematics, which could be an avoidance technique. Furthermore, the findings are in line with Vorster's (2008:35) results which showed that, "some teachers avoid topics such as word problems because they circumvent language by using a minimum of words and concentrate on

symbolic language and also they are uncomfortable with the LoLT". Learners were suggesting that their teacher should teach them how to answer questions properly in English through practice, as stated by Setati (2005:458) who notes that, "giving learners an opportunity to read the word problems before they solve it is important, because solving a problem is not only about mathematics but also about reading and fluency in the language of the task (English)".

Moreover, Setati and Adler (2001:248) remind us that, "the teacher understands her role as including the modelling of mathematical talk for learners who are struggling simultaneously with concepts and their appropriate naming in English, and with the language of learning and teaching". By listening to teachers' talk the learner adopts the appropriate way of communication in mathematics using the proper mathematical language. The teacher will give direction in the learning of mathematics for learners to acquire the needed concepts. In such a case the teacher is acting as a role model. This can be understood from the responses by L6 where their teacher was modelling mathematical language by using the mathematical terms during the mathematics lessons as well as encouraging learners to use and practice all the time.

Question 7 : If your answer to question 5 is 'yes', say what you think the causes are of you not being able to answer the questions asked by the teachers?

The responses to this question were as follows:

Lack of mathematical vocabulary

L1: *The problem is limited vocabulary for mathematical terms in mother languages, failure to communicate in English by learners and teachers.*
L2: *If you are alone, there will be no one to assist you because everything is written in English and we are used to code switching.*
L3: *The language used is difficult because of many words. We are having problems when it comes to word problems because of English. Questions are written in English that is where we get confused because we always use more IsiXhosa. We use IsiXhosa when we fail to speak in English.*

L4: *The teacher does not encourage us to speak IsiXhosa which make us encounter problems when it comes to word problems because of English.*

L5: *I had problems because of English words. I was confused and wanted the teacher to simplify the language to me.*

L6. *I feel free to express myself in English because we use English every day in mathematics class.*

The findings above show that the teacher allowed learners to use more IsiXhosa compared to English, which may have led to confusion when leaners encountered mathematical English words. Therefore, the teacher should not allow learners to speak IsiXhosa during mathematics periods. He should instead promote a culture of using English in mathematics lessons because learners are supposed to learn mathematics in English and their examinations are in English. According to Black and Williams (2001), there is a close relationship between how you teach and how you assess. If the assessment is through the medium of English, then teaching should be through the medium of English. The teacher needs to motivate and encourage learners to speak English so as to assist them in understanding questions when they are alone, for instance during examinations. However, learners and teachers still use the mother language when they are not able to express themselves fluently in English. In addition, learners complained that their teacher teaches in IsiXhosa and this may be ascribed to incompetence in English, a view which agrees with Müller and Neils' (2010:7) findings that, "if the knowledge, communication channel is obscured and hindered by limited English proficiency both on the side of the learner and of the teacher, then knowledge transfer cannot be effective".

4.4 Findings from teachers' interviews

4.4.1 Teachers' responses

Question 1: Is your mother language and your learners' the same?

TA: *Yes*

TB: *No*

TA's mother language is IsiXhosa whereas TB's mother language is not IsiXhosa because he is a foreign national. The researcher wanted to find out if the use of code switching is encouraged by sharing of the same mother language between the teacher and learners.

Question 2: Based on your answer in question 1, is this an advantage or a disadvantage in teaching mathematics using English? Why?

Translation

TA: *It is a disadvantage because their mother language is not English, so it may cause misunderstanding of the content taught. It may take more time for learners to respond to questions. I struggle to teach learners in English; therefore, I resort to code switching so that learners may participate actively.*

TB: *It is an advantage because learners will be geared up to learn mathematics in English (LoLT). I explain concepts in the English language only. I cannot explain in their mother language, therefore we resort to common language (LoLT) and I use only English as it is the LoLT.*

The findings based on the perception of teacher TA show that the use of English may be a disadvantage to learners, because English is not the learners' mother language. It is clear that learners may experience problems with English, especially in the teaching of mathematical word problems. Thus, the use of English will force the teacher to translate English to isiXhosa resulting in waste of teaching time. On the contrary, the other teacher sees the use of English as the LoLT as an advantage to both learners and teachers as they use the language that is expected by the DoE. The teacher (TB) said that he forces himself to look for simple mathematics words to explain to learners (informal language) so that they can understand what he will be teaching. He claimed that he used a lot of concrete examples which has resulted in an improvement in learner interaction. He further reported that he always started from learners' previous knowledge and built the lessons from there up to the abstract level. The use of English mathematics terms was an advantage because learners' LoLT was English, so it was in line with the School Language Policy.

Question 3: Mention mother languages of all learners' in your mathematics class

TA: *IsiXhosa*

TB: *IsiXhosa*

Mother languages of learners

The results show that all learners in the sample were IsiXhosa speakers, which indicates that the teacher could interact with these learners in both English and IsiXhosa languages if the teacher could speak IsiXhosa. The findings also show that no other languages could be used by the teachers since that would exclude learners from understanding these teachers when they used IsiXhosa or English in the learning of mathematics. In any case TB used English only because he could not speak or use IsiXhosa as he is a foreign national.

Question 4: What is the language of learning and teaching (LoLT) of your school and do you use it?

Language of learning and teaching

TA: *English, but I use it together with IsiXhosa. I think English is difficult for learners to use as it is a second language.*

TB: *English, School Language Policy is English. I use English during mathematics lessons*.

The two teachers used different languages when teaching mathematics. TA used both English and IsiXhosa languages, whereas TB used English only and was sticking to the requirements of the DoE (using English as LoLT).

Question 5: Can your learners interact in English beyond the classroom?

Use of LoLT beyond classrooms

TA: *They cannot because they are not ready; they still have many difficulties in answering word problems. Learners use mainly IsiXhosa out of the classroom and even in groups. I encourage them to use both languages.*

TB: *They are struggling and they use IsiXhosa. Sometimes they mix isiXhosa and English*.

These findings show, according to participating teachers, that learners are not able to use English beyond the classroom, maybe this is because they socialize with other IsiXhosa learners only since there are no English native speakers that can socialize with them and assist these learners in acquiring English proficiency. This observation is in line with Cummins' (1986) claim that learners can learn a language through socialization with native speakers. Moreover, teachers admitted that learners used IsiXhosa and English during group work, which concurs with the findings from classroom observations that learners used both IsiXhosa and English when working in groups. The results are supported by Latu's (2005:485) findings that learners interacted in their mother language and also in English during mathematics discussions and personal conversations. In addition, teachers said that learners communicated in IsiXhosa during break, lunchtime and in the school grounds. This comes out in the response by TB that: "*I always hear them (learners) when they play on the school grounds during sports and when they communicate with me during lunch or break times and even when they were sent by other teachers with message*". Therefore, it seems as though learners used IsiXhosa most of the time, which may result in them being incompetent in English.

Question 6: In your judgment are your learners ready to learn mathematics in English? Please explain.

Language deficiency by learners

TA: *They are not ready because mathematics is difficult because of the English language used.*

TB: *Learners are not quite ready, but are trying as there is a general trend of cooperating and participation in English as I am sticking to the use of the English language in order to expose learners.*

From the responses above it is clear that the respondents are in agreement as it relates to learners' English proficiency. The findings are in line with Youkhana (2010:45) who notes that learners code switched between English and their mother language when they lacked proficiency in the LoLT. Learners are said to be uncomfortable when the teacher uses the English language during the learning of mathematics. The findings showed that learners were reluctant to talk, contribute and were shy when the teacher used LoLT only. Lack of English proficiency may be

the reason why learners did not want to participate. This view is supported by TA when he said that, "*Learners participate when I use both IsiXhosa and English*". Thus, the results indicate that learners are experiencing problems with using the LoLT in the learning of mathematics because of their lack of English proficiency. However, TB said that his learners were able to use English as he helped them to use this language in a comfortable manner which allowed them to be confident, although they had some problems with the exclusive use of English.

Question 7: Name some of the different strategies you use to facilitate your learner's understanding of mathematical word problems taught using English.

Avoidance strategy

TA: *I mostly use code switching because IsiXhosa makes it easy for learners to understand, if I did not use both, then I will 'talk alone' in the classroom or learners will abscond the lesson*.

TB: *Intervention is through the reading period approach to make learners have more practice in English. We promote reading of task in mathematics, use of images, charts, telematics and conducting extra classes in mathematics*.

From the responses it is clear that TA uses code switching as a strategy for facilitating learning of word problems, whereas TB is concerned with developing and improving the LoLT (English) of learners. TB has made it clear that more practice in English is needed as the mathematical concepts are delivered in English. The school has devised ways of assisting learners in improving the English proficiency, which is in line with the school and Department of Education language policies. Thus, it is also clear that only one teacher used code switching as an avoidance strategy for not using the English language in the teaching of mathematics, as is clear when TA said that if he did not use code switching learners would not attend his lesson or even understand the content being taught.

4.5 Findings from classroom observations

The teaching methods used by mathematics teachers observed were found to be more teacher-centred in the case of TA and more learner-centred in TB's lessons. TA asked questions in English, IsiXhosa or code switched and learners answered accordingly. It was evident that TA used code switching in the teaching of word problems which may have assisted learners' understanding of a new mathematical language that enabled them to participate and contribute more freely in mathematics lessons. TA's learners were asked to work quietly and individually, there was no group work and little mathematical language was used. The teacher and learners used code switching as their common practice during the learning of mathematics. Learners used mostly IsiXhosa during mathematics conversations and were reluctant to use the English language. The teacher used IsiXhosa when he wanted to clarify mathematical concepts.

TA was talking to learners when introducing the lesson and asking questions as well as explaining concepts and providing feedback in both English and IsiXhosa. Both TA and his learners used both IsiXhosa and English, but mostly IsiXhosa, while TB and his learners used English only in the teaching and learning process. Through the classroom observations I was able to ascertain if code-switching was used in mathematics classrooms, the people who used code switching and the reasons for using code switching. Classroom observations allowed me to observe how teachers and learners interacted with each other during mathematics lessons in terms of interaction.

4.6.1 Activities and interaction in TA's classroom

In TA's classroom the desks were facing the white board, learners worked individually with no opportunities to work in groups, making it difficult for learners to interact. Learners had to answer questions when asked by the teacher. There was a great deal of teacher-talk (traditional teaching method) resulting in teacher centred pedagogy, which limited learner participation. The seating arrangement did not allow interaction between learners. Tasks were given to learners to work individually, which restricted learners from sharing ideas, interacting, engaging in creative thinking, and gaining confidence through the help of others. The findings are in line with

Mabrouk (2007:34) who observed that when learners are not working in groups they are deprived of mathematical argumentation as well as of freedom of expression.

Observation schedules were used to check if code switching was taking place in the learning of mathematical word problems in mathematics lessons. It was observed that both teachers and learners used code switching in TA's lessons. TA used code switching when learners did not respond to questions posed. The teacher translated English to IsiXhosa to try and explain the mathematics concepts in the questions. Learners were imitating the teacher as role model when he changed from one language to another. The observations have shown that the teacher is a role model for learners (learners code switched the same way their teacher did).

In some cases, learners would be quiet showing a fearful facial expression. They were reluctant to answer questions in English when the teacher insisted on the use of English. Learners were shy, in fear of being laughed at by their classmates. When the learners were not able to talk, TA explained in IsiXhosa and allowed learners to use IsiXhosa. That is when I observed many learners raising their hands and explaining as well as going to the board to write the solutions. Their facial expressions were relaxed and less tense. The findings concur with the interview data where a learner said that, "*Abanye bane ntloni zokuphendula imbuzo ngesilungu*" (Some learners are shy to answer questions in English). The findings are similar to those made by Youkhana (2010:37) which indicated that, "learners code switch when they are not competent in the language of learning and teaching to clarify their points to their classmates". Moreover, Kagwesage (2013) support the view that learners will not talk as they would be afraid of making mistakes because of the lack of English ability.

Learners were shy to answer questions in front of the whole class because they were incompetent in the use of LoLT, the teacher had to persuade learners to contribute by using motivating comments such as "good", "best attempt", "you can try" if learners responded. These views concur with the findings by Warren et al. (2007:780) that the teacher used positive reinforcement such as "good try" even if the answers were wrong to try to lure learners into the discussions so that they could contribute their knowledge freely. Warren et al. (2007:781) further observe that,

"many indigenous Australian learners did not like to be asked questions in front of the whole class and did not want their incorrect answers to be pursued". This is in agreement with the findings in this study which indicate that most learners did not want to talk because they were afraid of being laughed at by their classmates due to an English language deficiency which resulted in them being unable to express themselves in English. However, code switching may also be used for assisting learners in the learning process. These findings are in agreement with those made by Alenezi (2010) which showed that code switching is an important teaching and learning resource which promotes learner participation in the classroom. Web and Web (2008) echo the sentiments that code switching is a vital resource as it assists learners to understand concepts. From the discussion, it could be noted that when code switching is used, it may make learners contribute or participate more and share ideas without communication hindrances.

TA used code switching for classroom management purposes, such as to instruct the class to reduce noise and to make learners remain focused on what they were doing. The teacher used code switching to give clarity to learners about the procedure to answer word problems. Code switching was also utilized for classroom management as stated above, in attempting to regulate learners' behaviour so that they could pay attention. On one occasion TA instructed that, *"Thula wena ubale umsebenzi"* (You should keep quiet and write your work). He went on to say, *"Thula please"* (Please keep quiet). TA used code switching to ask for attention from learners when they made a noise and to make learners listen to what he was teaching. This was in line with Bose's and Choudhury (2010) observation that teachers use code switching to enforce authority and discipline in the classroom.

It is clear from the classroom observations that IsiXhosa is used to accommodate all learners in the classroom and to allow learners to express themselves precisely. The findings illustrated that code switching was used by the teacher to allow learners to understand clearly when they were not able to speak in English only. The teacher allowed code switching to encourage and motivate learners who were not able to express themselves in English only. Thus, building good interpersonal relationships with learners to create a conducive learning environment could increase participation and understanding of mathematics concepts.

4.6.2 Activities and interacting in TB's classroom

In TB's classroom the desks were arranged in groups for learners to be able to interact with each other. The teaching style was learner centred. The teacher acted as a facilitator and allowed high learner participation. Learners in TB's class were able to respond and present answers in English most of the time, except a few who had problems in expressing themselves; but, were given the opportunity to explain their solutions to the class by the teacher. The teacher used simple English so that his learners could understand. When teachers continually used English, learners followed suit and this coincides with the findings by De Wet (2009:122) that if mathematics teachers use simple and clear mathematical language learners may understand the concepts under discussion. TB's learners used English mostly because there was no other common language that he could use. Therefore, learners conformed to the use of English and copied what their teacher did as they did not have any option other than to use English. In addition, the findings have shown that learners are good at copying their teachers' actions, whether negative or positive. TB argued that mathematical word problems dealt with many mathematical words and learners should be conversant with the mathematical language. Therefore, there is a need for the teacher to teach in English without mixing it with IsiXhosa so that learners can learn and be able to apply the mathematics concepts in the near future. TB said that, "*I am trying to train my learners to deal with mathematical words because no one will assist them in examinations, therefore, they should learn how to find the meanings of new words through more practice in English language".*

In contrast, TA said that, "*Mathematical word problems are difficult for learners because there are some mathematical words that cannot be translated to IsiXhosa, making it difficult for me to explain mathematical words to learners in a better way"*. It is clear that teachers may leave or skip mathematical word problems because of the difficulty and their incompetence. The findings are supported by Voster (2008:35) who argues that most teachers ignore mathematical word problems because of the required specialized mathematical language and they end up doing questions with symbols only or skipping the topic. Moreover, Sajadi et al. (2013) agrees that mathematical word problems are not clearly taught by teachers because of language problems.

Evidence from the classroom observations showed that TB used English because he wanted learners to pass the examinations, so he used English mainly during mathematics lessons. The findings are in line with Setati and Adler's (2001) observation that a mathematics teacher limited the use of code switching to avoid too much use of learners' mother language as compared to English, which is the language used for examinations.

Sections 4.6.1 and 4.6.1 have revealed that code switching is allowed for communication and solidarity purposes, but contradicts with the requirements of examinations that are written in English only. Despite the call to use English in mathematics classrooms, learners were allowed to use IsiXhosa at certain times. The reason for this was that all learners understood and spoke IsiXhosa and were provided with a chance to participate by using the language they understood better, at least in the case of one of the two teachers observed.

4.7 Learner Interaction

There was little learner interaction in TA's class. This situation may have discouraged learners from sharing ideas and limited their creativity and response to questions. Learners were not able to answer questions because they were lost, their facial expression showed discouragement and fear as well as some confusion. The classroom atmosphere was tense, even though there was use of code switching. This was in contrast with TB's class. There was active participation, even though there was limited code switching. Learners in TB's class were able to interact. The facial expression of TB's learners was bright and relaxed. They were able to interact and contribute if picked on by the teacher to provide solutions. The classroom atmosphere was quite conducive to learning.

From the findings it could be seen that promotion of learner interaction may result in productive learning. In contrast, the use of code switching without learner-learner interaction may result in poor learning. The findings are in agreement with Mouhanna's (2010:14) observation that learner interaction in their mother language promotes more conversations, if given chances to discuss in groups without the teachers' intervention or disturbances. Learners would be able to

share ideas and discuss without fear because they would be in their comfort zone. However, Clegg and Afitska (2010) support the idea that using English in the learning of mathematics is beneficial to learners because English is used during the assessment process, as opposed to code switching. O'Keeffe and Ni' Riordain (2012:2) echo these sentiments, arguing that using proper language (LoLT) and continual exposure of learners to mathematical word problems will encourage learners to apply mathematical language, knowledge and skills to reason, decide and solve mathematical problems effectively. Modoodley and Kamwangamalu (2004:192) likewise agreed with the findings that too much use of the mother language or code switching could make learners forget the mathematical language, and may end up making it difficult for learners to understand mathematics expressed in LoLT during examinations. Even though one of the teachers insisted on the use of LoLT, during group work or pair work I observed that most learners were using their mother language to discuss questions and solutions. In the case of teacher TB learners were free to express themselves in IsiXhosa as compared to English.

4.8 Example of questions discussed during classroom observations

Question:

The length of a rectangle is twice the breadth. If the area is 128cm^2, determine the length and the breadth.

Extracts from observations for the above question discussed by two teachers TA and TB with learners in their different classes are as follows:

Classroom observation for TA

TA: *Who can answer the question?*

C: (quiet-no response from anyone).

TA: *What is the answer? Any volunteer?.*

C: (Silence)

TA: (Translates)-*Area – umbindi or ubungakanani.*

Breadth-ububanzi- umlinganiselo osuka kwelinye icala uye kwelinye.

Length-ubude- inobude obungakanani into ukusuka ekugaleni ukuya ekupheleni. Sebenzisa ifomula yomlinganiselo.

L: (Answers)

The findings show that TA translated English words to IsiXhosa so that learners could understand the concepts because they were quiet and unresponsive. In this situation code switching was used as a learning aid to put the meaning of concepts or instructions across. The findings agree with those by Yahaya et al. (2009:142) that when code switching is used, it assists learners to participate in the learning process. From the findings it could be seen that learners had difficulties in responding to the questions because of the mathematical language in the question. This observation is purported by Aziz, Mohamad Nor and Jusoff (2011:37) who notes that learners with a mother language which is different from English have difficulties in learning mathematics in English since the language of mathematics is complex and different from everyday language. Even when the teacher translated the question, learners experienced problems in linking the ideas to make sense of the information. This shows that the learners had problems in understanding mathematics terms.

When the learners were not doing the activity TA reprimanded them as shown by the extract:

TA: *Wenza ntoni ngoku* (what are you doing now)

C : **(**Kept quiet and started working)

The teacher was instilling discipline, checking for progress whether learners were doing the activity. Code switching was used to reprimand and enforce discipline in the classroom. This was seen through the silence of the learners. The learners did not talk; they started doing what the teacher had instructed them. This act of discipline stifles learners' urge to talk about the problem and to enter into discussion with other learners, as learners were not given a chance to work in groups.

Generally, the teacher did most of the talking in the class; this could be seen through the conversations. This may be blamed on code switching as learners were not given the chance to express themselves or even to try and use English to their level of ability. No practice or

encouragement was given from the side of the teacher. However, if learners could be given the opportunity to use the English language they could do better, rather than concluding that they do not know before giving or providing a platform for them to explore or practice (Clegg & Afitska, 2010:24).

In contrast, TB did not use translation but used English throughout his lesson. He admitted that he could have used code switching when his learners were stuck, but with the language barrier he could not, so he resorted to simplifying the concepts to the learners' level of understanding as revealed in the discussion below.

Classroom observations for TB

TB introduced the lesson by asking questions such as, Define the following: variable, word problem, unknown.

TB: *What is a variable?*

L: *Something that changes, a letter Sir.*

TB: *Yes. Can someone tell us where we use variables?*

C: *In equations* – (chorused answer)

The extract shows that the teacher took learners step-by-step through the main concepts in their LoLT. He introduced the lesson by recapturing the learners' previous knowledge about mathematical word problems, as depicted by the above extracts.

TB explained and discussed with the learners the important mathematics concepts and procedures for solving or manipulating mathematical word problems. Learners were also given a chance to check their answers by finding meanings from their text books and dictionaries before whole class discussion. The teacher's and learners' communication was in English throughout the mathematics lessons. The following examples clarify this.

TB: *Let us answer the question that follows together*.

Question:

The length of a rectangle is twice the breadth. If the area is 128cm^2, determine the length and the breadth.

TB: *I would like you to show me the length and the breadth of your table where you are seated? Can someone tell us which one is the breadth or the length?*

L: *The length is the longest and the breadth is the shorter one* (indicating by hands on the table).

TB: reinforces learner responses by further explaining the following:

Area is the size of the surface of a two dimensional shape.

Breadth-the distance between two points of the shortest side of a rectangle which can be called the width in other books.

Length is the distance of a longest side of a rectangle or how long is a side from one end to the other of a two dimensional shape. We can use a formula to find the area of a rectangle, but before we go any further we need to discuss the following:

TB: *What is the meaning of twice?*

L: *It means double or times two*.

TB: *What should we do now?*

L: We let the breadth be x *then our length will be* $2x$.

TB: *What is the formula for finding the area of a rectangle?*

L: $L \times B$

TB*: I would like you to answer the question. Can you form an equation now and solve?*

C: *Yes Sir*.

The teacher started to explain the question using concrete concepts such as using top of the table, to assist learners to answer the questions. The teacher taught from the known aspects to the unknown ones. He assisted and supervised learners when they were doing their work. The learners were able to get the correct solutions without any difficulties. From the discussion it shows that the teacher took learners to their basics and assisted them to have insight in answering complex questions without the use of code switching, as the examples below illustrate.

TB: *Who can read for us?*

L: *Yes Meneer. 'The sum of 27 and 12 is equal to 73 more than an unknown number, Find the number'.*

TB: *Who can explain what the question means?*

L: *We need to look for a number.*

TB: *Which number is it?*

C: Quiet

TB: *Who can give us the number, do we know the number*?

L: *It is unknown, we do not know it*.

TB: *Get into your groups and find the number*.

C: Learners started discussing in groups

TB: *Which group have finished*?

L: *Ours Meneer*.

TB: *Can you go to the chalkboard and explain*.

L: *We write an equation*: $27 + 12 = x + 73.39 = x + 73. \therefore x = 39 - 73 = -34.$

TB: *Why are you writing an equation*?

L: *It is because we are told that there is a sum and is equal to a number plus 73, there is more than*.

TB: *Excellent work guys, thank you very much for your brilliant answer*

From the extract, it could be seen that the teacher and learners were using English throughout their discussions. The teacher was teaching mathematics according to the School's Language Policy. Learners knew how to use and apply mathematical language as they were able to represent and explain the meaning of some of the terms. For instance, 'more than', 'equal to'; and some mathematical terms were interpreted properly, in line with Marc's (2005:513) observation that, "mathematics is a language that has its own syntax, symbols, grammar and a variety of representations which need to be explained to learners and used properly". Learners showed confidence in answering questions and even when presenting their answers to the whole class. The teacher's motivating comments could go a long way as learners may want to do more and better. Even though the presentation was in English, there was some use of code switching during group work when the teacher was not around. Furthermore, the findings agree with the Principles and Standards for School Mathematics (NCTM, 2000:60) which states that learners should be able to:

- Organize and consolidate their mathematical thinking through communication;
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- Analyse and evaluate the mathematical thinking and strategies of others; and
- Use the language of mathematics to express mathematical ideas precisely.

It may be seen that group work promoted sharing of ideas which may result in learners in getting correct answers. The findings show that TB's learners were competent in terms of using mathematical language as well as application of mathematical skills, as stated by Kaphesi (2003:267) who notes that, "It is important that the teachers become more effective in oral work in mathematics to assist learners in the development of general language skills". The proper application of mathematical language by learners reveals that the teacher had taught and guided his learners to use English appropriately, as stipulated by Garegae (2007:234) when observing that, "Mathematical language does not only consist of ordinary English, it also consists of

symbols and highly specialized language". TB insisted that the use of English was in line with the requirements of the Department of Education that English should be used in the teaching of Mathematics. TB therefore, enforced this to learners so that they could use English when dealing with questions concerning mathematical language. The findings from classroom observations concur with Lan and Tan's (2008:145) findings that, "the teacher was able to explain in simple and clear English to his learners and often emphasised an important point by repeating it".

4.9 Discussion of classroom observations

The findings from classroom observations concur with Jegede's (2011:48) findings that teachers in their study were using both learners' mother language and English so that they could cooperate in the teaching process. The observations revealed that learners participated better when IsiXhosa and English were used, compared to when there was exclusive use of English.

TA used mostly IsiXhosa with the idea that learners would be able to understand mathematics concepts. Classroom observation showed that learners were active when the teacher used code switching. They were interested in learning by participating during lesson discussions. TA relied heavily on translation to convey mathematics concepts to learners. Besides, classroom observations showed that learners were not active when questions were posed in English, but only became interested when the teacher translated English to IsiXhosa. The results showed that learners were conditioned to translation, which would make them reluctant to learn and answer questions in English. Translations have been used to make learners understand clearly, however, continuous use of translation may lead to a waste of time and promotion of laziness in learners. This may contribute to learner failure since learners would not answer mathematical word problems if they were taught using the LoLT only. Similarly, L2 said that the use of code switching disadvantaged them when it came to assessment tasks because there would be no one to assist them in terms of translation of English words to IsiXhosa, since the assessment tasks were set in English (LoLT) only.

Participants had divided thoughts about the use of code switching. TB was concerned about adhering with the School Language Policy and promoting the use of the English language during mathematics lessons for examinations and other school assessments. In addition, he encouraged learners to use the LoLT since it is used in examinations or in assessment tasks. In contrast, TA

was not concerned about the use of English only in mathematics lessons since his main aim was to make learners understand the concepts under discussion through code switching. TA did not worry about the LoLT much, but wanted to see learners learning comfortably without difficulties resulting from using the LoLT. He was concerned with the transfer of information through code switching. On the contrary, Channa (2012:762) states that, "teachers should strive to let learners practice English language in order for them to comprehend mathematics language vividly".

4.10 Findings from video recordings

I selected video segments from the available information and used them for analysis purposes by examining the clip to extract data about the relationship between the teacher and learners in terms of the use of languages: IsiXhosa, English or code switching of both English and IsiXhosa (Derry, 2007:23). I checked for non-verbal communication such as facial expressions, frowning and nodding reactions of learners and teachers. Therefore, video recordings clearly showed what transpired during classroom observations and semi-structured interviews which also showed how learners and teachers engaged and interacted in the classroom. TA used code switched while TB used LoLT entirely. Through the use of video recordings, it was found that TB and his learners used the LoLT to explain mathematical word problems. These findings showed that TA and his learners lacked mathematical vocabulary because they resorted to code switching as pointed by Web and Web (2008:30) that if learners and teachers have difficulties in expressing ideas and reasoning in LoLT they ended up using code switching. Gestures such as shaking the head and frowning of faces were observed during video recordings which showed that learners were lost during mathematics lessons in TA's classroom. On the other hand, utterances like agreeing or argue in the LoLT were observed in TB's mathematics classroom. The findings concurred with the ones in interviews and classroom observations where teacher TB said that he tried by all means to encourage learners to use the LoLT by using mathematics vocabulary. Through video-recordings, it could be found that learners were struggling to speak in LoLT and were reluctant to respond to the teacher's questions during classroom observations of teacher TA. The video recordings showed the body language when teacher TA alerted learners to use English when they were not able to respond in LoLT.

The way the teacher spoke, the hesitation and disability to explain in LoLT as well as some facial expression showed fear during classroom observations of teacher TA. The findings showed that

teacher TA and his learners were incompetent in the use of the LoLT and mathematical language. The teacher lacked confidence, not able to explain mathematical words precisely. These findings are supported by Voster (2008:36), who argues that incompetence in LoLT is seen by hesitation and fear in learners and teachers facial expressions.

4.11 Discussion

The study aimed at investigating the effects of code switching in the learning of mathematical word problems in Grade 10. The findings showed that there was generally a negative attitude towards code switching by learners and teachers, although there were respondents who supported the use of code switching in assisting learners to understand and participate, as well as for classroom management. There was a feeling that the use of code switching was dependent on the topic under discussion. Since mathematical word problems deal with specialised mathematical language, the use of code switching would not assist learners, the reason being that some of the mathematical vocabulary is difficult to translate to IsiXhosa. Another reason for not favouring code switching could be that there is wastage of time in repeating concepts in two languages which may cause misunderstanding. Therefore, it is better to use one language (LoLT) which could assist learners to be more proficient in English. Learners preferred monolingual teaching to strengthen their linguistic competence in English; they perceive the use of the LoLT as a means of strengthening their comprehension in mathematics (Alenezi, 2010:12). Furthermore, learners blamed teachers' lack of proficiency in English for their failure to answer mathematical word problems. Jitendra, DiPipi and Person-Jones (2002:26) state that, "learners and teachers experienced significant difficulties with mathematical problem solving because they are not proficient in English". Chowdury (2012:54) propounded that:

> The reasons for teachers' code switching may vary according to the lesson, topic, teaching experience and the learners' level and background. The teachers, however, need to remember that English is the medium of instruction and code switching should be kept to an effective minimum.

From the findings it could be seen that English proficiency was critical in the learning of mathematical word problems, and teachers indicated that their main problem was the language of teaching mathematics (English) since most learners were not proficient enough in LoLT.

The findings relating to TA are in agreement with Aziz's et al. (2011:37) and Little's (2009:5) findings that mathematics consists of complex, unfamiliar, specialized vocabulary and symbols that demand higher order thinking. Many problems encountered by TA were related to explaining mathematics concepts in English, which concurs with Bergeson's (2000:33) argument that more time is needed for learners to develop problem solving abilities as numerous skills grow at different paces. The reason for learners having difficulties in word problems may be that they were not previously exposed to word problems at an early stage. Learners complained that their teachers did not expose them to mathematical word problems in English, which may be the reason why they had problems in manipulating mathematical word problems. In addition, the findings are in line with Aziz's et al. (2011:39) findings that, "learners felt that learning mathematics in English had been tough because their teachers did not have a sufficient level of English language proficiency to make the lessons easy on them". The findings from the research are that learners were able to solve short word problems, but had difficulties with more complex ones. These findings are in line with Bergeson's (2000:33) observation that, "learners can solve most one-step problems, but have extreme difficulties trying to solve non-standard problems, problems requiring multi-steps, or problems with extraneous information". In contrast to learners taught by TA, TB's learners were willing to work under pressure and persevere and had self-confidence, were able to solve the questions. Sajadi et al. (2013:3) states that, "A mathematical word problem is a more unique and challenging task than the ordinary mathematics task".

Berger (2013:198) found that most of the South African teachers had degrees or diplomas that were unrelated to mathematics and they experienced problems with mathematical content. The idea concurs with the finding that TA had problems with mathematical terms which resulted in him resorting to code switching. Incompetence of teachers in teaching a particular learning area may culminate in the skipping of topics at an early stage which will give learners problems later, as they were not taught the content. Haryanto (2013:52) suggests that if teachers' English proficiency is perfect the teaching and learning process could be conducted efficiently and effectively. Yew and Nathan (2008:7) note that, "Clearly, one of the major issues that learners faced in learning mathematics were related to an inadequate grasp of the language of instruction

that plays such an important role on learners' development of conceptual understanding". Yew and Nathan (2008:9) go on to say:

> Hence, learners who are learning mathematics with a language background other than the language of instruction such as English will face tremendous difficulty in comprehending the textbooks, teaching aids and discussing in an unfamiliar language.

Both TA and his learners used code switching during classroom observations. Learners and the teacher code switched freely between English and IsiXhosa. TA's lack of English mathematical vocabulary made learners silent or reluctant to participate. This shows that learners lacked the English and mathematics foundation from previous grades, which affected their participation, and also prevented them from expressing themselves clearly in English. This may show that some teachers in South Africa are using a great deal of code switching, forgetting that this strategy should be used sparingly.

The findings from TB's responses concur with Aziz's et al. (2011:39) claim that learning mathematics in English is beneficial to learners because the concepts would be easier to understand when they are delivered in English. Learners reported that the concepts were easier to understand when explained in English because they had been using English in previous grades when learning mathematics, which may be the reason why they did not encounter major problems when solving mathematical word problems. Moreover, Nillas (2002:107) found that learners taught in English only performed significantly better compared to those taught through code switching (English and Filipino), which concurs with the above findings. The learners in Nillas's (2002) study were able to express their ideas in English (LoLT) which is used in examinations, as opposed to the use of code switching which is not catered for in examinations. This observation is in line with Chowdury's (2012:55) argument that learners should pass through the problems of expressing ideas in the target language which will make learners' work easier. Consequently, TB and his learners used the LoLT (English) because there were no examinations written in code switching of IsiXhosa and English or in IsiXhosa only.

The results also show that teachers were aware of the benefits of using English in the learning and teaching of mathematics word problems. Nonetheless, some of the teachers did not adhere to the LiEP and used code switching in their lessons. For instance, TA used code switching because

he was concerned more with learners' understanding of the concepts under discussion than with the learners' proficiency in mathematical language. On the contrary, TB did not use code switching because he was adhering to the LiEP and was concerned with the proficiency of learners in mathematical language.

Teachers used code switching mainly to explain the concepts to learners when they experienced difficulties in the lessons presented in English, as well to enable learners to express their ideas in IsiXhosa which invited learners to participate during the lesson. Thus, code switching was used as a learning and teaching resource to benefit learners. The findings of this study concur with Mokgwathi's (2011:252) research which found that learners were allowed to use code switching in class by their teachers when asking questions and when learners were unable to respond to questions posed in English. The major reason for allowing learners to use code switching in that study was that learners were not proficient in English.

The findings of the current study also reveal that the use of code switching in classrooms may negatively affect learners' proficiency in English. Furthermore, the responses of teachers and learners showed that they had a negative attitude towards the use of code switching in the learning of mathematical problems or of topics that dealt with specialised mathematical vocabulary and could be difficult to translate from English to IsiXhosa. Moreover, teachers and learners said that the use of code switching resulted in wastage of time through repeating of some information in English and IsiXhosa.

4.12 Conclusion

The chapter presented, analysed and discussed the findings of the research. The data obtained from classroom observations and from semi-structured interviews were analysed and discussed accordingly. The findings have revealed that teachers and learners used code switching for many reasons such as for classroom management, to enable learners' understanding, for translation and to aid explanation. However, some teachers and learners revealed that the use of code switching in learning mathematics undermines learners' ability in dealing with mathematical word problems.

Chapter 5 provides the conclusions and recommendations based on the findings of the research.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In Chapter 4 the findings of the study were discussed at length and linked to the literature review. The major findings of this research study were that code switching was used for academic purposes such as: clarification of concepts, explaining concepts in detail, inviting learners to participate, classroom management in terms of disciplining learners when they disrupted the class, and as an avoidance strategy in situations when the teacher or the learner were unable to express themselves in the LoLT due to low proficiency in English. In addition, the findings revealed that the use of code switching disadvantaged learners in the learning of mathematical word problems.

This chapter draws up some conclusions, presents a summary of the findings and makes some recommendations for future research around the effects of code switching in the learning of mathematical word problems.

5.2 Summary of previous chapters

This study was designed to investigate the effects of code switching (IsiXhosa /English) in the learning of mathematical word problems in Grade 10. The aim of the study was geared at ascertaining the effects of code switching in the learning of word problems in mathematics in Khayelitsha township schools in the Western Cape Province of South Africa. The research discussed previous literature and developed a theoretical framework to frame the discussion around code switching, reasons for code switching, mathematical language as well as word problems. Data was collected through classroom observation and interviews with the assistance of video-recordings. The use of various research techniques promoted validity of data collected through triangulation.

The findings showed that the use of code switching promoted clarity, understanding, explanation of concepts and classroom management. However, the excessive use of code switching showed that some teachers and learners lack English proficiency and so are incompetent in the use of LoLT (English). This has resulted in most learners encountering major problems when it comes

to mathematical word problems. The study has shown that learners who use English entirely in learning mathematical word problems do not encounter major problems when it comes to assessment tasks because these tasks are set in English (LoLT) and not in IsiXhosa.

5.3 Summary of the research findings

The study aimed at investigating the effects of code switching in the learning of mathematical word problems in Grade 10. The findings showed that some teachers and learners viewed the use of code switching in the learning of mathematical word problems as a mammoth task because the topic deals with specialised mathematical vocabulary that could be difficult for the translation of English words to IsiXhosa or vice versa.

Although there were respondents who supported the use of code switching in assisting learners to understand, participate and clarify mathematical concepts, there was a belief that the use of code switching in learning mathematics is dependent on the topic under discussion. Since mathematical word problems deal with specialized mathematical language, the use of code switching would not assist learners, the reason being that some of the mathematical vocabulary was difficult to translate from English to IsiXhosa.

Teachers tried to translate some English mathematical words to IsiXhosa to assist learners in understanding and for clarification (academic purposes) but admitted that they had difficulties with other mathematical words which showed that, even if teachers try to use IsiXhosa, they still have problems in translating English words to IsiXhosa. Furthermore, there was a waste of time in repeating concepts in two languages, which caused misunderstandings. Therefore, it appeared better to use the LoLT, which could assist learners to improve their English proficiency in the learning of mathematical word problems. In addition, learners preferred monolingual (English) teaching to strengthen their linguistic competence in English. Learners perceived the use of English as a way of strengthening their comprehension in mathematics (Alenezi, 2010:12). Many problems encountered by teachers and learners involved explaining mathematics concepts in English. The failures by learners to understand word problems could be the result of the demands from mathematical technical concepts that could not be available in IsiXhosa.

Furthermore, the classroom observations revealed that the use of code switching could prevent learners from learning mathematical word problems, since they encountered problems when

doing assessment tasks by themselves. On the contrary, the results have shown that learners who used English entirely had an advantage in dealing with mathematical word problems, since these learners were familiar with the mathematical language used compared to learners who used code switching only. Avoidance strategies have also shown that teachers are not adhering to the LoLT of the school, as TA said, "*We are no longer adhering to the LoLT and resort to code-switching due to a deficiency in the English language*". Some of the incidences that I recorded reflected teachers who used IsiXhosa during their lessons, who entirely forgot that the LoLT of learners was English. Even though the DoE may allow the use of code switching, teachers now seem to overuse it or not to use English at all. Mathematical word problems need to be taught in such a way that learners can comprehend the taught concepts.

Teachers' and learners' responses such as that by TA who said, "*The problem of misunderstanding is because of failure to communicate in English and limited mathematical vocabulary*", and by L1 who responded that, "*Mathematical word problems are difficult to understand because of English words, we are encountering a lot of problems due to language barriers"*, showed that there were problems in the understanding of mathematical concepts expressed in English. Most learners had difficulties in speaking in English because they mostly used their mother language for communication. However, learners taught in English only showed some potential in dealing with mathematical word problems. During classroom observations, it was noted that these learners were able to participate and manipulate mathematical word problems without the use of code switching. The findings showed that the language used by both teachers and learners has a great influence on their learning and teaching. Therefore, learners need to be taught and encouraged to use their LoLT, since their examinations will be set in English which is the official LoLT. This view is emphasized by Black and William (2001), who stress the close relationship between how we teach and how we assess.

Teachers were aware of the benefits of using English during the learning of mathematical language. For instance, the use of English (LoLT) assisted their learners in the development of the understanding of mathematical language which may be absent in the learners' mother language. Learners blamed teachers' lack of proficiency in English for their failure to answer mathematical word problems. For instance, L4 said that their teacher used a great deal of IsiXhosa than English, a situation which was disadvantaging them during examinations because

no one would be available to translate English to IsiXhosa since examinations were set in English only. It was clear that English proficiency was critical in the learning of mathematical word problems.

5.4 Recommendations

Teachers should encourage learners to make use of the LoLT (English) in the learning of mathematical word problems. Further research should be conducted on a larger scale with many schools to test the findings on the effects of code switching in the learning of mathematical word problems. In addition, the research should be conducted for a longer period of time and IsiXhosa should be enriched with mathematical terms that could be used to assist learners in learning of mathematical word problems more effectively. Teachers should use code switching to a minimum level to reduce too much dependence and reliance on learners' mother language (IsiXhosa). Moreover, this study recommends that teachers should adhere to the LoLT (English) of the school to assist learners in understanding mathematics concepts rather than depending on code switching (English/IsiXhosa), since the examinations or assessment tasks are conducted in LoLT. For example, learners using English as LoLT should be assisted to understand and use it properly to their advantage. Finally, it is recommended that teachers should exercise care when using code switching in the learning of mathematics, especially with the topics that involve word problems; as such topics are more aligned to certain mathematical language that could not be translated to IsiXhosa. This study strongly recommends that teachers and learners should use LoLT for learners to understand mathematical word problems because of the specialised mathematical vocabulary.

5.5 Conclusion

The relevant literature reviewed as well as the findings of the research revealed the need for teachers and learners to adhere to the LoLT in the learning of mathematical word problems, since the examinations are not conducted in learners' mother language. Code switching from English to IsiXhosa could be one of the contributory factors to the lack of proficiency in the LoLT, which may encourage teachers and learners to skip some topics in the syllabus. Even though some teachers and learners viewed the use of code switching as beneficial in terms of assisting learners to understand and participate, they admitted that the use of code switching in mathematical word

problems does not assist learners in any form. Rather, it prevented learners from gaining fluency in the LoLT and from understanding mathematics concepts.

In conclusion, this study has shown that even though code switching could be beneficial in the learning and teaching of mathematics, it was difficult for learners and teachers to use it in a way that enhances the learning of mathematics word problems because of the barriers in the use of specialized mathematical language.

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Appendix A: Letter requesting permission to undertake research

21 Draycott Avenue
Condor Park
Eersterivier
7100

10 February 2014

The Director Research
Western Cape Education Department
Golden Acre
Cape Town

Dear Sir/ Madam

RE: PERMISSION TO USE CHRIS HANI ARTS AND CULTURE HIGH SCHOOL FOR RESEARCH.

I hereby wish to apply to be granted permission to use Chris Hani Arts and Culture High School for my MEd (Mathematics Education) research.

The research is based on "Code switching in the learning of word problems in mathematics in Grade 10." Two mathematics educators and sixty learners will be used in this research during the period, March to June 2014. The lessons of the participating Educators will be observed and video recorded for transcription and analysis of code switching in the teaching and learning of mathematics.

I wish to inform you that all lesson recordings will be used for this research purposes and not for any other use.

I hope my request will be considered.

Yours faithfully

E. Mahofa. (084 756 6160)

Appendix B: Letter requesting permission from the principal

21 Draycott Avenue
Condor Park
Eersterivier
7100

10 February 2014

The Principal
Chris Hani Arts and Culture School
Cekeca Road
P.O Box 15
Makhaza
Khayelitsha
7784

Dear Sir

RE: REQUEST TO UTLISE MATHEMATICS EDUCATORS AND LEARNERS IN THE RESEARCH.

I hereby wish to use your mathematics educators and learners in my MEd (Mathematics Education) research.

My research is about code switching in the learning of word problems in mathematics in Grade 10. Two mathematics educators and sixty learners will be used, only two lessons per educator will be observed and video recorded.

I wish to inform you that all lesson recordings will be used for this research purposes and not for any other use.

It will be greatly appreciated if this application can be positively considered.

Yours faithfully

E. Mahofa

Appendix C: Interview guidelines

Interview guidelines for learners

Please feel free to speak your mind. This information will remain confidential, and your name will not be mentioned.

1. In which language is your mathematics classes supposed to be taught?
2. What languages do you usually use during mathematics lessons?
3. Do you mix IsiXhosa and English in the learning of mathematics? Provide reasons for your response.
4. What do you think are the effects of mixing the two languages in learning mathematics in the classroom?
5. Did you have any problems in answering questions during mathematics lessons?
6. If your answer to question 5 is 'yes', state the problems and give some solutions to these problems.
7. If your answer to question 5 is 'yes', say what you think the causes are of you not being able to answer the questions asked by the teachers?

Interview guidelines for teachers

Please feel free to speak your mind. This information will remain confidential, and your name will not be mentioned.

1 Is your mother-tongue language and your learners' the same?
2 If your answer in (1) 'no', is this an advantage or a disadvantage in teaching mathematics using English? Why?
3 Mention home languages of all learners' in your mathematics class
4 What is the language of learning and teaching (LoLT) of your school?
5 Can your learners use English beyond the classroom?
6 In your judgment are your learners ready to learn mathematics in English? Please explain.
7 Would you say English is a barrier to your learners' understanding mathematics?
8 Name some of the different strategies you use to facilitate your learner's understanding of mathematical word problems taught using English?

Appendix D: Observation Schedule

Name _____

Date and time _____

Observer _____

Site _____

Observations of events and behaviors

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Summary/ Comments

_____

_____

_____

_____

_____

Field Notes: Classroom observation

Grade 10

Subject Mathematics

Date _____

Lesson _____

Topic _____

Duration …… minutes

Textbook

Classroom layout

_____

_____

Description of the seating arrangement

_____

_____

_____

People involved	**Type of conversation**		
	Code switching	**LoLT(English)**	**Mother language**
Learner-Learner			
Teacher-Learners			
Group discussion			
Pair work			

Appendix E: Consent form for learners

By signing this form I understand and agree that:

My child will participate in a research concerning "Code switching in the learning of word problems in Mathematics Grade 10" that will be conducted by Mr. E. Mahofa.

My child's interactions in class discussions may be observed and videotaped as well as interviewed.

Video recordings of my child's images may be distributed for educational purposes only.

My child's name will not appear in any document.

I am free to withdraw my consent for the participation of my child in the research.

Any queries are welcome and can be forwarded to Mr. E. Mahofa (084 756 6160)

_____ _____

Child's Name Date

_____ _____

(Parent or Guardian Name) Parent or Guardian Signature.

Appendix F: Consent letter for parent/ guardians

21 Draycott Avenue
Condor Park
Eersterivier
7100

10 February 2014

Dear Parent/ Guardian

Your son or daughter will be participating in a research about "Code switching in the learning of word problems in Mathematics Grade 10" that is designed and conducted by Mr. Mahofa to find out the effects of code switching in the learning of word problems in mathematics.

I am writing to request your permission to allow me to observe, interview and videotape your child's class for educational purposes.

Please indicate by completing the consent form accompanying this letter that your child will participate in the research. If you have any queries you can contact me at 084 756 6160.

Sincerely

Mahofa. E (Educator)

Appendix G: Permission letter from Western Cape Department of Education

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard2@pgwc.gov.za

tel: +27 021 467 9272
Fax: 0865902282

Private Bag x9114, Cape Town, 8000

wced.wcape.gov.za

REFERENCE: 20140211-24552

ENQUIRIES: Dr A T Wyngaard

Mr Ernest Mahofa
21 Draycott Avenue
Condor Park
Eersterivier
7100

Dear Mr Ernest Mahofa

RESEARCH PROPOSAL: CODE SWITCHING IN THE LEARNING OF WORD PROBLEMS IN MATHEMATICS IN GRADE 10

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **01 March 2014 till 30 September 2014**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.

10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.

Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 11 February 2014

Appendix H: Editor's letter

Cape Peninsula University of Technology

FACULTY OF EDUCATION AND SOCIAL SCIENCES
DEPARTMENT OF RESEARCH

MOWBRAY CAMPUS
P O Box 652, CAPE TOWN, 8000
Highbury Road, MOWBRAY, 7700
Tel: +27 21 680 1572
Fax: +27 21 680 1504
Email: kwendac@cput.ac.za

The Higher Degrees Committee
03 November 2014

Language editing of M.Ed. Thesis (Ernest Mahofa)

I hereby confirm that I have language-edited the Master of Education thesis, 'Code Switching in the Learning of Mathematics Word Problems in Grade 10', submitted by Ernest Mahofa, a Master's student at Cape Peninsula University of Technology.

Thank you

Dr C. M. Kwenda

GET Department

Appendix I: Letter for formatting

Formating of M.Ed. Thesis (Ernest Mahofa)

I hereby confirm that I have formatted the Master of Education thesis, ‘‘Code Switching in the Learning of Mathematics Word Problems in Grade 10’’, submitted by Ernest Mahofa, a Master’s student at Cape Peninsula University of Technology.

Sincerely

Ms B.H. Phillips

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