USING LANGUAGE AS A RESOURCE:
STRATEGIES TO TEACH MATHEMATICS IN MULTILINGUAL CLASSES

By

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DECLARATION:

In accordance with Rule G4.6.3, I hereby declare that the above-mentioned treatise/dissertation/thesis is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

SIGNATURE: [Signature]

DATE: 13 December 2011
A research study of this magnitude could not have been done without the help and support of many.

I am grateful for the many blessings and strength God has blessed me with, enabling me to fulfill my dreams.

Dr Lyn Webb, my supervisor, is to be acknowledged for the time, effort, unstinting guidance and encouragement which she has so willingly rendered throughout this study.

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ABSTRACT

South Africa is a complex multilingual country. In the majority of schools in the Eastern Cape, a province in South Africa, the teachers and learners share the same home language, isiXhosa, but teach and learn mathematics in English. The purpose of this study was to encourage teachers to use the home language as a resource to teach mathematics in multilingual classes.

The study follows a mixed method design, using both qualitative and quantitative data. Qualitative data were collected from a survey and poetry, which teachers crafted, in which they highlighted their perceptions about language in their lives. They also reflected on their practices and submitted pieces of contemplative writing.

Quantitative data were collected from participating teachers who administered a pre-test to their learners as well as a post-test approximately nine months later after conducting an intervention.

The results showed that where strategies, such as the implementation of exploratory talk and code switching which used language as a resource, had been introduced mathematical reasoning improved and classroom climate became more positive. The learners’ lack of confidence in being able to express their reasoning in English was prevalent throughout the reflective writing. By enabling learners to use isiXhosa in discussions the teachers felt that the learners gained in both confidence and mathematical understanding.

This study has demonstrated that using the learners’ and teachers’ home language unlocks doors to communication and spotlights mathematical reasoning, but there is still an urgency to encourage learners to become fluent in Mathematical English. It is important to note that a positive classroom climate is essential for learners to build confidence and to encourage them to attempt to formulate sentences in English - to start on the journey from informal to formal usage of language as advocated by Setati and Adler (2001:250).
My main conclusion is that an intervention that develops exploratory talk by using language as a resource can improve learners’ mathematical reasoning. I wish to emphasise that I am not advocating teaching mathematics in isiXhosa only, but the research has shown the advantages of using the home language as a resource together with English in Eastern Cape multilingual mathematics classes. Learners need to be able to express themselves in English, written and spoken, in order to achieve mathematically. This study therefore shows that teachers can gauge their learners’ improvement in mathematical reasoning after an intervention that develops exploratory talk in class by using the home language as a resource.
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CHAPTER ONE
INTRODUCTION AND OVERVIEW

1. BACKGROUND

According to Setati and Adler (2001), learners need to be able to use their home language to be able to move from informal discussion in their home language to formal mathematical discussion in English. Despite research showing that discussion enhances learning (Mercer & Littleton, 2007) there is little evidence of discussion occurring in many Eastern Cape classrooms (Webb & Webb, 2008). Where discussion does take place, it was observed to be in English, although isiXhosa is the predominant home language for most of the teachers and learners in the Eastern Cape.

Since 1996 the constitution of South Africa has recognised 11 official languages; nine African languages together, with English and Afrikaans. Prior to 1996, English and Afrikaans were the only two official languages of the country. In the current constitution, the multilingual language policies in education were an attempt to balance the force of English (Janks, 2010). According to Statistics South Africa (2001) almost 80% of South Africans use an African language as their home language. The most commonly spoken home language is isiZulu (24%) followed by isiXhosa (18%). Although English is the preferred Language of Learning and Teaching (LoLT) in schools, it is the home language of only 8% of the South African population (Statistics South Africa, 2001).

The South African Department of Education’s Language-in-Education Policy (LiEP) of 1997 advocates an additive model of multilingualism. This implies that the learner’s home language is maintained throughout schooling and used along with other languages to enhance learning. Research has shown that English in South Africa is seen as a status symbol by those who speak it and it is perceived to enhance one’s chances of securing employment (Setati, 2005), thus English is afforded a higher status than the African languages. Parents want their children to learn in English as it is seen as the language of power and further education (Adler, 2001; Setati 2005, 2008).

According to Janks (2010) using English as the LoLT inhibits learner participation if English is not their home language. Many remain silent because of having to speak in English; whereas if the same children are allowed to use an African language, group
dynamics change as learners are “rescued from the silence imposed by English” (Janks, 2010: 129). This stance is further supported by Cummins (1981) who highlights the difference between Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP). The latter is necessary for a learner to be able to progress academically.

This study investigated whether teachers can embrace different teaching and learning strategies and implement them in their classrooms - strategies that use learners’ home language as a resource that could improve mathematics levels in Grades 4 to 7 language diverse mathematics classrooms. The main strategy that will be focused on is increasing dialogue by introducing exploratory talk to the teachers, who will in turn introduce the strategy to their learners.

2. STATEMENT OF THE PROBLEM

The main problem that I have identified for this study is that in the Eastern Cape language diverse mathematics classes the focus is on teacher talk in mathematical classrooms instead of a focus on being learner centred. I am hoping that this study will show that learners’ mathematics can improve if they are exposed to talking and discussing mathematics in their classes.

From Grade four most South African school children are taught and assessed through the medium of English, although they have been taught in their home language for the first three years of schooling.

According to Fleisch (2008) it is essential that children are proficient in their home language. In mathematics classes many learners struggle with ordinary English (OE) let alone the mathematical English (ME) needed to be able to read, write and face higher order questioning in mathematics. “…unless children have a deep understanding of their home language, particularly proficiency in the complex decontextualised discourse of educational subject material, they cannot transfer the understanding to the second language.” (Fleisch, 2008:105).

3. RESEARCH OBJECTIVES

My objectives of this study are:

1. To identify teachers’ perceptions about language.

2. To ascertain whether teachers can introduce dialogue in the form of exploratory talk in their multilingual mathematics classes.
3. To determine if an intervention using language as a resource can improve mathematical levels of achievement.

4. RESEARCH QUESTION AND SUB-QUESTIONS

The research aim and objectives can be reformulated into a main research question and sub-questions. The main question of this study is:

Can teachers use language as a resource to introduce strategies to teach mathematics in language diverse classes?

The sub-questions which will inform the central question are:

- What are teachers’ perceptions about language?
- Can teachers introduce dialogue in the form of exploratory talk in their mathematics classes?
- Can an intervention using language as a resource improve mathematical levels of achievement?

The instruments that were used to identify the teachers’ perceptions of language were their own poetry and a language survey. Teachers were encouraged to write about their inner feelings concerning language in a short poem that could be written in either English or their home language. In order to address sub-question two, teachers submitted a reflective writing piece describing the introduction of exploratory talk into their mathematics classrooms and a reflective writing piece after the introduction of the RUCSAC strategy to solve word problems. Data were triangulated with observational feedback from a researcher who visited each teacher’s mathematics class to ascertain if the teachers’ perceptions were accurate about introducing dialogue in their mathematics classes. The last sub question was addressed by comparing the learners’ pre- and post-test results before and after an intervention that targeted strategies to teach mathematics in language diverse mathematics classes.

5. THEORETICAL FRAMEWORK

This research is socioculturally situated and is located within a Vygotskian framework. Vygotsky (1978) maintains that learners build on their knowledge when they interact socially. This concept of social interaction is also supported by Wenger’s (1999) theory of a community of practice, where four components, namely community, identity, meaning and practice need to be combined for meaningful learning to take place within a community.
6. LITERATURE REVIEW

As has been stated previously, despite isiXhosa being the home language of many Eastern Cape teachers, they teach Mathematics in English in the majority of schools, even though it is not the home language of either the learners or teacher (Webb & Webb, 2008). Although research and policy supports the use of the learners’ home language for learning, parents, teachers and learners chose English as the LoLT as it is seen as a means to social goods, or power (Setati, 2005).

I will be making use of a funnel analogy throughout this study to illustrate how I have looked at international research, then national research within South Africa and then funnelled down to the local Port Elizabeth area where I have conducted my research.

6.1. Language diverse classrooms: moving the gaze from international to local

According to Moschkovich (2010) learners need to talk about mathematics in their home language before they can translate the concepts into English. Moschkovich (2010) refers to Spanish speaking learners and explains how they make use of code switching to aid learning in bilingual classrooms. Moschkovich (2005) defines code switching as the alternate use of two languages during conversations. Setati and Adler (2001) concur that code switching is valuable as it allows learners to make use of their home language to support their learning. In other words it aids the “journey” from informal to more formal mathematical language.

Research shows that an increase in home language usage in the classroom assists with mathematical reasoning (Setati, 2008; Westcott, 2004). Adler (2001) is of the opinion that all teachers of mathematics face language challenges in their classroom, but that these challenges become more complex in language diverse classrooms where learners learn mathematics in a language which is not their home language as learners are faced with learning the language of Mathematics as well as the LoLT, in this case English, at the same time. Adler (2001) posits that when teachers use English as the medium of instruction in language diverse classrooms learner-centred talk and writing are limited.

“The informal discourse refers to the restricted usage of language, characterised by short simple sentences, limited vocabulary and grammar, and language which tends to be used for commands, questions and statements” (Fleisch, 2008:62). Formal discourse tends to be a more formal academic language learners need to be familiar with in the
school context. Most children in the Eastern Cape use their home language for informal discourse; however, in the senior phase at school the academic discourse is conducted in English. In mathematics classes the added mathematical discourse, with a specialised vocabulary, exacerbates the confusion in the learners’ minds. Durkin (1991:3) eloquently emphasises the role of language in mathematics education as it “begins in language, it advances and stumbles because of language, and its outcomes are often assessed in language.”

Cause for concern about the standard of mathematics in South Africa is highlighted by the findings of international benchmark studies such as the Trends in International Mathematics and Science Study (TIMSS), 2003, where South African participants scored an average of 264 for mathematics compared with the international average of 474 (Fleisch, 2008:13).

6.2. Types of talk

Despite the learners being seated in groups, Webb and Webb (2008) found that little discussion occurs in most multilingual mathematics classrooms. Studies by Mercer and Littleton (2007) have shown that discourse plays an integral role in the constructing of mathematical knowledge and reasoning. Mercer (1995) divides learners' talk into:

1. Disputational talk which is characterised by disagreements.
2. Cumulative talk where learners build on statements made by fellow learners.
3. Exploratory talk where partners all actively participate, and opinions are sought and considered before decisions are jointly made.

Mercer and Littleton (2007:59) define exploratory talk as:

Exploratory talk is talk in which partners engage critically but constructively with each other’s ideas. Statements and suggestions are offered for joint consideration. These may be challenged and counter-challenged, but challenges are justified and alternative hypotheses are offered. Partners all actively participate and opinions are sought and considered before decisions are jointly made. In exploratory talk knowledge is made more publicly accountable and reasoning is more visible in the talk.

According to Mercer and Littleton (2007) exploratory talk needs to be practised regularly for it to be effective. Learners should be able to use their home language together with English in group discussions which should aid their mathematical learning and reasoning.
Mercer (1995) claims that if learners could be trained in the tenets of exploratory talk an improvement in mathematical reasoning could occur. From the outset I would like to emphasise that the teacher learning during the intervention occurred through their own experiential learning. It was not a top-down intervention, as they were not shown or taught, but they experienced the strategies themselves before introducing them into their classrooms. In this study, in order to encourage exploratory talk, triggers in the form of concept cartoons, cartoon style drawings showing different characters, which are designed to promote discussion and thinking (Naylor and Keogh, 2000) are one example of a strategy that could be introduced. In addition, in this study teachers were exposed to Raven’s standard progressive matrices as there is no written text and teachers have to select the missing piece to complete a picture. After they were introduced to exploratory talk through using triggers teachers experimented with how to use the strategy with word sums.

6.3. International and national assessments

Later in this study I will peruse results of international and national assessments which highlight the urgent need for effective intervention in South Africa. I make use of a funnel analogy to illustrate how I looked at international results, TIMSS and SACMEQ 111, then nationally at the Systemic evaluations and Annual National Assessments (ANAs) within South Africa and lastly the local Port Elizabeth district’s Common Task Assessments (CTAs).
In all of these various international and national assessments South Africa has performed dismally, as will be attested to in chapter two.

7. RESEARCH DESIGN AND METHODOLOGY

The research design followed in this study was a mixed method design, using both quantitative and qualitative data, in the interpretive paradigm.

Quantitative data about the mathematical reasoning levels of learners in Grades 4 to 7 was collected by participating teachers from a pre-test, a diagnostic baseline assessment task per grade that was administered under controlled conditions. Each assessment contained questions from each of the five learning outcomes. The five learning outcomes are:

- **Learning Outcome 1: Numbers, Operations and Relationships.**
  In this section learners build their number sense.

- **Learning Outcome 2: Patterns, Functions and Algebra**
  Here learners recognise, describe and represent patterns as well as solve problems using algebraic language and skills.

- **Learning Outcome 3: Space and Shape (Geometry)**
Two and three dimensional objects characteristics and relationships in a variety of orientations and positions are studied.

- **Learning Outcome 4: Measurement**
  The use of appropriate measuring units, instruments and formulae in a variety of contexts is covered in this section.

- **Learning Outcome 5: Data Handling**
  Collect, summarise, display and critically analyse data in order to draw conclusions and make predictions, and to interpret and determine chance variation.

  *(Extract from Revised National Curriculum Statement (RNCS) 2002:34-38)*

Post-tests were administered once the teachers had been exposed to the intervention and had implemented strategies in their classrooms. The intervention lasted approximately nine months. The post-tests were administered to ascertain whether any significant changes in mathematical reasoning had occurred. During the intervention teachers learned experientially how to introduce exploratory talk into their mathematics classes and the importance of affording learners the opportunity to use their home language, in this case isiXhosa, to assist with the LoLT of the Mathematics classroom, namely English, by being encouraged to code switch and translate.

Qualitative data was collected from poetry which the teachers wrote where they highlighted their perceptions about language. The teachers’ had to do four pieces of reflective writing after they had: administered the pre-test; implemented exploratory talk; after they had implemented the RUCSAC method of doing word sums and lastly after the post-test. This was to gain insight into what happened in the groups when teachers’ were exposed to exploratory talk and so that teachers could see what they could expect from their learners. Teachers were asked to complete a language survey researching their school’s language environment and LoLT. Teacher discussions with regard to language used for instructions at their particular school were scrutinised.

During the intervention, strategies were trialled in order to assist the teacher to improve their mathematical reasoning. Exploratory talk was introduced to the teachers who later cascaded the strategy down to the learners, by using a non-verbal trigger such as a concept cartoon. Untrue statements were recognised and challenged through reasoning and using mathematical concepts and mathematical language, in their home language. They endeavoured to supply true statements.
Another strategy that was introduced to increase dialogue was the acronym RUCSAC, which stands for: read the problem, understand the problem, choose the correct operation, select a procedure and collect the appropriate information. Teachers practised the RUCSAC method with curriculum-based word sums (Sparklebox, 2010). This method is a more modern version of Polya’s (1973) four steps for problem solving. The teachers described in their reflective writing the introduction of RUCSAC into their classrooms.

The teachers were encouraged to ensure a positive classroom climate where learners were comfortable to use English or their home language or to code switch. The importance of being able to talk mathematically in English and their home language were highlighted throughout the course.

A visual detailing the methods and instruments acts as a summary.

*Figure 1.2* Summary of research methodology instruments
8. ETHICAL CONSIDERATIONS

I have obtained permission from the Research Ethics Committee at NMMU and from the DoE Eastern Cape. All material used for research purposes will be kept safe and secure. The anonymity and confidentiality of teachers, learners and schools will be ensured. Videos and data materials will be used for research purposes only.

9. SUMMARY AND OUTLINE OF CHAPTER

In this chapter I have detailed my research problem and stated my main research question together with the sub-questions which I aim to explore in this study. I have given a background to the choice of English as a medium of instruction due to its perceived social, economic power and political pressure (Alexander, in Westcott, 2004). Teachers in the Eastern Cape have to teach, and learners have to learn mathematics, in English despite it not being their mother tongue. I have looked briefly at recent research that has been done in the field. I have looked at how teachers can use language as a resource to introduce strategies to teach mathematics in language diverse classrooms.

Chapter two includes an expanded review of pertinent literature whilst the research design is dealt with in chapter three. The quantitative and qualitative results are presented and discussed in chapter four. Chapter five looks at the relevance of the findings of this study and gives suggestions for further research.
CHAPTER TWO
LITERATURE REVIEW

In the previous chapter I stated the main research question: Can teachers use language as a resource to introduce strategies to teach mathematics in language diverse classes.

I also listed the objectives which could lead to teachers and learners increasing the use of exploratory talk in mathematics classes. This study also aims to ascertain whether these strategies could lead to an improvement in learners’ mathematical reasoning, by using a comparison of learners’ pre- and post-test results. I have provided background to the situation particularly in the Eastern Cape where the LoLT is often not the learners’ home language.

This chapter focuses on research which has been conducted both internationally and nationally on the strategies of code switching and the introduction of exploratory talk to enhance mathematical reasoning in language diverse classrooms. I also look at strategies which research has shown could be effective in encouraging learners to talk in their language of choice.

Vygotsky (1978) points out that language is a tool for thinking and that student’s need language to learn. According to Setati and Adler (2001) mathematics education is about the informal and formal use of spoken language. Learners come to class with informal spoken language and with the help of the teacher learners are able to move to more formal mathematics language.

1. THEORETICAL FRAMEWORK

Vygotsky (1978) maintains that the construction of knowledge is developed through social interaction. This position is confirmed and expanded by Wenger (1999:1) who uses the term “communities of practice” to refer to “a group of people who share a concern or passion for something they do and learn how to do it better as they interact regularly”. This concept provides a useful perspective on learning with the main focus being that learning involves social interaction. Wenger’s model proposes that learning takes place following an involvement in a community of practice.
Figure 2.1 Wenger’s Social theory of learning (Wenger, 1999:211)

From the model in Figure 2.1 it is important to note that Wenger’s framework for learning consists of four components: community, identity, meaning and practice. These components need to be integrated for successful learning to take place. These components of learning are defined by Wenger (1999:211) as follows:

- Community - a way of talking about the social configurations in which our enterprises are defined as worth pursuing;
- Identity - a way of talking about how learning changes who we are;
- Meaning - a way of talking about our ability to experience the world as meaningful;
- Practice - a way of talking about shared historical and social resources, frameworks and perspectives that can sustain mutual engagement in action.

Wenger (1999) claims that learning is a process of co-operation within a community whereas Campbell (2006) states that conversations are the glue which holds relationships together. Dialogue is a powerful learning tool as it assists learners by identifying gaps in their own understanding and in so doing helping them to construct knowledge. Conversations, whether individual, in small groups or as a whole class, all develop reasoning and problem solving abilities as well as build self confidence and improve social skills.

Gee (1994) highlights the importance of Discourses (mathematical and non-mathematical) to support the learning of mathematics. According to Gee (1994:7),
“discourse” using a lower case “d” refers to how language is used “on site” to enact activities. The primary discourse is the oral language learnt as a child. This primary discourse is built on in order to be able to use the language of mathematics in the classroom, a secondary discourse. However, “Discourse” using an upper case “D” involves much more than words. An example of discourse includes conversations whilst Discourse refers to mathematical language.

2. LANGUAGE PRACTICES IN MULTILINGUAL CLASSROOMS

According to Mercer (1995), Gee (1994) and Wenger (1999) talk is a social thinking tool and learners need to talk to be able to learn. Mercer and Littleton (2007) and Gee (1994) show that discourse plays an important role in the construction of knowledge and learning. Language is a tool which allows for shared understanding, the testing of possible solutions and the attempt to reach some form of consensus within a group situation (Mercer & Littleton, 2007:2).

2.1 Code Switching

Setati and Adler (2001) researched language practices in primary multilingual mathematics classrooms in South Africa. In their research they examined the practice of code switching which, although encouraged as a learning and teaching resource, causes problems for mathematics teachers. Teachers and pupils do not have English, the LoLT, as their home language. These teachers have to teach mathematics and teach proficiency in English at the same time. Learners have to cope with the language of mathematics and the new language which mathematics is taught in, namely English. For many learners English is only spoken, written and heard in the formal school context. In South Africa code switching is reluctantly used as teachers are depriving their learners of learning English, the language of power.

Moschkovich (2002) found that where classroom conversations included the use of the students’ first language as a resource, it offered support to students in learning to communicate mathematically. Moschkovich (2005) found the practice of “revoicing” and “modelling” by the teacher assisted Spanish speaking learners in the United States of America (USA) to move from their informal or incomplete mathematical language into more formal mathematical language.

Code switching as a teaching and learning tool has been researched in Southern Africa by Adler (2001) and Setati (2005, 2008) and in the USA by Moschkovich (2010) among others. Their studies have argued for the use of the learners’ home language to
support the LoLT whilst simultaneously learning mathematics. They claim that learners need to be able to use talking as a learning tool through making use of their main language and code switching, as talking is a social thinking tool (Mercer, 1995).

Chitera (2009) found that code switching in teacher training colleges in Malawi was considered problematic. She advocates the use of code switching as a teaching method to teach a new concept or for praise.

Code switching has become a recognised feature in multilingual classrooms where two or more languages are used, in South Africa usually English and an indigenous language, to enhance conceptualisation in mathematics (Vorster, 2008). Setati and Adler (2001) describe code switching in the South African context where mathematics is taught in English, but teachers and students also speak Setswana.

2.2 Exploratory talk

Exploratory talk represents a distinctive social mode of thinking. It is a communicative process for reasoning through talk in the context of some specific joint activity (Mercer, Wegerif & Dawes, 1999). Research has shown that exploratory talk is the effective use of talking by learners as a social mode of thinking (Mercer, Wegerif & Dawes, 1999). According to Mercer and Littleton (2007:59) learner talk can be divided into three categories. They maintain that teachers need to be aware of these types of talk so that learners can engage in meaningful discussions.

- **Disputational talk** which is characterised by disagreements and individuals make few attempts to pool their resources.

- **Cumulative talk** where learners build uncritically on others’ statements. This kind of talk is characterised by repetitions and confirmations.

- **Exploratory talk** where learners engage critically, but constructively with the ideas of others eventually reaching a joint consensus. Points are challenged, but justified and alternative hypotheses are offered.

Kinman (2010) highlights the importance of communication to argue and justify mathematical reasoning. Rojas-Drummond and Zapata (2004) used an experimental group of Mexican primary school children and found that those exposed to exploratory talk presented better arguments, were able to give opinions and reason which resulted in them being better problem solvers.
Wegerif, Mercer and Dawes’ (1999) study produced four main findings. Exploratory talk can: improve group reasoning; be taught; transfer between educational contexts and standard non-verbal reasoning test results improved significantly as a result of teaching exploratory talk.

2.2.1 Effective rules for group work

A culture of dialogue is not the norm in Eastern Cape classrooms but teachers can use exploratory talk as a strategy so learners can use their home language together with English, the LoLT, to enhance learning. In order to be able to do this ground rules need to be in place (Webb & Webb, 2011).

Effective ground rules for classroom talk need to be negotiated as talking affects the way learners think together (Mercer, 1995). Mercer and Littleton (2007:71) suggested rules as follows: all information must be shared; we talk one at a time; we respect each others’ opinions; all members should contribute to the discussion; all ideas must be respected and considered; challenges and alternatives must be made explicit and the learners must seek to reach consensus. It is important that these rules are negotiated with learners and not imposed so that learners ‘buy in’ to the process.

Classroom dialogue deserves more attention according to Mercer and Littleton (2007) as learning involves some special ways of using language. Language is the teacher’s main tool for guiding learners to be able to reason, through learning and working collaboratively in a group. Mercer and Littleton (2007:4) maintain that language is the main tool for building knowledge. They maintain that learners need language to develop intellectually and become an effective member of society. Three main elements are connected to dialogue namely: sharing knowledge that is relevant, jointly constructing new knowledge and improving understanding (Mercer & Littleton, 2007:136).

When learners refrain from talking, because they either do not understand the question or do not have the vocabulary to be able to answer, or ask, a question themselves in a mathematics lesson, teachers need ways and means of getting them to talk. Two triggers which could promote exploratory talk are Raven’s Standard Progressive Matrices (RSPM) and concept cartoons.
2.2.2 Raven’s Standard Progressive Matrices

Raven’s Standard Progressive Matrices make use of problems from validated tests to assess learners’ reasoning independent of language ability. Learners have to identify the piece of the pattern which is missing. An example is detailed in figure 2.2. These tests are context-free and non-verbal in language diverse classrooms.

![Raven's Standard Progressive Matrices](image)

*Figure 2.2 Example of Raven's Standard Progressive Matrices item*

2.2.3 Concept cartoons

Concept cartoons are triggers to facilitate talking whether it is by debate, conflict, in order to promote dialogue or to inspire participation. Learners need to read the different comments that are in the speech bubbles which are intended to act as a catalyst to encourage discussion affording learners the opportunity to use exploratory talk about whether statements are correct or incorrect and support their decisions with reasons. According to Dabell (2008), concept cartoons are cognitive drawings or visual disagreements that make use of a cartoon-style design to present mathematical
conversations inside speech bubbles. Naylor and Keogh (2000) believe that concept cartoons afford learners the opportunity to talk and argue about an issue ensuring that a meaningful result is obtained. When arguing a point learners may experience conflict as differences between their views and those of others become apparent. This type of argumentation allows learners to make a statement, substantiate their opinion and defend it until a meaningful solution is arrived at (Webb, Williams & Meiring, 2008). The group then needs to devise a mathematically acceptable explanation which they write into the empty speech bubble. Figure 2.3 is an example of a concept cartoon developed by researchers from the Faculty of Education at Nelson Mandela Metropolitan University specifically for an Eastern Cape context.

![Figure 2.3 Example of a concept cartoon.](image)

*(Extract from NMMU Mathematical Reasoning Study Guide, 2011:92)*
Teachers need to afford learners opportunities to talk to make explicit their thinking and reasoning. They need to be able to build on each other’s contributions and either accept or disagree with what has been said thereby enabling the learners the opportunity to scaffold their own knowledge (Mercer & Littleton, 2007). This opportunity was provided by triggers.

2.2.4 Word sums

According to Verschaffel, Greer, Van Dooren and Mukhopadhyay (2009) learners are not given enough opportunities to improve their problem solving abilities. For learners to be able to problem solve they need to be able to read and write as well as distinguish between ordinary English (OE) and mathematical English (ME).

“The lack of problem solving skills in South Africa may perhaps be as a result of the way it has been taught in schools” (Brijlall, 2008:52). According to Brijlall (2008) learners are not given enough opportunities to solve problems at school and improve their problem solving skills. In the past problem solving tasks were mainly solved individually by learners. Many examples selected are abstract and foreign to learners and as a result many develop a dislike for problem solving tasks believing they are too difficult (Greer, as cited in Verschaffel et al., 2009).

To develop true problem solving skills learners need to be able to work independently as well as interdependently within a group. The Revised National Curriculum Statement Grades 1 to 9 (Department of Education, 2002) mentions problem solving ability as an outcome and the ability to work effectively, independently and a member of a team.

Verschaffel et al. (2009) define word problems as “textual descriptions of situations assumed to be comprehensible to the reader.” Researchers have argued for the inclusion of more “realistic” or “authentic” word problems that represent “out of school” situations.

An example of a real life mathematical word problem without meaning could be as follows: “You have 10 red pencils in your left pocket and 10 blue pencils in your right pocket. How old are you?” Learners are often told to use the numbers to solve a mathematical problem so researchers Verschaffel et al. (2009:353) were not surprised when learners answered 20 years old. For many language diverse learners, the words used in the question are often not understood, which adds to confusion.
Problem solving today is still based on the four steps outlined by Polya (1973) namely: understand the problem, devise a plan, carry out the plan and look back. An adaptation of Polya’s theory is the acronym RUCSAC which stands for Read, Understand, Choose, Solve, Answer and Check (RUCSAC, 2010). Learners can understand the method easier as it is more contextual and modern. The learners relate to the rucksack in the picture as learners are familiar with a rucksack and are able to use the acronym as a means to guide their thinking process.

![RUCSAC Method](image)

**Figure 2.4 RUCSAC Method**

Classroom talk is often limited to the teacher asking the question and the learner answering (Mercer & Littleton, 2007). This is true of many Eastern Cape classrooms where learners find it difficult to express their reasoning or thinking in the LoLT (Webb & Webb, 2008). According to Fleisch (2008) access to quality pre-primary schooling, the culture of books at home and the exposure to the basics of reading, writing and abstract thinking are often lacking in poorer resourced South African schools. A further issue is that the language which parents use to speak to their children, at home, is different from the language of conversation at school. In many homes where English is not the home language the modelling of reading practices by parents is lacking as many are illiterate or poorly educated themselves (Fleisch, 2008:61).

### 2.3 BICS and CALP

Cummins (1981) distinguishes between basic interpersonal communication skills (BICS) and cognitive academic language proficiency (CALP). BICS refers to the
language that learners may competently be able to use amongst their peers and in social settings whereas the CALP refers to the proficiency needed in the classroom to progress successfully academically. Research has shown that it will take a second language learner about two years to become competent in BICS and that it takes between five to seven years for them to reach the same level as their first language peers in CALP (Du Plessis and Louw, 2008). The challenge facing many of our isiXhosa speaking learners is that they are learning BICS and CALP simultaneously. Some will display a BICS - CALP gap where they may be able to understand the Ordinary English (OE) needed to make oneself understood socially but have still not developed the Mathematical English (ME) which they need to be able to master concepts in mathematics. Cummins’ theory is visually displayed in Figure 2.5.

![Cummins Quadrant (Cummins, 1981)](image)

*Figure 2.5 Cummins Quadrant (Cummins, 1981)*

The vertical axis in Figure 2.5 extends from cognitively undemanding (requiring a learner to for example be able to name an angle or identify a quadrilateral) to cognitively demanding (where they could be required to analyse, evaluate or hypothesise) The horizontal axis represents context which can range from embedded (where the context is rich and assists with making meaning and may include a picture) to reduced. These two axes together form four quadrants. According to the description of Cummin’s Quadrants (Cummins, 1981) BICS tends to be found in the bottom left corner whilst CALP is in the top right hand corner of the diagram. An example to illustrate a position on the quadrant where context is not embedded is one of a flower bed. A learner
responded by drawing a picture of a bed with flowers growing on it as he had no conception of a ‘flower bed’ (Wilburne, Marinak & Strickland, 2011).

The problems that learners encounter when moving from BICS to formal oral and written language has been recognised by Setati and Adler (2001) and extensive research has been conducted on code switching (Setati & Adler, 2001; Moschkovich 2005). Learners who lack BICS have no framework to develop CALP. Code switching is a tool to provide this. “Where children are allowed to use an African language they come alive. The group dynamics change as there is a flood of ideas and the children are rescued from the silence imposed by English.” (Janks, 2010:129). Learners need to be able to talk informally in their home language and move to more formal talk in mathematics in English.

Heugh (as cited in Fleisch, 2008:105) states that “unless children have a deep understanding of their first language, particularly proficiency in the complex decontextualised discourse of educational subject material, they cannot transfer the understanding to the second language”, thus preventing learners from developing formal mathematical language in English.

Most researchers have argued for the partial use of the learners’ home language as the LoLT (Adler, 2001; Moschkovich, 2010; Setati 2005, 2008 ; Setati & Adler, 2001). The strategic usage of learner’s home language in the teaching and learning of mathematics is advocated as many learners are not yet fluent in English which is the LoLT in the majority of South African mathematics classrooms. Setati, Molefe and Langa (2008:15) posit, “let’s stop sitting on the fence and make a hard decision. We must either shore up the mother tongue teaching of maths and sciences, or switch completely to English if we want to succeed.”

Heugh’s (2006) stance is that the early exit from mother tongue (transitional bilingualism) or the ‘straight to English’ teaching option (subtractive bilingualism) are main reasons for South Africa’s dismal mathematics and literacy results. She maintains that children should be proficient in their home language before they learn a second language as the academic contexts in which they have to read and write in a language are different as well as having to face high order questioning in a variety of subjects. Children also have to face high order questioning in a variety of subjects. Heugh (2006) advocates mother-tongue instruction whilst Howie (2003) maintains that “the most significant factor in learning Mathematics and Science is whether they are fluent in English.” In the same article Howie (2003) calls on South Africans to choose only one
language for teaching and learning in multilingual classroom. Setati, Molefe and Langa (2008) believe that the choice as suggested by Howie is not as easy. In this study learners were encouraged to deliberately draw on their home language while learning Mathematics while they develop proficiency in English, the LoLT (Gee, 1994).

Moschkovich (2007) names two categories of mathematical Discourses, namely procedural and conceptual. Procedural Discourse refers to following a set of procedures without furnishing any reasons as to why you are doing it in a certain way whereas conceptual Discourses refer to giving reasons for using particular procedures. In this latter form of Discourse learners share, reflect, verbalise and refine their understanding of mathematics. Setati (2005) found that English was used for procedural discourse whilst Setswana the home language of was used for conceptual discourse in Gauteng. In my study I aim to encourage teachers to develop the use of the main language for conceptual Discourse to support the more procedural use of English in an attempt to improve mathematical reasoning in their classes.

Adler (2001) and Setati (2005, 2008) in their research found that teachers in multilingual mathematics classes face having to teach mathematics in English as well as mathematical concepts. Research by Webb and Webb (2008) shows that learners are often reluctant to answer questions concerning their mathematical reasoning in English, as they experience difficulty in expressing themselves fluently. This study advocates that learners should be able to discuss mathematics in the language with which they are comfortable.

Adler (2001) is aware that all teachers of mathematics face language challenges in their classroom, but these challenges become more complex in multilingual classrooms especially where teachers need to teach mathematics and English at the same time. Learners in these classrooms are faced with learning the language of mathematics and at the same time learning a new language, English, in which mathematics is being taught. These teachers are constantly grappling with decisions regarding the implicit and explicit teaching of the mathematics language; decisions regarding the use of informal and formal mathematical discourse as well as the dilemma of whether to switch or not code switch in their daily teaching. Adler (2001:21) is of the opinion that “one of the effects here is that as some teachers struggle to communicate mathematics in English, errors are fossilized and conveyed as such to learners.”
Figure 2.6 shows Setati and Adler’s (2001) visual conception of the development of meaningful communication in a mathematics class at three levels namely from spoken to written, from home language to English and from informal to formal language.

![Diagram](image)

**Figure 2.6 Possible journeys from informal spoken maths in the home language to formal spoken mathematics in English. (Setati & Adler, 2001:250)**

In Figure 2.6 the possible routes are denoted by various lines. One example could be for a learner to write down her thoughts in her home language, then translate this into informal mathematical English and finally make her written answer more formal. The challenge teachers’ face is to guide their learners to write their informal thoughts in more formal language. Two ways could be used to achieve this. Either learners could write down their informal spoken language and then work at changing the language used to more formal language or alternatively to work at the spoken language becoming more formal prior to it being written down. In a multilingual classroom this is more complicated when the learners’ informal spoken language is different from the LoLT.

### 2.4 Sink or Swim DVD

Fluency in the language of instruction is the ability to talk about what one is learning thereby being able to make learning meaningful, as shown in the DVD, Sink or Swim. The use of LoLT is highlighted in the DVD, which shows how pupils in a “former Model C” school (a well-resourced school which is partially funded and run by its school governing body) cope when they are taught Science through the medium of isiXhosa by an isiXhosa speaking teacher (Westcott, 2004). Top students in Science either refrained from participating in the lesson or were easily bored as the terminology in
isiXhosa was foreign to them. Many learners in this insert remarked on how difficult it must be for isiXhosa students to learn content in a second language.

### 2.5 Drawing versus written text

Janks (2010) highlights this difficulty between what a non-English speaking Grade 3 child is able to draw depicting a school playground compared with the written text.

![Figure 2.7 Grade 3 child’s drawing of the school playground (Janks, 2010:130)](image)

In the drawing the learner depicts children skipping, playing hopscotch and a game of ‘catches.’ The learner has included a tree, wall and tyres to demarcate a flower bed. The reader is able to see clearly that this represents a school playground.

![Figure 2.8 Grade 3 language diverse child’s written description of the school playground](image)
In contrast Figure 2.8 shows the child’s limited linguistic ability which curtails his description of their playground as it has to be written in English.

2.6 Questions in English and learners’ home language

Vorster (2008) found it was good practice to ask written Mathematics questions in English with the Setswana translation immediately below it. This idea of setting questions in more than one language was supported by Setati (2005) who felt that there is a need for educators to consider multilingual assessment practices, where test questions can be set in English and the learners’ home language and that learners will have the option to respond in the language of their choice.

Robinson (2010) found that Spanish speakers performed better in mathematics when tested in Spanish instead of English.

3. SOUTH AFRICA’S ACHIEVEMENTS IN INTERNATIONAL AND NATIONAL TESTS

In Eastern Cape schools where children are taught in isiXhosa from Grades 1 to 3, they learn English as a subject. From Grade 4 English is the LoLT for mathematics, a language which the learners are only starting to master as their Home Language is NOT English. Their teachers are also not teaching in their home language. In practice many teachers regularly code switch between English and isiXhosa, in order to facilitate understanding (Janks, 2010). The use of English and not their home language as LoLT may result in learners feeling threatened or intimidated. They may fear ridicule or misunderstanding from their teacher and/or peers in their efforts to communicate mathematics in English. School Governing Bodies decide on the Language Policy for their particular school. The schools select English because of parent resistance to using an African language despite research that shows that the switch in language of instruction is a key factor in the high failure rate (Adler, 2001:26). Parents are also of the opinion that English is the “language of power” and provides learners with access to “social goods” whether it be further education or employment (Setati, 2005, 2008).

Fleisch (2008) looks at the findings which indicate that South African learners are performing well below international norms with regard to mathematics. Results of the following assessments will be scrutinised:

International tests:

- Trends in International Mathematics and Science Study (TIMSS)
Chapter 2: Literature Review

- Southern and East African Consortium for Monitoring Educational Quality (SACMEQ III)

National tests:
- Systemic Evaluation
- Annual National Assessment (ANA)

Provincial tests:
- Common Task Assessments (CTA)

3.1 Trends in International Mathematics and Science Study (TIMSS)

The Human Science Research Council (HSRC) administered TIMSS 2003 to 9,000 Grade 8 learners (15 year olds) nationally. The results reflected little change from South Africa’s 1999 results. South Africa once again appeared at the bottom of the country list with the lowest average score for mathematics and science. South Africa’s average for mathematics was 264 whilst the international average was 467.

3.2 Southern and East African Consortium for Monitoring Educational Quality (SACMEQ III)

SACMEQ III was conducted in South Africa in 2007 and reflects the latest international survey data on primary school performance in the country. This was developed by the Institute for Educational Planning in conjunction with Southern and East African Ministers of Education. 9,083 Grade 6 students and 1,488 teachers from 392 schools across South Africa were surveyed. It was the first survey where teachers were tested in addition to students. The questionnaires were only available in English and Afrikaans in South Africa. All questions were multiple choice with questions ranging from level 1: pre numeracy to level 8: abstract problem solving. South Africa ranked 10th out of 15 countries for student reading and 8th out of 15 for student maths performance.

3.3 Systemic Evaluation

Systemic evaluation studies are designed to measure learner achievement at key points of the South African education system namely Grades 3, 6 and 9. They are designed to benchmark performance and track each learner’s progress. The SA government’s initiative to implement systemic evaluation was “designed to gather baseline information” on learners first three years of schooling (Fleisch, 2008:4).
In 2001, 51 000 Grade 3 learners were randomly selected as part of the South African Government initiative to take part in a systemic evaluation. The three tasks included multiple choice and free response questions. The results reflected that the Grade 3s had a poor grasp of elementary mathematics scoring an average of 30 % for numeracy whilst in the literacy task the average was 54%.

Below is a graph depicting the findings of Systemic Evaluation conducted in the Eastern Cape in Grade Six in 2004. The graph displays the mathematics achievement levels. Cause for concern is further highlighted in Figure 2.9.

![Figure 2.9 Eastern Cape Grade 6 Mathematics Achievement levels (HSRC, 2004)](image)

However, in the Eastern Cape Grade 6 Systemic Evaluation, (figure 2.9) concur with the Grade 6 Eastern Cape Mathematics results (figure 2.10) which showed that only scholars who have the same home language as the LoLT scored an average of 23% in the Eastern Cape whereas scholars whose home language is the same as the LoLt scored an average of 45%. In Figure 2.10 one can see visually the impact the learners’ home language makes on their mathematics results in the different provinces of South Africa.
The Department of Basic Education (DBE, 2010) released their findings for the 2007 Annual School Survey of learners revealing that 20% have isiXhosa as their home language with only 7% having English as their home language.

Less than 10% of South African children have English as their HL (Statistics South Africa, 2001), yet by the beginning of Grade 4 most learners are taught and assessed in English. Underachievement in reading, writing and mathematics raises three major concerns:

- Is it because learners learn through a second language?
- Is it because learners learn through English only?
- Is it caused by the early exit from mother tongue? (Fleisch, 2008)

### 3.4 Annual National Assessments (ANAs)

The 2011 Annual National Assessment (ANA) results for Grade 6 revealed an average score of 28% in languages and 30% in mathematics. The Basic Education Department is aiming for 60% in both learning areas as part of its Action Plan 2014. The poor performance of pupils in literacy and numeracy has been a concern for a long time. In the Rapport (2 July, 2011) the Eastern Cape Grade 6 Mathematics Annual National Assessment results were as follows:

- Not achieved 71%
- Partly achieved 2%
Achieved 8%
Outstanding 1%

Nationally the results showed that only 12% of South African Grade 6’s are capable of doing mathematical calculations; 3% were outstanding and only 9% were able to do the work that their age dictates of them. It was compulsory nationally for all Grade 6 learners to write. One must bear in mind that these results could have been inflated as teachers marked their own learners’ work.

The aforementioned results and findings have motivated me to pursue an investigation into introducing discussion in the form of exploratory talk in multilingual mathematics classes which could have an effect on mathematical reasoning in Grade 4 to 7 learners.

3.5 Common Task Assessments (CTAs)

Common Task Assessments (CTA) are a form of systemic evaluation which assesses the effectiveness of the entire educational system, set provincially, in South Africa and measures learner achievement in Grades 3, 6 and 9. The main aim of these tests is to benchmark performance and track progress. This is a new name for the previously mentioned systemic evaluation. The Grade Six Common Task Assessment (CTA) results for May 2010 from the Eastern Cape Department of Education revealed that out of 11 709 learners who wrote, 6 923 learners performed at a level 1 i.e. they have not achieved the required milestones in Mathematics.

Table: 2.1

Grade 6 EC CTA results (Extract from Principals’ meeting, July 2010)

<table>
<thead>
<tr>
<th>LA</th>
<th>No. of Learners per Rating code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>English First Additional Language</td>
<td>7 106</td>
</tr>
<tr>
<td>English Home Language</td>
<td>3 651</td>
</tr>
<tr>
<td>Xhosa Home Language</td>
<td>5 516</td>
</tr>
<tr>
<td>Mathematics</td>
<td>11 709</td>
</tr>
</tbody>
</table>

The majority of learners who struggle with languages are operating at a level 1 and are unable to satisfy the requirements for Grade 6. The results of the 2010 CTAs also
revealed that most Mathematics learners performed at a level 1 i.e. they have not acquired the required milestones in Mathematics. It is therefore incumbent on this research to ascertain whether exploratory talk can be introduced using learners’ mother tongue as a resource together with English in order to increase language diverse learners’ mathematical reasoning levels from 4 towards 3, 2 and even 1.

4. CHAPTER SUMMARY

This chapter situates my study in both international and national research arenas for language diverse mathematics classrooms. The literature review reinforces the opinion that social interaction and discourse could enhance the development of mathematical reasoning.

I looked at reasons why children are taught mathematics in English when their home language is isiXhosa, by teachers who are also not first language English speakers. I found research which supported dialogic practises in the classroom as well as code switching and ways to assist teachers to encourage these learners to improve their mathematical reasoning.

I used research by Mercer and Littleton (2007) to evaluate the importance of dialogic practices in the classroom for learning and development.

I focused on the various international and national forms of assessment that are used in South Africa as benchmarks and which to date have recorded an underachievement in mathematics.

In the following chapter I describe the research methods that I feel were best suited for this study to answer the question that prompted this research, namely:

Can teachers use language as a resource to introduce strategies to teach mathematics in language diverse classes?

My objectives of this study are:

1. To identify teachers’ perceptions about language.
2. To ascertain whether teachers can introduce dialogue in the form of exploratory talk in their multilingual mathematics classes.
3. To determine if an intervention using language as a resource can improve mathematical levels of achievement.
CHAPTER THREE
RESEARCH DESIGN AND METHOD

In the previous chapter the relevant literature from Adler (2001), Setati (2005, 2008), Fleisch (2008), Gee (1994) Mercer and Littleton (2007) and Moschkovich (2010), among others, was discussed. For the theoretical framework I made use of the work of Vygotsky (1978) in social interaction, and Wenger’s (1999) community of practice in relation to communities of teachers experiencing the intervention and learners using exploratory talk in groups in the classroom.

A justification of the value of the study is that the Education Department, together with universities which offer teacher training and the teachers themselves would benefit from this research. Teachers would be able to implement exploratory talk in their classrooms and learners would benefit from being able to use their home language to assist them with their mathematics. The problems uncovered and the strategies investigated could be implemented in Port Elizabeth multilingual mathematics classrooms, to the benefit of the learners.

1. BACKGROUND

There were 12 schools in the Port Elizabeth district that were invited by a donor to be participants in the study. As the teachers were sponsored to participate in the project it was a convenient sample for me to use for this study. Two teachers from each of the 12 schools were selected by the respective school principals so that the teachers could assist and encourage each other; however, two teachers did not attend the full intervention and complete the reflective writing or post-tests so they were excluded from the results of the study. The participating teachers met weekly at the Nelson Mandela Metropolitan University’s (NMMU) Missionvale campus over a period of nine months to workshop strategies which research has shown could increase dialogue and improve reasoning in multilingual mathematics classes. All the 22 participants are teachers from schools in the Northern Area in the Port Elizabeth district where they are currently teaching mathematics in English, which is their second language as well as being the second or third language of their learners. The learners who participated in the study were boys and girls from Grades four to seven (ten to thirteen years old) whose
teachers were attending the workshops. The teachers participating in the study were predominantly isiXhosa speaking teachers teaching classrooms of predominantly isiXhosa speaking pupils who were faced with mathematics being taught through a second language as well as having to face the transition of LoLT from isiXhosa to English at the end of grade three.

My position in this research study is that of an outsider looking in. I am a Grade 7 Mathematics teacher with more than 25 years in education, currently heading up an English-medium school Mathematics department from Grades 4 to 7. I am passionate about the teaching of Mathematics and have in the past been invited to present workshops to teachers in the Port Elizabeth district. I felt it was time that I wear a different “hat” and research strategies that could help language diverse mathematics teachers and learners.

2. RESEARCH DESIGN

The research design followed a mixed method design, using both quantitative and qualitative data, in the interpretive paradigm.

According to Creswell (2009) the interpretive paradigm affords people the opportunity to develop meanings from their interactions with others. Social constructivists (often combined with interpretivists) assume that individuals seek understanding of the world in which they live and work (Creswell, 2009:8) Constructivist researchers focus on the contexts in which people live and work in order to be able to focus on the historical and cultural settings of their participants. Researchers making use of this paradigm are acutely aware that their own background shapes their interpretation so I needed to take cognisance of this in my research and work with evidence and not personal experience.

Creswell (2009) supports the use of both methods in a mixed method study as it involves the use of both qualitative and quantitative approaches in tandem so that the overall strength of a study is greater than either one on its own.

Definitions of the three approaches, qualitative, quantitative and mixed methods, follow according to Creswell (2009:4):

Qualitative research is a means of exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant’s setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data.
Quantitative research is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analysed used statistical procedures.

Mixed methods research is an approach that combines both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches and the mixing of both approaches in a study.

My research aim was to see if there were initiatives that could be implemented in classrooms to integrate the home language as a resource together with English to enhance learners’ conceptual understanding of mathematics. Strategies needed to be experienced by the teachers through experiential learning then implemented in the classrooms to encourage children to talk in their language of choice in an environment where they felt safe and secure, in order to to facilitate the scaffolding of mathematical reasoning. Mathematics teachers workshopped the introduction of exploratory talk and code switching as possible helpful strategies which they could implement in their multilingual classes. The intervention aimed at improving learners’ mathematical reasoning.

3. DATA GATHERING INSTRUMENTS

During the intervention a variety of data were collected through various instruments in order to achieve three objectives which would lead to the answering of the primary aim of this study.

3.1 Objective One

My first objective was to identify teachers’ perceptions about language.

3.1.1 Language survey

Teachers’ completed a language survey where they detailed what their home language was together with the language used in the classroom by the teachers and learners for teaching and learning. A copy of the language survey is reproduced as Appendix E. I wanted this information as it opened windows into the backgrounds of the teachers and schools that took part in the intervention.

3.1.2 Teachers’ poetry

In order to elicit the teachers’ perceptions about language I investigated strategies which could reach emotionally into the teachers’ psyche. Teachers used poetry as a means to express what it feels like for one to learn a subject in a second language. Teachers then shared their poems as well as their own personal experiences with each other. The teachers developed empathy for the children they taught and realised that their peers were experiencing the same guilt when they used their home
language to explain concepts in the mathematics class that were in English. They were afforded the opportunity to write their poetry in any language but if they made use of their mother tongue then they were encouraged to supply a translation as well. The poetry afforded the teachers the opportunity to share their emotions rather than a mere clinical outcome.

3.2 **Objective Two**

My second objective was to ascertain whether teachers could introduce dialogue in the form of exploratory talk in their mathematics classes.

3.2.1 **Reflective writing after the introduction of exploratory talk in the classroom**

The teachers were each given a writing frame where they had to describe an instance of exploratory that had developed in their classroom and supply a transcript. They also had to identify characteristics of the talk they had described in their transcript to support their identification of the talk as being exploratory. Lastly they had to reflect on the introduction of exploratory talk in their classroom.

3.2.2 **Reflective writing after the introduction of the RUCSAC strategy in the classroom**

Teachers were introduced to a generic strategy to solve problems in the form of word sums using the acronym RUCSAC. Later, grade-specific examples of word sums were developed. Teachers commented on how this strategy assisted both them and their learners to be able to solve word sums.

3.2.3 **Researcher observations**

I made use of a researcher to observe three lessons of each participant-teacher in the classroom. I wanted the researcher be able to experience classroom practice prior to the intervention, during the intervention and again toward the end of the intervention to ascertain if there had been any changes. I also did not want to rely solely on the teachers’ responses but wanted to be able to see if the teachers’ feedback concurred with that of the researcher observer. The observation schedules that were used assessed implementations in the classrooms of strategies that the teachers had experienced during the intervention

The researcher first conducted a classroom observation where the focus was on the language spoken during a lesson. The observation schedule is reproduced as Appendix F. The focus areas were:

- The teacher’s use of language when giving instructions
The teacher’s use of language when explaining concepts
- The learners’ use of language in the whole class
- The learners’ use of language during group discussions
- The use of language during teacher-learner talk and learner-learner talk
- The learners’ use of language when reporting back to the whole class

The second observation was a rubric to assess the implementation of exploratory talk and the third observation was a rubric to assess the introduction of word sum activities in the classroom. (see Appendix J).

3.3 Objective Three
A total of 555, Grade 4 to 7 (ten to thirteen years old), learners from previously disadvantaged schools in Motherwell, eBayi and Kwadesi in the Port Elizabeth district, completed a baseline mathematics assessment, based on their previous grade’s work, which tested a range of skills and competencies. All the teachers and learners were isiXhosa first language speakers. Teachers then had to graph the results of their learners’ pre-test results followed by the post-test results nine months later in order to determine whether the strategies that the teachers had experienced during the intervention, and had subsequently introduced in their cases, had made any difference to the learners mathematical reasoning.

3.3.1 Pre-test
The main purpose of a pre-test is that of a baseline which was intended to identify the problematic areas which required more focus and enabled teachers to reflect on their practice. In Mathematics it is important that teachers build on the previous year’s work that has been covered as per the progression indicated in the Revised National Curriculum Statement (RNCS) grade progression.

3.3.2 Reflective writing after pre-test
The teachers were encouraged to write a reflective report on their findings after the learners had written the baseline pre-test. They needed to discuss the purpose of a baseline; list challenges that they experienced while administering the test; list their areas of concern about their learners’ mathematical results; list the content areas that would require special attention as well as give reasons as to the efficacy of reflecting their learners’ results on a graph.
3.3.3 Post-test

After a period of intervention teachers administered the post-test to their learners to see if there had or had not been an improvement.

3.3.4 Reflective writing after post-test

Teachers identified areas of weakness that their learners were still experiencing as well as specific areas within each Learning Outcome where learners were still struggling. They also made mention of areas where there had been an increase in their learners’ performance e.g. from most learners achieving a level 1 in the pre-test to more learners achieving a level 3 or 4 after intervention. They also raised concerns that they had as teachers and listed learning areas which still required special attention.

4. INTERVENTION

I wanted the teachers to experience being a learner again so that what they were learning they would in turn apply in their mathematics classrooms. I wanted them to experience using isiXhosa, their home language, to assist them to learn mathematics in English. I also wanted the teachers to see and feel the power of exploratory talk when they made use of triggers such as the concept cartoons. I wanted them to notice what happened in their groups as teachers so that they would be aware of what there learners would be doing.

4.1 Introduction to pre-test

The pre-test was to afford teachers the opportunity to be empowered and equipped with the necessary tools: to be able to administer a pre-test; record and graph results as well as analyse and reflect on these results so that they would confidently be able to see at what level their learners were performing in the five Learning Outcomes (LO) in mathematics. The pre-test served as a baseline test and could be developed into a diagnostic tool, although this was not an objective of the intervention.

Initially the teachers were tasked to design their own baseline assessment for their specific grade; however, a number of teachers set questions mainly from Learning Outcome 1 (Numbers Operations and Relationships) and set calculations using the minimum amount of language. For example they chose to ask “17+79 = ” rather than phrase the question using language e.g. “Find the sum of the following two numbers: 17 and 79”. The level of questions was also mainly targeted at taxonomy level 1: knowing, and very few questions addressed the other levels of Bloom’s taxonomy: understanding, applying, analysing, evaluating or creating. Many teachers struggled to include
questions on space and shape (Learning Outcome 3) as well as data handling (Learning Outcome 5).

Having seen how the teachers had struggled to set their own baseline test it was decided to model a baseline test which their tutor set. The modelling provided valuable learning experiences as teachers then experienced how to design a balanced baseline assessment task which covered all five learning outcomes and where a variety of questioning techniques and Department of Education (DoE) assessment levels (based on Blooms taxonomy) were used (see appendix K).

The teachers had to implement the pre-test in their mathematics classes. The teachers marked the pre-tests and recorded the learners’ test scores on an analysis sheet. They then had to use the conversion table to convert their learners’ mark to an achievement level (see Appendix A). They had to count and record the number of learners who achieved each level for each Learning Outcome using achievement levels one to four for grades 4 to 6 and achievement levels 1 to 7 for grade 7. Level one represented “not achieved” and level four represented “outstanding or excellent” achievement. These results were required in order to graph their classes’ learner performance. (see Appendix B).

I wanted the teachers to experience physically drawing the graphs and writing a report on their learners’ results in order to be aware of their learners’ ability in each LO, rather than impose solutions on them.

The learners’ mark needed to be converted to a percentage. A level is allotted to each percentage from Grade 4 to 6 based on a four point scale as detailed in table 3.1:

Table 3.1

<table>
<thead>
<tr>
<th>Rating code</th>
<th>Percentages</th>
<th>Description of competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>70-100</td>
<td>Outstanding/Excellent achievement</td>
</tr>
<tr>
<td>3</td>
<td>50-69</td>
<td>Satisfactory achievement</td>
</tr>
<tr>
<td>2</td>
<td>35-49</td>
<td>Partial achievement</td>
</tr>
<tr>
<td>1</td>
<td>1-34</td>
<td>Not achieved</td>
</tr>
</tbody>
</table>

If a learner in Grade 4 to 6 scored 14 out of 20 which is 70% they were given a level 4 while a learner who scores 9 out of 20 which 45% were given a level 2.
A Grade 7 learner scoring 14 out of 20 (70%) was given a level 6 while a learner who scores 45% received a level 3 as Grade 7 works on a 7 point scale as detailed in table 3.2:

Table 3.2
*Grade 7 seven point rating scale*

<table>
<thead>
<tr>
<th>Rating code</th>
<th>Percentages</th>
<th>Description of competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>80-100</td>
<td>Outstanding achievement</td>
</tr>
<tr>
<td>6</td>
<td>70-79</td>
<td>Meritorious achievement</td>
</tr>
<tr>
<td>5</td>
<td>60-69</td>
<td>Substantial achievement</td>
</tr>
<tr>
<td>4</td>
<td>50-59</td>
<td>Adequate achievement</td>
</tr>
<tr>
<td>3</td>
<td>40-49</td>
<td>Moderate achievement</td>
</tr>
<tr>
<td>2</td>
<td>30-39</td>
<td>Elementary achievement</td>
</tr>
<tr>
<td>1</td>
<td>0-29</td>
<td>Not achieved</td>
</tr>
</tbody>
</table>

The Annual National Assessments (ANAs) could not be used for the purpose of pre-testing as the DoE assessment does not distinguish between the various Learning Outcomes. I did ask the teachers to compare their baseline marks with ANA results, for interest, but the results of the comparison is beyond the scope of this study.

The five Learning Outcomes are weighted by the DoE according to the table below:

Table 3.3
*Weighting of Learning Outcomes in Mathematics for Grade 1 to 7*

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Intermediate Phase Grades 4 - 6 (Ages 10 - 12)</th>
<th>Senior Phase Grades 7 - 9 (Ages 13 - 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade 7</td>
<td>Grade 9</td>
</tr>
<tr>
<td>LO 1</td>
<td>40%</td>
<td>25%</td>
</tr>
<tr>
<td>LO 2</td>
<td>15%</td>
<td>25%</td>
</tr>
<tr>
<td>LO 3</td>
<td>30%</td>
<td>25%</td>
</tr>
<tr>
<td>LO 4</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>LO 5</td>
<td>15%</td>
<td>15%</td>
</tr>
</tbody>
</table>

I have included a copy of the Grade 7 pre-test to indicate how the baseline test was constructed using the delimitations according to Learning Outcomes as shown in Table
3.3. (see Appendix C). Table 3.3 shows the five Learning Outcomes and the time allocated as a percentage to each Outcome in the Intermediate and Senior phases. For example in Grade 7: 25 % of learners' time is dedicated to each of the first three Learning Outcomes: LO 1 Numbers; LO 2 Patterns; LO 3 Geometry whilst 10% is given to LO 4 Measurement and 15 % to LO 5 Data handling.

4.2 Implementation of exploratory talk to the teachers

According to Wenger (1999) children need to be able to talk about mathematics. Teachers needed to provide opportunities for learners to be able to talk and practice working together effectively in small groups. (Mercer & Littleton, 2007)
Once again I made use of the analogy of a funnel to illustrate the design of the intervention for introducing exploratory talk. The purpose of the intervention was for the teachers, and later the learners, to use their home language during exploratory talk. First ground rules needed to be negotiated. Initially use was made of Raven’s matrices to trigger or promote exploratory talk thereafter concept cartoons and curriculum word sums were used. Embedded in all the exploratory talk was code switching where teachers made use of their home language together with English.
4.2.1 Negotiation of ground rules

Teachers had to brainstorm ideas in their respective groups during the intervention as to what would be acceptable ground rules for group work. Some examples that they presented from their group discussions and wrote on newsprint were:

- Everyone is encouraged to contribute;
- Ideas and opinions are treated with respect;
- Information is shared;
- Challenges are welcomed;
- Reasons are required;
- Contributions could be built on what has gone before;
- Alternatives are discussed before decisions are taken.

Teachers learned experientially how Ravens items and concept cartoons could be used in their classrooms as a trigger to encourage children’s talking. Ground rules for group work were discussed whereby everyone in the group was encouraged to participate; information was shared; challenges of the answers supplied were encouraged, alternatives were discussed and the group worked towards an agreement. The teachers realised from their experience the value of negotiating ground rules for exploratory talk as they realised in their own working groups that some members tended to monopolise the conversation. They also realised how easy it was to discuss their answers and their reasoning in their home language, or to code switch. This resulted in discussions among the teachers where they acknowledged that by insisting that their learners use English, they were impeding the development of mathematical reasoning in their learners.

4.2.2 Raven’s Standard Progressive Matrices (RSPM)

The aim of the intervention was to trigger appropriate exploratory talk in a mathematical context. I started with RSPM items which required the teachers to select the missing piece to complete the given picture as well as to explain why they had selected that particular piece. I used this first as it tests reasoning without relying on language ability. There is no written text for the teachers to read and the language which they choose to discuss their answer is also not prescriptive. RSPM is culture- and language-free. No teacher knew the answers as they had not encountered the items before and they had to discuss their findings, developing appropriate discourse.
4.2.3 Concept cartoons

I chose concept cartoons as another trigger as they promote dialogue within a group, as members have to debate the options and discuss the given possibilities. They need to support their answers with reasons so that their reasoning is explicit. They had to use words “I think …” and “… because …” which are traits of exploratory talk.

A concept cartoon is an illustration showing a group of learners discussing a mathematical problem. In the concept cartoon used in figure 3.2 the children in the cartoon had to decide which fraction of the loaf they would choose if they were hungry. The possible options to the question included: $\frac{7}{12}$; $\frac{1}{2}$; $\frac{5}{16}$; $\frac{4}{8}$. The teachers were arranged in grade groups with one concept cartoon per group. The teachers had to read the comments of each child printed in the speech bubble above the child and decide which concepts were correct and which were incorrect - and give reasons for their opinions. They then had to provide an acceptable mathematical answer to the problem which they had to write in the empty speech bubble, so as to move from informal talk in mainly isiXhosa towards more formal mathematical Discourse in English.

As the group members went through all the possibilities in the speech bubbles it was evident that some agreed with the solutions that were offered, as they harboured similar misconceptions. The teachers needed to look at the validity of each option and finally write a correct solution giving a reason for their answer.
In order to understand the mathematical context of a concept cartoon a participant needs to be able to read and understand the text. The object of using concept cartoons was to get teachers to experience the power of exploratory talk in mathematical Discourse.

Figure 3.2 Example of Concept Cartoon  
During the intervention the teachers workshopped and analysed concept cartoons with the help of course notes that were developed for the intervention. An extract from the NMMU Mathematical Reasoning Study Guide (2011: 91) is reproduced:

In order to understand what to do with a concept cartoon a child needs to be able to read and understand OE (Ordinary English) and ME (Mathematical English). For this reading to lead to understanding and critical thinking the learners must practise a number of critical reading skills (Cf. Fractions Concept Cartoon):

1. Children may have to read and understand a question in OE (ordinary English) e.g.: Choose which fraction of the loaf you want:
   Children may have to read an equation using numerals and symbols and understand what mathematical operation they have to perform, for example:
   \[ 4 \div \frac{1}{2} = \]

2. Children then have to read the statements written in Mathematical English (ME) in the speech bubbles and identify whether the statements are true or false and give reasons in ME for their conclusions.

3. They need further to be able reason in order to:
   - Recognize and have knowledge of the mathematical concepts involved so they can think about the problem.
   - Identify what equations need to be used and apply them correctly.
   - Know their number facts, bonds and tables, well enough to calculate correctly.
   - Have sufficient mathematical knowledge to recognize whether an answer is correct or incorrect and whether the reasoning provided is adequate.
   - Recognize and explain misconceptions.

4. Finally, children need to have a sufficient knowledge of Ordinary English and Mathematical English in order to formulate statements which reflect their group findings and which provide reasons for their answers

The teachers experienced themselves the activities and strategies that they later introduced to their learners.

**4.2.4 Word sums**

Teachers experienced solving word sums using the acronym RUCSAC (Read, Understand, Choose, Solve, Answer and Check). This provided a structured approach to reading and understanding word sums based on Polya’s four problem solving strategies. This approach provided opportunities for teachers using their first additional language for learning mathematics, to learn the language of mathematics.
Many teachers admitted that they simply did not teach word sums because it was too difficult. The following approach was followed in the intervention and has been found by teachers to be very effective:

Activity:

**RUCSAC** – Read, Understand, Choose, Solve, Answer and Check

Dad picked three baskets of oranges with 24 oranges in each basket. When we cut them open, we found that 15 of the orange had worms in them. How many good oranges did we have?

**Read** the sum very carefully. **What is the important information?**

- 3 baskets
- 24 oranges are in each basket
- 15 oranges are bad

**Understand** the question. **What do you have to find out?**

How many good oranges there are.

**Choose** the correct operation or operations → X and –

AND

write out the number sentence → 3 x 24 – 15 = [ ] oranges

**Solve** the problem. Make sure that you do all the working out. (Calculations)

**Answer** the question. **What were you meant to find out?**

There are 57 good oranges.

**Check** your answer. If possible use the opposite operation to check your working out.

57 + 15 = 72 → then 72 divided by 3 = 24

An example of one of the exercises used in the intervention, to enable teachers to experience the power of the strategy, highlighted the various terms which could be used for the addition operation - which include add, combine, sum, increased by; and; plus; more than and total. From using terms in isiXhosa the teachers revoiced different options for the operation in English. They thus practised strategies that were useful in a multilingual mathematics class. They themselves worked through the following:

1. Circle all the numbers. Underline key words and questions.

My mother buys twelve (12) pairs of socks at R12.50 per pair. My brother, sister and I (3) share the socks equally.

a) How many pairs of socks do I get? (Number)

b) What did my mom pay for all the socks? (Money)

(a)

2. Write your number sentence: 12 ÷ 3 = _____ socks

(If learners don't know their tables teachers were encouraged to let them draw a picture, using dots to represent the socks.)

For example:  ****  ****  ****

3. Do your working out: 12 ÷ 3 = 4 pairs of socks

4. Answer the question: How many pairs of socks do I get?

5. Answer: I get 4 pairs of socks.

(b)

1. Read your word sum again making sure you understand the question.
2. Write your number sentence: \(R12.50 \times 12 = R\) 

3. Do your working out: 

\[
\begin{array}{c}
1250 \\
\times 12 \\
\hline
1500 \\
12500 \\
\hline
15000 \\
\end{array}
\] 

\[= R150,00\]

4. Answer the question: What did my mom pay for all the socks?

5. Answer: My mom paid R150,00 for 12 pairs of socks.


Teachers experienced first hand what their learners feel like in language diverse classrooms and they recognised the importance of scaffolding techniques to guide their thinking.

In another experiential exercise the teachers had to read the following transcript where they saw how learners challenge each other’s ideas and gave reasons for their statements even though they did not always use the format of “I think...because...”

They were given the following question and transcript of a section of learners’ talk:

A farm consists of 2 200 hectares. 5/11 of it cannot be ploughed. How many hectares of land can the farmer plough?

Girl 2: I think that we should ask how many hectares. How many hectares can the farmer not plough? I think it is 200 because 11 divides into 2200 and the answer is 200. So we need to subtract that 200 from the 2 200.

Girl 1: What about that 5?

Girl 2: Alright 5 x 200 is ...

Girl 1: 1000

Girl 2: Yes. And now we need to subtract that 1000 from the 2 200. What do you think?

Girl 1: I think so too. Because the 5/11 of 2 200 is 1000, which is 1 200 hectares.

(NMMU Mathematical Reasoning Study Guide, 2011:84)

The teachers discussed the transcript of the learners’ talk and had to identify characteristics of exploratory talk that could be present in the transcript. This was practised so that they would be able to identify instances of exploratory talk in their own classes.

In yet another exercise the teachers were asked in their groups to solve the following word sum problem.
It was interesting to note that all discussion in their groups took place in isiXhosa. In all the exercises the emphasis was on the implementation of discussion, in whatever language the participants felt most comfortable. This highlighted the importance of using the learners’ home language as a resource to make reasoning explicit.

The teachers also had to complete a questionnaire detailing an instance of exploratory talk which took place in their classroom. They also had to identify characteristics of the talk which identify it as being exploratory as well reflected on exploratory talk within their classroom (see Appendix I).

4.2.5 Code switching

Teachers themselves used code switching effectively in their groups when practising exploratory talk. An idea or concept was read in English thereafter teachers were able to talk about the concept in their small groups in isiXhosa, their home language. This is where the code switching was used so that they could make meaning using their home language in a small group situation where nobody other than their peers were listening. When they engaged in exploratory talk they began to transfer the maths concepts out of English into isiXhosa, although they used mathematical terms in English. They were encouraged to aim for understanding rather than formal written language, which is found in the bottom right hand corner of the Adler and Setati diagram (Setati & Adler, 2001:250). A similar transition applies when they read in English, discuss in isiXhosa and then have to record what they have decided in English. They are using the isiXhosa vocabulary in this instance as a support base to scaffold the development of formal mathematical language in English.

A family of five people need to cross a river. They have a raft which can carry a maximum of 100kg. To save time they want to make as few trips as possible.

- Jabu’s mass is 57 kg.
- Khaba’s mass is 85 kg.
- Linda’s mass is 38 kg
- Mandla’s mass is 60 kg
- Nandi’s mass is 35 kg

How can they get everyone across on the raft?
What is the smallest number of trips they can use to do it?
4.2.6 DVD: Sink or Swim

The motion picture, which was shown to teachers at the beginning of their intervention, was pivotal as it afforded the teachers attending the course the opportunity to listen to what English first language learners have to say when they have been taught Science in isiXhosa, which is their second additional language. Learners were unable to understand Science terminology in isiXhosa. This seemed to free the teachers attending the course to be able to say that they do in fact make use of their learners’ home language to teach mathematics. The DVD created a virtual community of practice with teachers in the Western Cape who experienced similar problems. The participants felt a kinship with others who experienced the same problems in language diverse classrooms.

4.2.7 Post-test

Once again the teachers had to conduct the post-test under similar conditions as the pre-test and mark their learners’ scripts and record these results on an analysis sheet. They had to use the conversion table to change the learners’ mark into a level. They had to count the number learners who had achieved each of the levels in each Learning Outcome and graph these results. This time the teacher had to do a comparison between the scores of the baseline assessment with those of the summative assessment detailing their findings. The teachers were tasked with writing a reflection on the comparison of scores between pre- and post-tests.

5. CHAPTER SUMMARY

In this chapter I have described the background of the participants and explained how the sample was selected. I have also detailed my rationale for conducting this research study.

I have named the instruments I have used and described what I did in order to be able to answer my three sub-objectives which in turn will inform my main objective.

- To identify teachers’ perceptions about language I made use of a language survey and teachers’ poetry.
- To ascertain if teachers could introduce dialogue in the form of exploratory talk in their maths classes I made use of a questionnaire, teachers’ reflective writing after introducing exploratory talk and the word sum strategy RUCSAC as well as the observation schedules of a research observer.
To determine if an intervention using language as a resource can improve mathematical levels I made use of a pre- and post-test and reflective reports from teachers.

The results of the data collection and discussion of the results follow in chapter four.
1. INTRODUCTION

In the previous chapter I outlined the research design and paradigm that informed my study and described the methods used to gather data in order to find answers to the main question that underpins this study, namely:

Can teachers use language as a resource to introduce strategies to teach mathematics in language diverse classes?

I will discuss the results gleaned from the instruments described in the previous chapter. I will discuss the results for:

- objective 1 using the language survey and teachers’ poetry
- objective 2 using reflective writing after the introduction of exploratory talk, reflective writing after the introduction of the RUCSAC strategy in the classroom as well as researcher observations
- objective 3 using the pre-and post-test results and reflective writing after the pre- and post-tests

2. DATA GATHERING

2.1 Objective One

I have made use of a language survey to ground teachers’ backgrounds in a milieu and I made use of teachers’ poetry to identify themes which informed me about their perceptions of language.

2.1.1 Language survey

I required quantitative data to explain the background of the teachers before they described their lives qualitatively in their poetry.

The language survey completed by 15 out of 22 teachers provided the following data. IsiXhosa is the home language of 11 of these teachers with the remaining four speaking English as their home language. The language chosen by the teachers in the classroom showed 11 used English, two spoke isiXhosa and two made use of both
English and isiXhosa. The predominant language used by learners in the classroom showed that seven believed the majority of their learners used English, three isiXhosa and five made use of both English and isiXhosa.

2.1.2 Teachers’ poetry

As an innovative means of evaluating perceptions, teachers were asked to write a poem about their inner feelings concerning language issues. They were encouraged to write in any language but to provide their own translations in English if they used another language so that they could be meaningfully understood by non-isiXhosa speakers.

From the poetry the following themes were coded and continually repeated:

- pride in their home language, isiXhosa;
- the universal communication of English;
- difficulty in learning English;
- challenges, frustrations and humiliations experienced;
- a political connotation

2.1.2.1 Pride in their home language

The following extract from one of the participant’s poem highlights the strong emotions teachers express about their pride in their African language with its special nuances.

We like our language and we are proud of it
Even if you can challenge us in a foreign language

AND

I love its clicks and sounds

2.1.2.2 The universal communication of English

The theme of global interactions through English is portrayed in the next extract:

Because you can easily communicate with the outside world.

AND

Language is the key to open your mouth
It is means of communication

AND
All institutions, starting at home make use of me
Others operate in silence using me
They may not be vocal but can read what they say
Schools use me as vehicle to communicate ideas
Moulding the young minds for better future
I am language, that's what they call me

AND

Without it you cannot write
Without it you cannot count
Without it education is for the rich
Without it you feel despondent

2.1.2.3 Difficulty in learning English

The following extracts highlight the theme of complexity and difficulty involved with learning English.

To learn a language is so difficult from the beginning
But at the end of the tunnel you will get a little light

AND

We can't write nor spell words
We can't sometimes translate

AND

Do you know how challenging it is
To learn something without your mother tongue?

AND

Think what it is like to be taught everything in the language you do not know
You proceed with a painful heart
You end up not liking school
You only go because you are afraid of your parents

The poignant longing for some improvement in their lives and the desperation of having an added burden of learning in a foreign tongue was clearly apparent. A distressing theme, insinuated into some poems, was the sense that, if they were only fluent in English, the social goods Setati (2005) and Gee (1994) mentions would automatically pour into their lives – “…it opens the doors.”
2.1.2.4 Challenges, frustrations and humiliations

Yet another theme includes the challenges, frustrations and humiliations experienced when one does not understand a simple instruction.

- Makes us shy and lets us feel humiliated
- You make us feel less popular
- We don’t hear nor understand others
- We can’t write nor spell words
- We can’t sometimes translate
- Because you are a language but
- Not a mother tongue

AND

- You see people laughing but you do not know what they are laughing at
- While you are asked to stand, and you sit down

The poets evocatively portrayed their sense of mortification and embarrassment in a world where they felt like outsiders. This concurs with Gee’s (1994) standpoint that people are positioned in practices as powerful or powerless according to the structure of the Discourse.

2.1.2.5 Political connotation

A political suggestion is also evident in a number of the poems.

- Language is the real weapon
- It makes a nation strong

One teacher makes use of a rallying cry, seemingly calling teachers into battle

- Forward teachers with the changes – forward!
- Forward teachers with the changes – forward!
- Our future is in your hands - forward!

These sentiments echo Setati’s (2005) standpoint that language is always political.

They did feel it was necessary to develop fluency in English as this is perceived as the language of power, language of mathematics, language for further education and for job opportunities.
2.1.2.6 Combination of themes

The first poem entitled “How I wish” was originally written in English by the teacher poet.

How I wish
To understand my teacher when talking
To be the first participant when grouped
To hear those praises referred to
“Well done Sipho. Keep it up”
Oh! How I wish it were me!

Is it me who takes long to understand?
Is it the teacher who does not explain?
Is it the language that prevents me from understanding?
“How I wish to know the maths”

Like my friend in a Private School
Talking about ‘discount’, ‘decrease’ and ‘loss’
While I only know ‘less’ or ‘subtract’
Talking about ‘increase’, ‘profit’ and ‘raise’
While I only know about ‘more’ or ‘add’

Although I try my best to pass
Language is my barrier
My teacher tries her very best
But this language comes in many ways

Homework is given to practice
Nobody at home can help me practice
Nobody understands the maths terminology
Come the maths period “Let me see your homework?”
“I couldn’t finish it teacher”
“Oh well, it’s detention for you!”

Oh! How I wish!
That more time could be spent on this language
So that I can understand maths more
To avoid boredom, avoid frustration
And dodging this period

Because it seems English is here to stay
As my mother is heard to say

This poem encompasses the themes of: English as a universal tool, the difficulty of learning English and challenges, frustrations and humiliations. The poet poses questions which link directly with the themes expressed by other teachers which I have
identified in the poetry, as well as with sentiments from other research as described in my literature review.

When the poet says “...English is here to stay...” she is echoing the theme that English is a universal communication tool. It is for this reason that parents choose English as the language of learning and teaching as they see it as a means to social goods (Setati, 2005). Parents believe that English is the language for further education and employment despite research to the contrary by Adler (2001), Moschkovich (2010) and Setati (2005, 2008) who have argued for the use of the learners’ home language as a resource in mathematics classrooms.

When the poet uses the lines, “Is it me who takes long to understand? Is it the teacher who does not explain? Is it the language that prevents me from understanding?”, she is highlighting the theme of the difficulty learners’ experience when learning in English. Setati and Adler (2001) found that in multilingual classrooms teachers have to teach English at the same time as they have to teach mathematics. Gee (1994) warns that mainstream dominant discourses privilege those who have mastered them and do significant harm to those who have not – the non-mainstream outsiders.

Many teachers are teaching mathematics in English which is not their home language. Learners have to cope with the language of mathematics as well as English, a new language as most learners have isiXhosa as their home language. The poet highlights this when she uses the words, “Nobody understands the maths terminology.” Cummins (1996) found that learners were struggling with ordinary English (OE), basic interpersonal communication skills (BICS), when they were expected to be performing at the mathematical English (ME) level which requires cognitive academic language proficiency (CALP) to be able to progress successfully in the classroom situation. Webb and Webb’s (2008) findings highlight that learners are often unable to express themselves fluently as they lack the vocabulary to be able to express themselves in English. Much of the time they do not understand English even if the teacher is using ordinary English (OE) before introducing the mathematical English (ME). In other words learners have not progressed along the continuum from informal talk in their home language towards formal spoken mathematical discourse in English.

The words “language is my barrier” and “to avoid boredom, to avoid frustration” are two examples which triangulate with the theme of challenges, frustrations and
humiliations expressed in the poetry and the literature review. This scenario was further highlighted when the teachers were shown the DVD: Sink or Swim, (Westcott, 2004) which highlighted the difficulties experienced by English speaking learners learning Science in a second language, isiXhosa, and how learners refrain from talking because they do not understand the questions posed by the teacher or lack the vocabulary to be able to answer the question. Some learners only hear English spoken at school and not socially. Learners also have to deal with mathematics terminology, expressions and phrases that are used in a mathematics class. When they go home parents are also of no help to them because some parents have not had advanced education.

“Nobody at home can help me practice. Nobody understands the maths terminology”

This often results in incompleteness of the task and also not doing their work at all. The language impacts on their mathematics as evident in the following lines from the poem:

“Let me see your homework?”
“I couldn’t finish it teacher”

The reader of the poem is swamped by a sense of needless helplessness expressed by the mythical mathematics learner.

The second poem I selected was written originally in isiXhosa. The teacher provided her own English translation.

**ULWIMI**

*Ndiyalathanda ulwimi lwam.*
*Ndaluncanca kumama wam.*
*Ndhanda nezandi zalo.*
*Alufani nezinye iilwimi.*
*Nangona amathuba alo emancinci.*

*Ndiv’intwmbi xa ndingaluva lutethwa.*
*Ndiv’intwembi xa ndilulahla.*
*Ngenxa yemeko ezithile.*
*Ngenxa yokuyanzelwa yimpangelo.*
*Ngenxa yokunyanzelwa yimfundo.*

*Kunzima ukufunda into ungayiqondi.*
*Uyfuna ukuyiqonda uxakw’elulwimi.*
Lwimi ndini endingalaziyo.
Ndifuna ukulithetha ntonje,
Ndixakwa sisigama.

Ngubani ongnadikhupha kule mbandezelo?
Ngubani ongnandicedayo kule ngcinezelo?
Akukho bani undivayo,
Akukho bani ongandihlangula.
Lwimindini undivalela amathuba.
Lwimindini undivimba ulwazi.

Translation by poet
I love my language
It is my mother tongue
I love its clicks and sounds
It’s different from other languages
I’m worried when it is forbidden
Due to education and work purposes
It’s difficult to learn
when you don’t understand the language
You want to express yourself
You don’t have the vocabulary
Who can rescue me from this misery?
Who can free me from this oppression
No one hears me
No one can save me
This language hinders me
From acquiring knowledge
It hinders me from reaching my goals.

This poet highlights the pride she feels for her home language with its unique clicks.

I love my language
AND
I love its clicks and sounds
She mentions the difficulties and challenges faced when one does not understand the language of instruction and her inability to express herself in her new language.

It's difficult to learn
when you don't understand the language
You want to express yourself
You don't have the vocabulary

The importance of language to communicate in order to learn and for work purposes is mentioned.

No one hears me
No one can save me
This language hinders me
From acquiring knowledge.

The power of language is expressed as well as the overt political overtones with the use of the word “oppression,” particularly in a South African context. Oppression is no longer because of race but is still insidiously evident in the hegemony of English.

It hinders me from reaching my goals
AND
Who can rescue me from this misery?
Who can free me from this oppression

A further selection of teacher’s poems encompassing the themes that have been identified can be found in Appendix G.

2.2 Objective Two

I will make use of the teachers’ reflective writing on the introduction of exploratory talk and the introduction of word sum strategies as well as information from a researcher observer to ascertain whether teachers could increase dialogue by introducing exploratory talk in their mathematics classes.

2.2.1 Teachers’ reflection after exploratory talk

Using RSPM items provided an opportunity for experiential learning which had teachers talking in their home language, an indication of what their learners would do. This showed how language could make the powerless powerful (Gee, 1994).
Data concerning teachers’ feedback after the introduction of exploratory talk into their mathematics classes was drawn from their reflective writing submitted at intervals throughout the intervention after the introduction of exploratory talk (see Appendix I) and the introduction of word sum strategies.

- **Instances of exploratory talk**

  An example of an instance of exploratory talk that developed in one teacher’s classroom is detailed below:

  How many quarter hours in 75 minutes?

  Person 1: We need to divide because there are 15 minutes in a quarter of an hour
  Person 2: Yes I agree
  Person 3: No, what if we divide 75 by 5
  Person 4: I think we are mistaken if we divide 75 by 5 we’ll get 15 quarters
  Person 5: Would you divide 75 by 15?
  Person 6: Could we have done it otherwise.

  She felt the above transcript was an example of a lesson which used exploratory talk as words such as ‘because’, ‘I agree’, ‘I disagree’, ‘I think’, and ‘could’ were used effectively. Reasons were given for all suppositions and counter arguments were backed up with justifications.

  A further instance of exploratory talk was transcribed as follows:

  **Jonas:** John’s father said a third is for the parents. I wonder how much is left for all the four children?
  **Kate:** Let’s see when we cut this apple into three equal parts. Kubaitthird,sijonga i-denominator cause the denominator isixelele zingaphi iipieces then i-numerator isixelele zingaphi ii-pieces ezisebenzileyo or ezishiyekileyo.
  **Bulelwa:** It means xa sibeka ecalenii-third,abantwana bona bashiyeka nezimbini ii-pieces.
  **Kate:** Children will get smaller pieces than their parentskuba banintsi bona.
  **Bulelwa:** No, asikwazi kutsho cause asigqibanga ukuyi-calucate(a).
  **Jonas:** First we need to change the integers into fractions so that we can be able to calculate.
  **Bulelwa:** We have \( \frac{2}{3} \) for abantwana abayi-4. We can write it as \( \frac{2}{3} \div \frac{4}{1} \).
This was identified by the teacher as an instance of exploratory talk because the learners were giving reasons or explanations for their answers. She also commented about the use of the home language, which enabled the learners to express their reasoning.

Code switching and supporting learning through use of the mother tongue while developing the language of learning and teaching were described by the teachers in their transcripts. This was similar to the findings of Moschkovich (2010).

- **Identifying characteristics of exploratory talk.**

  One teacher justified her transcript as she explained Mercer’s (1995) characteristics of exploratory talk as:

  The characteristics which identified the talk as being exploratory included the wording “I think... because.” when they were making their argument. They had to give a reason for their answer. Learners were all given the opportunity to listen and to speak.

- **Reflection on exploratory talk.**

  From the participants’ reflections several themes emerged repeatedly:
  
  - Learners’ involvement in the lesson
  - Building of learners’ confidence
  - Increased use of code switching by learners
  - Developing a more positive classroom climate

  - Learners’ involvement in lesson

  The theme of involvement and engagement was mentioned by many teachers to which the quotes from their reflective writing attest.

  Learners were actively involved in the lesson and were talking amongst themselves.

  AND

  It engages the learners more effectively because they become part of the discussion in the lesson.

  AND

  Prior to attending the course my learners did not want to talk in class. If I put them in groups they would always fight as some would dominate and overpower the slower learners.
Until they had introduced exploratory talk in the classroom the teachers had not thought much about their learners’ involvement in the mathematics lessons. Their silence was perceived to be “listening attentively”.

- **Building of learners’ confidence**
  
The teachers felt that the exploratory talk helped learners to build confidence and realise they have a valuable contribution to make to the lesson.
  
  Learners grew in confidence as they listened to one another and gave each other the chance to speak in a group situation.
  
  AND
  
  It even encouraged the quite (sic) learner to get involved. They were eager and excited to get involved and shared their information.
  
  These findings echo the views of Janks (2010) who observed that learners’ confidence increased when they were allowed to speak in their language of choice. These quotes show that learners within a group formed a community of practice (Wenger, 1999).

- **Increased use of code switching by learners**
  
The teachers mentioned that the learners seemed to understand better when they themselves code switched or spoke in a language they understand amongst themselves as the participants explained.
  
  I pride myself on only teaching in English but notice that my class is switched off.
  
  AND
  
  I need to bridge the language gap between Grade 3 and 4 with the switch of medium of instruction from isiXhosa to English.
  
  AND
  
  I have to translate for them into their mother tongue.
  
  When learners are able to use their home language to support the LoLT they are able to enhance their conceptualisation in mathematics (Vorster, 2008).

- **Developing a more positive classroom climate**
  
  When a teacher exposed her learners to working in groups or pairs she noted a positive attitude amongst the learners in her class.
  
  As soon as learner confidence increased less copying took place, homework tasks were done more regularly, absenteeism rates dropped. Learners were no longer
passive in class as they were free to express and opinion or ask a constructive question.

AND

A positive climate is conducive to learners being willing to try new strategies as they feel safe and secure.

2.2.2 Teachers’ reflection on RUCSAC

The following sentiment was echoed, in various ways, by all the teachers who attended the course.

If I must go back and think how I hated teaching word sums to my learners, I am so relieved that it is not a “mountain” that I have to climb any longer.

They felt that prior to the intervention they avoided the teaching of word sums. The teachers also felt that the lack of reading and comprehension skills also had a role to play.

If you write the problem like this $7 + 9 = \underline{}$, learners will attempt to solve it. If you write it like this: seven plus nine, it becomes a problem.

During the intervention teachers were introduced to RUCSAC with steps that they could follow to solve word sums. In turn the teachers then had to teach and implement this strategy to their learners. A teacher physically brought a rucksack to emphasise the strategy.

I first introduced the RUCSAC to my learners practically. I used my backpack and took out one letter at a time, explaining the process. After that I explained the steps using one of the sums that were given to me at the workshop.

Learners were taught to underline new, difficult or important words and circled numbers even if they appeared as words. An example of a learner’s work has been scanned to illustrate this.
Learners were allowed to sit in groups and discuss their word sums using the tenets of exploratory talk. One teacher felt that she could sense their “AHA!” moments, when they understood what was expected of them. RUCSAC was a popular tool for both the teachers and the learners. After the introduction of the RUCSAC strategy together with the consistent emphasis on exploratory talk “word sums became easy.”

It was noted that a number of teachers reported an eagerness to do word sums on a more regular basis as the learners enjoyed being able to share their ideas and work in groups which helped them to understand certain concepts better.

My learners enjoy mathematics especially the word problems because they understand what to do by following the different RUCSAC steps.

AND

The learners all want to know when it will be their turn to report back to the class from their group findings. Since the intervention one teacher says, before this course my learners were mostly passive onlookers, but now they are active participants.

A concern of mine was that initially everyone used the same word sums for Grade 4 to 7. An example from a Grade 7 learner’s book is as follows:

Figure 4.1 Scanned example from learner’s workbook
Paula has 3 ribbons. Nicky has twice as many ribbons as Paula. How many ribbons does Nicky have?

A sample of grade specific word sums were developed by one of the intervention presenters. Examples of Grade 7 appropriate word sums can be found in Appendix H.

2.2.3 Teachers’ reflection after intervention

Teachers all felt that the changes that they had implemented in their respective classes were very effective because their learners now enjoyed coming to the maths class because the work was not as difficult or boring as it was before. They mentioned the following:

- changes that they had made to their teaching practice to enhance the learning of mathematics in their classroom.
- responses to activities and changes in classroom climate before and after the intervention.

**o Changes to teaching practice:**

Teachers reflected on changes after they had attended the intervention course. Some examples are detailed below:

Frequently use the terminology that learners must know and make use of code switching.

**AND**

Make use of concrete apparatus.

**AND**

Allow learners to talk in groups using exploratory talk.

**AND**

A baseline assessment is an essential tool to establish learner’s prior knowledge and identify barriers they may experience.

**o Responses to activities and changes in classroom practice before and after the intervention.**

Teachers highlighted changes that they had noticed in their classroom and commented on strategies that they had implemented in their classrooms after intervention.

Strategies taught during the course are worth implementing because it empowered me so I could assist and motivate my learners.
Strategies helped me to improve learner performance in mathematics.

AND

Through exploratory talk learners interact in their home language.

AND

I mix the two languages during the teaching time to help my learners.

AND

The introduction of the acronym RUCSAC was found to be a most effective as a tool to assist learners when dealing with word sums.

Creating a positive classroom climate was deemed by the teachers to be very important and conducive to learning.

Prior to intervention learners were passive as if they were empty vessels. The classroom environment was dull and learners were not co-operative. Learners had a tendency of not doing their homework.

AND

It is important for teachers to praise learners as well as emphasise the positive as this will in turn boost learner’s confidence and motivation.

AND

Exploratory talk helped me to create a classroom atmosphere in which learners feel free to participate and respond to questions.

Most teachers reported a change of approach as to how they taught mathematics. The teachers are enjoying the mathematics themselves because they gained information about strategies on how to administer a pre- and post-test and how to introduce their learners to exploratory talk using concept cartoons and the RUCSAC method of doing word sums. Teachers felt more comfortable when they stood in front of their learners. The teachers also noted a change in their learners’ attitude to mathematics. The learners also have learnt to respect each other and no longer laugh if someone gives the wrong answer. Learners feel at ease to come and the teacher to explain if they do not understand. The atmosphere in the classroom is also more relaxed.
2.2.4 Researcher’s Observations

I interviewed one of the researchers who observed lessons in the teachers’ classrooms. I did not want to take the teachers’ views at face value thus I was corroborating their statements with those of the researcher.

She reported that prior to the introduction of exploratory talk children were seated in groups but there was no evidence of effective group work. The following were absent from lessons observed: collaborative learning, word sums; open ended questions and discovery learning. There was also no evidence of written tasks which would demand reading in English or word sums which required writing answers in English.

However, this was not the case after intervention. She reported that there had been a noticeable improvement in learner participation on most classroom observation sheets. She found that after the intervention there were recognisable instances of exploratory talk taking place.

An example follows of a typical rubric assessment which was used towards the end of the intervention. This shows that the number of level 1s had decreased. Initially most teachers were at a level 1 but after intervention there were fewer level 1s and more level 2s and even some level 3s.
Figure 4.2 Rubric assessing exploratory talk in classroom

The teachers saw the research observer as a resource who was not judgemental. They constantly asked for her to come and observe their class or to watch a special lesson so that they could share their successes with her. The learners became familiar with the research observer being present and she was not perceived as an outsider.
2.3 Objective Three

The teachers’ reflective writing consisted of two parts the first before the intervention to identify mathematical topics from the baseline test that would require special attention and second after intervention had taken place in order to gauge if there had been an improvement after the intervention. Themes that emerged from the reflective writing included:

- Barriers to learning
- Pre-test
- Post-test

2.3.1 Barriers to learning

After marking their learners’ pre-test teachers had to identify the mathematical topics which their learners were struggling with. The most commonly mentioned barriers were language and their difficulty with reading and talking. The majority of teachers mentioned a language problem.

Learners have the problem that they are taught in school in a language that is different from their primary or home language.

AND

They are especially in Maths classes, nervous, not interested, bored etc. The result of the language problem leads to academic failure.

Mathematical literacy is a language by itself, and if the learners don’t understand it, they have a problem with maths.

AND

They speak in their home language when at home and amongst friends, so the only time they hear the LoLT is when they are in the classroom.

AND

When learners are taught in a different language than their home language, it helps to code-switch when you find they don’t understand, and in cases where they don’t understand their home language, ask learners to translate.

AND

When the teacher teaches isiXhosa learners in English, and the teacher cannot speak the language, it immediately influences the atmosphere in the class. Learners and the teacher are stressed. The learning environment established by the teacher can support or hinder pupils learning.
The teachers mentioned their learners’ difficulties with reading English in the following quotes:

Learners have difficulty in understanding the written instructions given by educators. They cannot read fluently and struggle with comprehension of what they have read. They get confused and are not certain what the teacher wants. They show their confusion by giggling, afraid to answer, blank stares.

AND

The poor ANA and Common Examination results are directly linked to the language and reading problems in my school.

AND

The fact that the question paper consists of a lot of reading and comprehension, they find it difficult to cope.

2.3.2 Pre-test

The assessment was to test the learners’ prior knowledge in the five learning areas which were detailed in chapter 3. One teacher reported that the learners in her class were nervous because she had never administered a formal test before to determine their competencies. Therefore she decided to tell her class that she was going to give them a test based on each of the learning outcomes in maths.

Some did not understand the questions while others did not have the ability to read the questions.

One teacher analysed the findings of her Grade 6 class’s baseline assessment according to the different learning outcomes as follows:

Language barrier in numbers and relationships (LO 1)

In Learning Outcome (LO) 1 there were word sums which they could not do due to their reading problem, and the two given numbers just had to be added. Many wanted to ask the learner next to them for help instead of me.

The results of the baseline assessment were poor especially in LO 1 where all the learners scored a level 1. This told me that they could not read, comprehend, recognise mathematical language, count, calculate etc.

Number Patterns (LO 2)

In LO 2, more than half of my class scored a level 3 or 4. This is because they have the ability to recognise which numbers were missing, but they found describing the pattern in their own words problematic.
Shape and geometry (LO 3)

Most or all of my learners scored either a level 3 or level 4. This means that my learners could cope in this LO because a level 3 means achieved and a level 4 means outstanding or excellent.

Measurement (LO 4)

Thirty seven of my forty learners scored a level 1 (attempted – but not achieved) and a level 2 (partially achieved). They had very little measuring skills and knowledge of measuring units.

Data Handling (LO5)

In LO 5 the competency level ranged from not achieved to excellent.

Another teacher’s grade 4 graph results are detailed to show how the teachers collated their results and represented them graphically.
Chapter 4: Results and Discussion

Figure 4.3 An example of pre- and post-tests graphed results for LO 1 to 5
Chapter 4: Results and Discussion

The graph reflected the five learning outcomes with the four levels and their pre-and post-test results that were graphed. It made for easy analysis to see if the high number of level 1s in the pre-test dropped significantly in the post-test and the number of level 3 and 4s increased in the post-test.

2.3.3 Post-test

Following the strategies that the teachers implemented after intervention these are the results from one grade 6 teacher’s learners in the post-test. In LO 1 her learners achieved 24 level 1s; 11 level 2s and 5 level 3s and the level 4s increased by 375%. This increase can be attributed to a better understanding of patterns after much practical work using counters, beads etc. In LO 3 there was a 50% decrease in the number of level 3s and a 50% increase in the number of level 4s. Learners were now able to identify 2D shapes and understand the vocabulary of faces, vertices and edges. In LO 4 the level 1s decreased and the level 3s increased. In LO 5 there was a 64% decrease in the number of level 1s and 2s and the number of level 3s and 4s increased by 64%. She analysed the results and concluded.

The learners have a better understanding of graphs and interpreting graphs after we did this section practically.

I will report on the learners’ pre and post test results to ascertain whether an intervention which uses language as a resource could improve mathematics levels. This research study investigates if the strategies which teachers experienced resulted in any noticeable changes in learner performance over time i.e. if results improved from the pre-test which was carried out in February prior to intervention and the post test which was conducted after intervention nine months later.

2.3.4 Comparison pre- and post-test results

Initially teachers were tasked with designing their own pre-test based on the previous grades work. It was only once the teachers handed in their baseline tests they had designed that the presenters of the intervention realized the original task was too ambitious as the teachers were experiencing difficulty with asking a variety of questions theirs were mainly all level one questions (simple recall). They mostly covered LO 1 (Numbers) and there was little on LO 3 (Space and Shape) and LO 5 (Data Handling). Each teacher received a grade specific copy of a baseline assessment which covered a variety of different ways of asking questions and it covered all five learning outcomes. The teachers could use the baseline assessment with other classes as an exemplar.
The teachers felt that a pre-test was useful if done at the beginning of a grade to enable them to be able to identify their prior knowledge and to identify which areas were problematic and needed more focus.

One teacher stated that from the test results she was:

Able to establish what learners know from the previous grade and it assists teachers with planning.

Teachers were able to highlight the areas and concepts which learners were experiencing difficulty with and identify instances where they had to go back to re-teach a section of work prior to starting with their current grade’s work.

### 2.3.5 Graphical representation of results

I have decided to represent LO 1 (Numbers) and LO 3 (Space and Shape) graphically as I believe they are two important learning outcomes that continue into algebra and geometry. The other three learning outcomes I have tabulated for easy access to how results changed from pre-test to post-test.

#### Grade 4 LO 1 Results

I shall be reporting on the total number of Grade 4s results and will not specify results of individual teachers unless a class had data that contradicted the trend.

![GRPADE 4: LO 1 RESULTS](image)

n(pre-test) = 151; n(post-test) = 151

*Figure 4.4 Distribution of Grade 4 LO 1 Pre- and Post-test results*
The number of level 1 and 2s decreased and there was an increase in the number of level 3 and 4s. This is despite Grade 3 learners being taught in their home language and the jump to being tested in English at the beginning of Grade 4.

Common areas of difficulty from the grade 4 to 7 teachers’ comments about their learners’ improvement in the post-test on LO 1 include:

- the four basic operations,
- place value,
- mathematical language
- word sums.

Examples that the Grade 4s battled with in basic operations include the sums:

\[ 546 + 567 = \quad \text{AND} \quad 800 - 654 = \]

The teachers reported a general trend that the Grade 4s were unable to carry or borrow a number when asked the sums given above. For example, learners were generally unable to answer the following question from the pre-test correctly:

What is the value of the underlined digit in the number 473?

as they lacked the correct understanding of place value. The teachers commented that this was the first time that they had looked at learners’ results with a diagnostic gaze. Previously they had seen their learners as ‘passing’ or ‘failing’ but had not teased out the causes for the learners’ misconceptions. Lengthy discussions ensued with the teachers sharing their learners’ difficulties in individual questions. They involuntarily moved into discussions about strategies to remediate their learners’ difficulties.

![GRADE 5: LO 1 RESULTS](image)

*Figure 4.5 Distribution of Grade 5 LO 1 Pre- and Post-test results*
n(pre-test) = 156; n(post-test) = 156

In grade 5 there was a decrease of 69% in the number of level 1s in the post-test and an enormous increase of 371% in the number of level 4s in the post-test. The teachers claimed that the increase could be ascribed to the intervention methods that teachers were exposed to.

Examples which they Grade 5s found difficult in basic operations included:

6 337 + 1 986

AND

4 163 - 2 492

One teacher commented that his learners struggled in calculating the four basic operations especially in subtraction and addition in the same way as they did in grade 4. Their weakness was once again the concepts of ‘borrow’ and ‘carry.’ This implied that although the numbers were 10 times greater than in grade 4, the learners still had not mastered the skill of borrowing and carrying. Again in groups, the teachers’ talk turned to ways of remediating the situation.

In grade 5 the questions on place value were similar although larger numbers were used:

Write down the value of the underlined digit e.g. 3 503

AND

Write the value of the 7 in each of the following numbers: 107; 71 304; 70

Again the learners displayed a lack understanding in place value or they may not have understood the sense of the question. This led to a discussion on how confusion is not allayed from one year to the next. Language once again had a role to play in mathematics. The teachers’ code switched the terms ‘borrowing’ and ‘carrying.’ The learners lack of understanding of the language increase their sense of being non-mainstream outsiders. (Gee, 1994).

One teacher mentioned that she had to explain the word ‘product’ in the pre-test question:

Find the product of 159 and 6
whilst another teacher had to explain the terminology of ‘ascending’ to her class in the example:

Arrange each row in ascending order: 102; 201; 112; 222

Learners once again need to make use of their home language as a resource to confirm what the terminology is requiring them to do.

Grade 6 LO 1 Results

![GRADE 6: LO 1 RESULTS](image)

n(pre-test) = 139; n(post-test) = 139

*Figure 4.6 Distribution of Grade 6 LO 1 Pre- and Post-test results*

Once again after the intervention there was a decrease in level 1 and 2 in the post-test compared with the increase in the number of learners who achieved a level 3 and 4.

As with grades 4 and 5, a common theme for the difficulties that the learners experienced as expressed by the grade 6 teachers’ were the four basic operations. In Grade 6 the examples are more complicated; however, the basic mathematical principles are the same as for grade 5. In this instance learners forgot to include the place holder ‘zero’ when multiplying by ten in the following examples:

Multiply a 3 digit number by a 2 digit number e.g. 123 x 45

OR

Find the product of 134 and 23

OR

Long division sums e.g. 4 682 ÷ 24 were not well answered by the majority of the learners
The use of language especially in the grade 6 paper had a pivotal role to play in the understanding and ability to answer the questions being asked.

Grade 7 LO 1 Results

![Grades 7 LO 1 Results](image)

n(pre-test) = 110; n(post-test) = 111

*Figure 4.7 Distribution of Grade 7 LO 1 Pre- and Post-test results*

From the graph above concern is highlighted by the fact that 44% of the learners who wrote the pre-test scored at a level 1 which represents “not achieved” for the section on Numbers, Operations and Relationships. After the intervention the number of level 1s in the summative assessment decreased by 27% and there was an increase in the number of level 3s and a significant increase of 12% in the number of learners who achieved at a level 4. The teachers maintained that this increase could be attributed to the intervention programme.

2.3.6 Reflective writing after post-test

Again Grade 7 teachers’ comments about their learners’ difficulties were focused on the four basic operations, although in grade 7 the examples in the pre- and post-tests were more complicated. They also commented that in the pre-tests the majority of their learners had difficulties with word sums.

e.g. Mary earns R 3 468 per month and her friend Patsy earns R 850 per week. Who earned the most at the end of the month? (Show your working out.)

Long division was again another cause for concern e.g. Divide 78 948 by 12
Teachers commented that some learners calculated and wrote a remainder whether there was one or not because they were under the perception that when calculating long division there must be a remainder.

LO 1 is our common problem because our learners are very scared of word sums. Even as teachers we don’t often do word sums. Also they hate problem solving because they do not understand the language, others cannot even read.

I have opted for a table to report on LO 2 (patterns, functions and algebra) results.

Table 4.1

*Grade 4 to 7 LO 2 Results*

<table>
<thead>
<tr>
<th>LO 2 RESULTS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Grade 4</td>
<td>51</td>
<td>26</td>
<td>35</td>
<td>37</td>
</tr>
<tr>
<td>Grade 5</td>
<td>23</td>
<td>16</td>
<td>50</td>
<td>29</td>
</tr>
<tr>
<td>Grade 6</td>
<td>77</td>
<td>47</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>Grade 7</td>
<td>42</td>
<td>35</td>
<td>29</td>
<td>24</td>
</tr>
<tr>
<td>TOTAL</td>
<td>193</td>
<td>124</td>
<td>138</td>
<td>115</td>
</tr>
<tr>
<td>%</td>
<td>34,8</td>
<td>22,3</td>
<td>24,9</td>
<td>20,7</td>
</tr>
</tbody>
</table>

n (pre-test) = 554; n (post-test) = 555

In this Learning Outcome only 31% and 9, 2% of the grade 4 to 7s performed at the achieved or outstanding level i.e. levels 3 or 4 in the pre-test. After intervention it was most reassuring to note the drop in the number of level 1s from 34,8% to 22,3% and quite a considerable increase in the number of level 3 scorers from 31% to 42,7%. The level 4s increased from 9,2 to 14,2%

The difficulties the learners had in grade 4 with LO 2 examples were with examples such as:

Complete this pattern by filling in the next three answers:

30; 60; 90; ________________
Learners’ difficulties could be attributed to the fact that in grade 4 they did not understand the word pattern, for example. The same difficulty was encountered in grade 7 where the learners struggled to understand what was required especially when the letter n was used as in the following pre-test example.

Which of the expressions will help you to find the \( n^{th} \) term in the sequence? 3; 9; 27; 81

- a. \( n^2 \)
- b. \( n+3 \)
- c. \( 3n \)
- d. \( 2n+1 \)

One teacher remarked that the impression he got was that LO 2 was not completed in the previous grade, or not done in detail.

The use of ME language increases with each grade and deliberate scaffolding is needed by teachers in language, code switching and discourse as a more sophisticated discourse is necessary in grade 7 where mainly English only is spoken,

**Grade 4 LO 3 Results**

This section deals with shape and space.

![Diagram of Grade 4: LO 3 Results](image)

n(pre-test) = 151; n(post-test) = 151

*Figure 4.8 Distribution of Grade 4 LO 3 Pre and Post-test results*

In grade 4 in LO 3 the level 1s decreased by 68% whilst the number of level 2, 3 and 4s increased collectively by 213%.
A number of learners in Grade 4 were able to match the shape with its correct name as well as differentiate between 2D and 3D shapes. However, they found a question on the difference between a square and a rectangle most challenging. The former could be attributed to the increased use of Mathematical English and the transition year from home language to English.

**Grade 5 LO 3 Results**

![Figure 4.9 Distribution of Grade 5 LO 3 Pre- and Post-test results](image)

n(pre-test) = 156; n(post-test) =156

**Figure 4.9 Distribution of Grade 5 LO 3 Pre- and Post-test results**

The number of level 1s decreased by 62, 4 %. The percentage increase in level 3s was 207, 7% whilst the percentage increase in level 4s was 733,3%.
Grade 6 LO 3 Results

After the intervention the number level 1s decreased by 47.7% and the level 4s increased by 250%.

The question with which the grade 6 learners had most difficulty was where they had to match 3D shapes with mathematical names and identify the number of faces for each shape. Learners knew the names of shapes but did not know how to write them.

Language once again has a role to play in hindering mathematical competence.
Grade 7 LO 3 Results

Figure 4.11 Distribution of Grade 7 LO 3 Pre- and Post-test results

In Learning Outcome 3 it was most concerning to note that the number of level 1s, (not achieved), increased from 49 in the pre- test to 61 in the post- test whilst at the same time the number of level 4’s dropped from 35 in the pre to 27 in the post test.

One teacher’s results resulted in the grade 7 results being skewed as he was unable to relinquish total control of the class. An in depth quantitative study of the grade 7 LO 3 results could shed more light on the reasons for this anomaly.

Teachers’ reflected that:

Learners’ had no background of space and shape

AND

Vocabulary such as vertices, faces and edges as well as the word tetrahedron gave learners problems.

AND

I think on this one I should teach starting at the level of grade 4 because it seems as if they have no ideas of shape and space.

Teachers felt they were reluctant to teach LO 3 because they found this section very difficult and they themselves struggled with the terminology of faces, vertices and edges.
Table 4.2

*Grades 4 to 7 LO 4 Results*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Grade 4</td>
<td>117</td>
<td>85</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Grade 5</td>
<td>45</td>
<td>29</td>
<td>37</td>
<td>28</td>
</tr>
<tr>
<td>Grade 6</td>
<td>60</td>
<td>22</td>
<td>26</td>
<td>31</td>
</tr>
<tr>
<td>Grade 7</td>
<td>55</td>
<td>31</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>TOTAL</td>
<td>277</td>
<td>167</td>
<td>98</td>
<td>104</td>
</tr>
<tr>
<td>%</td>
<td>50</td>
<td>30,1</td>
<td>17,7</td>
<td>18,7</td>
</tr>
</tbody>
</table>

n(pre-test) = 554; n(post-test) = 555

The LO 4 results show that 50% of grade 4 to 7 learners were functioning at level 1 and 18% at a level 2 in the pre-test. After intervention level 1s decreased to 30% and the number of level 3s increased to 34%. The number of level 4s increased to 19%.

According to teachers’ learners struggle with conversions in LO 4.

* e.g. How many minutes in half an hour?

* AND *

Use a train schedule to determine how long the train stops at Station A?

<table>
<thead>
<tr>
<th>STATION</th>
<th>ARRIVES</th>
<th>DEPARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>09:50</td>
<td>10:05</td>
</tr>
</tbody>
</table>

* AND *

Convert 2h to minutes

* AND *

Change 3.10p.m. to a 24 hour time

Further comments from the teachers in their reflective writing included concerns about learners’ difficulties in LO 4:

They struggle with how to do time sums and converting minutes to hours as well as writing digital and analogue time.
AND

Learners struggle with conversions of cm to m or km.

Teachers found that learners could identify angles but struggled with the manipulation of a protractor as well as experienced problems with conversions.

Table 4.3

Grade 4 to 7 LO 5 Results

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Grade 4</td>
<td>120</td>
<td>92</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Grade 5</td>
<td>42</td>
<td>23</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>Grade 6</td>
<td>108</td>
<td>59</td>
<td>18</td>
<td>37</td>
</tr>
<tr>
<td>Grade 7</td>
<td>52</td>
<td>43</td>
<td>42</td>
<td>43</td>
</tr>
<tr>
<td>TOTAL</td>
<td>322</td>
<td>217</td>
<td>113</td>
<td>116</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>58,1</td>
<td>39,1</td>
<td>20,4</td>
<td>20,9</td>
<td>11,7</td>
<td>17,1</td>
</tr>
<tr>
<td></td>
<td>23,2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n(pre-test) = 554; n(post-test) = 555

The LO 5 results show that 58,1% of the learners were functioning at a level 1, after the pre-test. After the intervention these level 1 figures decreased to 39,1%. The increase in the number of level 4s from 59 to 129 represented a 118,6% increase.

Language was considered by the teachers to be the greatest obstacle to learning because the learners struggle to decode the questions such as the pre-test example.

What is the difference in rainfall between 2002 and 2003?

The teachers themselves felt very vulnerable when they had to graph their learners' results as some did not know how to draw a graph accurately. They teach the section on graphs in their classes, yet many teachers were unable to draw and to interpret the required graphs themselves. During the intervention the teachers were guided as to how to convert the raw data from the pre- and post-tests to a bar graph and how to analyse the graphs meaningfully.
The teachers found that the baseline assessment task took far longer than initially anticipated. This was as a result of all the questions learners asked as well as the translation of English into isiXhosa seemed necessary for clarity. It was found that where teachers translated the questions learners were willing to tackle the problem. For future deliveries of the intervention each learning outcome will be tested separately, prior to that section of work being covered as part of the curriculum in class.

The teachers found the baseline assessments useful in that they highlighted a number of barriers that teachers and learners face when they teach and learn mathematics in English, their second language. They commented:

- I explain in English and more than 70 % of our learners' mother tongue language is isiXhosa.
- Need to translate before being able to solve actual problem.
- Have limited vocabulary and do not understand mathematical terminology.
- My learners were unable to read with understanding.

Other difficulties experienced by teachers with the baseline assessments included:

- Lack of writing skills. Many Grade 4 learners were unable to construct a sentence.
- Assessment task printed in English only.
- Wording of some questions.
- Assistance needed with how to remediate learners who are struggling.

One teacher commented that she noticed that as soon as her learners struggled with the language in the mathematics paper they tended to give up. They found the paper long, with too much writing.

Pupils were very slow and could not finish the paper in one day.
The analysis of learners’ results and teachers’ reflections suggests that the intervention strategies significantly improved learners’ results. The strategies which were work shopped as part of the intervention and then introduced into the multilingual mathematics classes seemed to have influenced learners’ abilities significantly. The teachers specifically mentioned the changes that they felt exploratory talk, code switching and the RUCSAC method of solving word sums made to the classroom climate, their learners’ attitudes and their learners’ mathematics results.

3. CHAPTER SUMMARY

In this chapter I have identified themes that emerged from the teachers’ poetry where they wrote poems about their inner feelings concerning language issues. The themes of the hegemony of English, pride in their home language, isiXhosa, difficulties in becoming proficient in English, and the concomitant frustrations thereof, and the political power of language resonate with themes mentioned by other researchers such as Adler, Setati and Gee.

The usefulness of a baseline assessment at the beginning of a section highlights what the learners do and do not know. I have collated the pre- and post-test assessments and have analysed the results as well as identified themes which are areas of concern in each Learning Outcome. The graphs and tables show a substantive change in results from the pre- to post-test.

From the teacher reflections they themselves claimed that the changes in their classroom practice made a difference to their learners due to the introduction of exploratory talk in their learners’ home language. They had experientially learned the strategies that they passed on to their learners so they knew how it felt to be able to converse in any language in which they felt most comfortable. They had far more empathy with the learners in that they realised how powerful a tool language could be when making their reasoning overt.
CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

In the previous chapter the results of this study were noted and discussed. The main question that I have sought to answer in this study is:

Can teachers use language as a resource to introduce strategies to teach mathematics in language diverse classes?

The main finding that came out of my research study is that when learners’ talk and make their thinking visible mathematical reasoning is improved; however, when learners are not conversant in Ordinary English (OE) they are unable to move along the continuum towards Mathematical English (ME) - and they “are mute” (Janks, 2010:129). This study demonstrated that using the home language as a resource released the learners from their silence, as Janks (2010) maintains. The improvement in results from the pre- to the post-test, as well as the teacher reflections demonstrates this result.

1. IMPLICATIONS OF FINDINGS

In this chapter I will take each sub question and discuss the implications of the findings which have emerged from my study and which enable me to answer the following sub-questions.

1. What are teachers’ perceptions about language?
2. Can teachers introduce dialogue in the form of exploratory talk in their multilingual mathematics classes?
3. Can an intervention using language as a resource improve mathematical levels of achievement?

1.1 Sub-question One

The poetry was an innovative way of obtaining the teachers’ perceptions. The poetry shows the depth of their feelings where they honestly expressed their love for their African language. I found the data that was mined from the poetry far richer than
data that I would have obtained from a questionnaire. The teachers were able to express themselves in their own home language if they chose to.

The poetry highlighted the obstacle facing teachers and learners who struggle to learn mathematics in a language which is not their home language.

Teachers need to be aware of how their learners’ struggle to learn Mathematics in English. The results of my study showed that teachers need to introduce the learners’ home language into their Mathematics class and allow the use of code switching to assist their learners to move from the informal use of English to the formal language needed for academic achievement.

The poetry afforded the teachers the opportunity to feel as if they owned their own dilemma of learning through the medium of English. I am not advocating the use of isiXhosa as the LoLT, but I am arguing for more mathematical discussion, in the form of exploratory talk, in the classroom. Teachers learned experientially that they can use the learners’ home language as a resource to encourage meaningful mathematical dialogue.

Setati (2005) suggests English provides access to social goods and many teachers in the area feel that English is often the focal point in a mathematics class when in fact mathematics should be. Some teachers are trying to teach English at the same time as Mathematics when they should be teaching the latter only. Research has shown that mathematical reasoning can be constructed through learner-to-learner and learner-to-teacher talk (Mercer & Littleton, 2007).

Parents perceive that their children need to be educated in English so they can eventually study further and find employment. My study has shown that learners need to be able to use their home language so that they can improve their OE which will in turn improve their ME. Setati (2005) maintains that people see English as the gateway to opportunity. One option to open the gateway is for the teachers to make use of code switching between their home language and English (Moschkovich, 2010). Prior to the intervention course teachers felt guilty if they code-switched but my research results, as demonstrated through the comments of the teachers during the intervention, show that the teachers feel comfortable with the concept of code switching as they can see the benefit it has for their learners.
This is further supported by Alexander’s words from the DVD, Sink or Swim (Westcott, 2004):

The language question is not simply about language, it is very much about the depth in which a child understands these concepts... The way forward is what I call “bilingual mother-tongue based education”, in other words giving priority to the home language but also accepting that English medium is desired and desirable, but not to the exclusion of the child’s first language.

Code switching was seen by many of the teachers in this study as a possible solution it is part of the “toolkit for teachers” as advocated by Vorster (2008). This finding implies that teachers are using their home language as a positive strategy to assist them in the classroom and that they no longer feel guilty about making use of code switching, as teachers previously expressed in a study by Setati (2005).

The poetry and the language survey enable me to conclude that this study has revealed in a trustworthy manner the perceptions about language that the participant teachers in this study harbour.

1.2 Sub-question Two

The second sub-question was: Can teachers introduce dialogue in the form of exploratory talk in their multilingual mathematics classes?

Teachers attending the intervention were exposed to the strategy of exploratory talk through their own experience of solving problems - firstly using triggers (RSPM and concept cartoons) and then moving to curriculum word problems. In their discussions in groups, it was pointed out to the teachers that they were talking in isiXhosa or code switching. In their quest to find the answer to the problem they had been unaware of the language mix that they were using. Through the introduction of exploratory talk into their multilingual mathematics classes teachers could see how important it was for their learners to be allowed to express their mathematical reasoning in their home language.

The reflective writing accounts submitted by the teachers were corroborated by classroom observation by a researcher. Initially reflective writing highlighted the learners’ reluctance to participate in a lesson. Research described in chapter two has demonstrated that it is important that group work and learner participation, in the language with which the learners are most familiar, are encouraged to assist with the scaffolding of knowledge amongst peers. According to Mercer and Littleton (2005), in order to be able to construct their own knowledge, learners need to take responsibility for their learning. The task that teachers, as well as learners, face is being able to use
OE as a support for ME through code switching or the use of exploratory talk. (Vorster, 2008, Webb & Webb, 2008).

The learners’ lack of confidence in being able to use English was prevalent throughout the reflective writing. By enabling learners to use isiXhosa in discussions the teachers felt that the learners gained in both confidence and mathematical understanding. This study has demonstrated that using home language unlocks doors to communication and spotlights reasoning in the mind, but there is still an urgency to make learners fluent in Mathematical English. It is important to note that a positive classroom climate is essential for learners to build confidence and to encourage them to try sentences in English - to start on the journey from informal to formal usage of language as advocated by Setati and Adler (2001:250). Introducing dialogue into the mathematics class makes a difference. It is important to encourage learners to talk in their home language, which will allow them to overcome the barrier of English.

The introduction of the RUCSAC method of doing word sums offered teachers a systematic way of approaching word sums with six steps to follow. Teachers repeatedly mentioned in their reflective writing that the RUCSAC strategy of solving curriculum word problems transformed their teaching. The use of both exploratory talk and code switching afforded learners the opportunity to switch to their home language when necessary either to ask or answer a question. This proved most effective with the implementation of the RUCSAC strategy to assist learners when dealing with word sums.

The triggers to promote exploratory talk in the classroom proved to be beneficial to both teachers and learners. The teachers experienced themselves the power of the use of dialogue and the development of reasoning through the use of exploratory talk. They, in turn, were thus able to orchestrate the use of dialogue in their own language diverse mathematics classes. I therefore can conclude that this study proved that teachers can introduce dialogue in the form of exploratory talk in their multilingual mathematics classes.

1.3 Sub-question Three

Thirdly I looked at whether an intervention using language as a resource could improve learners’ mathematical levels of achievement.

The improvement in results evident in the graphs from the pre- to the post-test results are proof that the intervention focussing on the implementation of exploratory
talk in mathematics classes had a major part to play in the improvement of mathematics levels.

2. SUGGESTIONS FOR FURTHER RESEARCH

   The main target for mathematics teachers in language diverse classrooms is to assist their learners in their movement from their informal home language to formal mathematical English, both spoken and written. A suggestion for further research would be to document this journey in different case studies so that a more generalised picture could emerge of strategies that could be effective at different stages along the path. In this study teachers were able to start the movement of learners along the continuum; however further research is required to enable learners to.

   A possible additional strategy to add to the intervention could be the introduction of a ‘maths buddy’ who could aid mathematical learning. ‘Maths buddies’ would be allowed to agree or disagree about a particular concept as long as they are challenging each other and giving mathematically sound reasons for their suppositions i.e. “I think the correct answer is ... because of ...”.

   Another suggestion for further study could be to research the added strategies of using visualization and gestures that could enhance mathematical reasoning. For example, the drawing of parallel lines on the board together with using gestures by using arms to indicate parallel lines could be researachable strategies in language diverse classes.

   Yet another possibility for research could be to develop the pre-test into a diagnostic assessment and to encourage teachers to develop remedial exercises. This was an added trajectory during this study, but I abandoned it through lack of intervention time.

3. LIMITATIONS OF THE STUDY

   The pre- and post-tests were conducted only in English. A suggestion for further implementation could be to translate the test into Afrikaans and isiXhosa so that the learners can have a dual test in the languages. The pre-test covered all five Learning outcomes in one sitting. In future each learning outcome should be assessed, one at a time, prior to that particular section being taught.
Another limitation could have been the process whereby a small selection of teachers from similar schools where chosen and sponsored to attend the intervention course. The study was thus limited to a particular section of the Port Elizabeth schools.

It is possible that the passing of time, the developing maturity of the learners and regular teaching practices helped improve post-test marks. It was impossible to isolate the development of exploratory talk as the only factor that affected the quantitative results. I also did not prove statistically the significant increase in the pre- and post-test results. The object of this study was to show teachers how the introduction of exploratory talk in the learners’ home language had caused the learners marks to improve. The teachers could understand the improvement in results in the criterion based test and the graphs that they themselves drew attested visually to their learners’ improvement. I felt the teacher interaction with the results would have more impact than statistical evidence.

4. THEORETICAL UNDERPINNING

The following four communities of practice were built and a sense of solidarity was noted when teachers used dialogue in their home language (Wenger, 1999). There was a community of teachers attending the intervention; a community of teachers at the participating schools; a community of learners within a class, as well as a community between the teacher and her class of learners. Throughout the intervention the teachers mentioned their sense of belonging as they experienced and ‘did’ the strategies. They were becoming more confident in their teaching practice in multilingual mathematics classes (figure 5.1).

![Figure 5.1 Wenger's Social theory of learning (Wenger, 1999:211)](image-url)
Learners and teachers both experienced difficulty with the concept cartoons especially if the question asked highlighted a common misconception. Many of the teachers and learners were unsure as to the correct solution themselves. By being part of a community of practice and being able to learn through social interaction they were able to discuss the problem at hand in their group. Exploratory talk allowed learners to be engaged actively in a lesson by agreeing or disagreeing and reaching consensus eventually.

According to Wenger (1999) learnership involves learning in a community of practice so one can develop practices or routines. Mathematical identity is defined as an “individual relationship with mathematics” (Leatham and Hill, 2010:226). All of the above play a role in ensuring that one understands, the meaning, of mathematics better.

5. CONCLUSION

This research method allowed teachers to plot and analyse graphs, to administer tests, to introduce exploratory talk, to introduce the triggers that they had experientially explored in the intervention and to see the results of their labour in a simple, understandable context.

My results concur with the findings of Wegerif, Mercer and Dawes (1999) study which produced four main findings that exploratory talk can improve group reasoning; exploratory talk can be taught; exploratory talk can transfer between educational contexts and standard non-verbal reasoning test results improved significantly as a result of teaching exploratory talk.

I wish to emphasise again that I am not advocating teaching mathematics in isiXhosa, but the research has shown the advantages of using the home language as a resource in mathematics classes. Learners need to be able to express themselves in English, written and spoken, in order to achieve mathematically. This study therefore shows that teachers and learners can gauge their improvement in mathematical reasoning after an intervention that develops exploratory talk by using the home language as a resource.
BIBLIOGRAPHY


Westcott, N. (Director). (2004). *Sink or Swim* [Motion Picture].

# APPENDIX A

## BASELINE ASSESSMENT RECORDING SHEET

<table>
<thead>
<tr>
<th>YEAR:</th>
<th>GRADE:</th>
<th>Learners’ Name</th>
<th>LO 1: Numbers, Operations ...</th>
<th>LO 2: Patterns, Functions ...</th>
<th>LO 3: Space and Shapes</th>
<th>LO 4: Measurement</th>
<th>LO 5: Data Handling</th>
<th>FINAL TOTAL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>50</td>
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</table>

<table>
<thead>
<tr>
<th>Observations</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Rating Scale</th>
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<tbody>
<tr>
<td>Marks</td>
</tr>
<tr>
<td>35 - 50</td>
</tr>
<tr>
<td>25 - 34.5</td>
</tr>
<tr>
<td>17.5 - 24.5</td>
</tr>
<tr>
<td>0 - 17</td>
</tr>
</tbody>
</table>

### TOTALS (%)

---

99
APPENDIX B

STEP 7

LEARNER PERFORMANCE GRAPH

Present the results of each LO visually on a graph. See the example provided below:

Name of teacher: ___________________ Name of School: ___________________

Grade: ___________ Date of assessment: ___________

LEARNER PERFORMANCE GRAPH

<table>
<thead>
<tr>
<th>LO 1</th>
<th>LO 2</th>
<th>LO 3</th>
<th>LO 4</th>
<th>LO 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers, Operations and Relationships</td>
<td>Patterns, Functions and Algebra</td>
<td>Shape and Space</td>
<td>Measurement</td>
<td>Data Handling</td>
</tr>
</tbody>
</table>

Key

1 - Not achieved
2 - Partially achieved
3 - Achieved
4 - Outstanding/Excellent

Colour

1
2
3
4
APPENDIX C

MATHEMATICAL REASONING
BASELINE ASSESSMENT

Grade 7

School:  
Today's date:  
Name:  
Class:  
Mathematics teacher:  
Age:  
Gender:  

Please do not turn the page until you are told to do so
Appendices

BASELINE ASSESSMENT
GRADE 7

Instructions to learners
1. Read the questions carefully and work neatly.
2. In some questions you have to draw a circle around the letter of the correct answer.
   These questions have only one correct answer.
3. In some questions you have to write or fill in the correct answer.
4. You have 60 minutes to answer all the questions

LO 1: Numbers, Operations and Relationships

1. Round off:
   a. 62,347 to the nearest hundredth.
   b. 43,9471 to the nearest thousandth

2. Add:
   \[
   \begin{array}{c}
   23147 \\
   +45689 \\
   \end{array}
   \]

3. Subtract:
   \[
   \begin{array}{c}
   198203 \\
   -23499 \\
   \end{array}
   \]

4. Find the product of 21,065 and 25

5. Divide 78,948 by 12

6. Fill in the correct sign: >, <, =
   a. 0.5 ___ 0.505
   b. 7.3 ___ 37
   c. \[\frac{1}{3} \phantom{\ldots} \phantom{\ldots} \phantom{\ldots} \phantom{\ldots} \frac{1}{3}\]
   d. \[\frac{4}{3} \phantom{\ldots} \phantom{\ldots} \phantom{\ldots} \phantom{\ldots} \frac{4}{3}\]
5. Write in words the value of the underlined digit:
   a. 98 432 567
   b. 1 876 549

6. Fill in the correct number to make the following number sentence true:
   a. 14 687 029 + __________ = 14 697 029
   b. 816 745 - __________ = 816 045
   c. 7 382 628 + __________ = 7 502 626
   d. 2 217 885 - __________ = 2 117 885

7. Write the next number in the sequence:
   a. 3, 5; 3, 8; 4, 0; __________
   b. 12,32; 12,28; 12,24; __________

8. Write the value of the underlined digit.
   a. 43 563 =
   b. 13 803 =

9. Draw a circle around the letter of the correct answer.
   Which monthly salary is the largest?
   a. R780 299
   b. R708 219
   c. R788 210
   d. R788 209

10. Mary earns R3 468 per month and her friend Patsy earns R850 per week. Who earned the most at the end of the month? (Show your working out.)

11. Complete the following table by filling in the correct values.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.4</td>
<td>75%</td>
</tr>
</tbody>
</table>
Appendices

12. Draw a circle around the letter of the correct answer.
   Which set of numbers divides exactly into 25?
   a. 5; 1; 25
   b. 5; 7; 10
   c. 5; 1; 7
   d. 5; 3; 2

   (1)

13. From the list of numbers below, write two prime numbers.
   4, 5, 9, 11, 15
   __________ and __________

   (1)

14. Peter’s Motors sold \( \frac{3}{5} \) of 42 vehicles during the month of May. How many vehicles did they sell in May?

   (1)

15. Mr Smith has R 60 000 and pays for the following items.

   \[
   \begin{array}{|c|c|}
   \hline
   \text{Cement} & \text{R10 407} \\
   \text{Timber} & \text{R 34 567} \\
   \text{Paint} & \text{R 7 790} \\
   \hline
   \end{array}
   \]

   How much change will he have left?

   (1)

   Total: 20 marks

LO 2: Patterns, Functions and Algebra

16. Draw a circle around the letter of the correct answer.

   Pick out the rule for the given number sequence. 22, 27, 32, …
   a. Start with 22 and add 6 repeatedly.
   b. Start with 22 and add 4 repeatedly.
   c. Start with 22 and add 5 repeatedly.
   d. Start with 22 and add 7 repeatedly.

   (1)

17. Draw a circle around the letter of the correct answer.

   Which of the following statements best suits for the table?

   \[
   \begin{array}{|l|c|c|c|c|}
   \hline
   \text{Number of hours} & 1 & 2 & 3 & 4 \\
   \hline
   \text{Parking rates} & \text{R2,00} & \text{R2,75} & \text{R3,50} & \text{R4,25} \\
   \hline
   \end{array}
   \]

   a. Parking rate for every vehicle increases by R0,75.
   b. Parking rate for every additional hour decreases by R2.
   c. Parking rate for every additional hour increases by R2.
   d. Parking rate for every additional hour increases by R2.

   (1)
18. Draw a circle around the letter of the correct answer.

Which of the expressions will help you to find the \( n \)th term in the sequence?

3, 9, 27, 81, ...

a. \( n^2 \)
b. \( n + 3 \)
c. 3n
d. 2n + 1

19. Draw a circle around the letter of the correct answer.

Identify the rule that justifies the given sequence. 16384, 4096, 1024, ...

a. Start with 16384 and multiply 5 repeatedly.
b. Start with 16384 and multiply by 15 repeatedly.
c. Start with 16384 and multiply by 14 repeatedly.
d. Start with 16384 and multiply by 4 repeatedly

20. Draw a circle around the letter of the correct answer.

Which number comes next in the pattern? 66, 76, 86, __, ...

a. 106
b. 96
c. 98
d. 104

21. Draw a circle around the letter of the correct answer.

Find the next three terms in the sequence. 114, 342, 1026, __, __, __, ...

a. 2964, 9234, 27702
b. 3078, 9120, 27702
c. 3078, 9234, 27588
d. 3078, 9234, 27702

22. Draw a circle around the letter of the correct answer.

A man walks for 6 hours covering 5 km per hour. Find the distance covered by him in 5 hours.

a. 20km
b. 30km
c. 35km
d. 25km

Total: 7 marks
LO 3: Space and Shapes

23. Match the pyramids to their bases. Write A, B, C or D on the base.

24. Answer the question below

a. Which of the above pyramids is a tetrahedron? 

b. How many faces has pyramid D? 

c. How many edges has pyramid C? 

d. How many faces has pyramid A? 

e. How many edges has pyramid B? 

Total: 8 marks
LO 4: Measurement

25. Draw a circle around the letter of the correct answer.

Jason lives in a house 3 kilometres from the nearest shopping centre. His school is further 350 m from the shopping centre. How far is Jason’s house from the school in metres?

a. 353
b. 347
c. 3350
d. 2350

27. Draw a circle around the letter of the correct answer.

A glass has a volume of 250 ml. How many glasses can we fill from a 2-litre bottle of cool drink?

a. 4 glasses
b. 8 glasses
c. 10 glasses
d. 2 glasses

28. Look at the angles below. Use the following symbols to indicate if these angles are < ; = to a right angle.

\[ \hat{ABC} = 90^\circ \]
\[ \hat{GHI} = 90^\circ \]
\[ \hat{MNO} = 90^\circ \]

\[ \hat{DEF} = 90^\circ \]
\[ \hat{JKL} = 90^\circ \]
\[ \hat{PQR} = 90^\circ \]
29. Draw a circle around the letter of the correct answer.

In the diagram $S = 120^\circ$, $O = 180^\circ$.

What is the measurement of angle $W$?
- a. $180^\circ - 120^\circ$
- b. $360^\circ - 120^\circ$
- c. $120^\circ + 90^\circ$
- d. $360^\circ + 120^\circ$

30. On a winter morning, the reading on the thermometer was $-1^\circ C$ at 6 o'clock. At 2 o'clock, the same afternoon, the temperature rises to $18^\circ C$.
Write down how many degrees the temperature increased during the day.

LO 5: Data Handling

31. On Saturday evening 1 250 000 viewers were watching different channels on television:

<table>
<thead>
<tr>
<th>CHANNELS</th>
<th>Percentage of Viewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25%</td>
</tr>
<tr>
<td>B</td>
<td>15%</td>
</tr>
<tr>
<td>C</td>
<td>20%</td>
</tr>
<tr>
<td>D</td>
<td>40%</td>
</tr>
</tbody>
</table>

a. Fill in the percentage of viewers watching each channel on the graph below:
b. How many people were watching each channel?

<table>
<thead>
<tr>
<th>CHANNELS</th>
<th>Number of people watching</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

(2)

c. Which was the most popular channel? Give a reason for your answer.

(1)

d. How many viewers were watching channel A, C and D? (Show your working out)

(1)

e. If the numbers of viewers doubled in the following year. How many viewers would there be? (Show your working out.)

(1)

LO 1 = 20 marks
LO 2 = 7 marks
LO 3 = 8 marks
LO 4 = 8 marks
LO 5 = 7 marks

Total: 50 marks
APPENDIX D

RUCSAC STRATEGY

Read: Read the question carefully. What is the important information?

Understand: Understand the question. What do you have to find out?

Choose: Choose the right operation(s) and method of calculation.

Solve: Solve the problem! Make sure you follow all the steps.

Answer: Have you answered the question? What were you meant to find out?

Check: Check your answer. If possible, use the inverse to check your working out.
APPENDIX E

LANGUAGE SURVEY

SCHOOL SURVEY

Researching your school’s language environment

Name of School

---

**Step 1: Conducting a school language survey**

Conduct a survey at your school in order to find out the information needed to complete the tables below:

<table>
<thead>
<tr>
<th>Total number of learners at the school</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of teachers at the school</td>
<td></td>
</tr>
<tr>
<td>Primary language of most learners at the school</td>
<td></td>
</tr>
<tr>
<td>Primary language of most teachers at the school</td>
<td></td>
</tr>
<tr>
<td>Language of learning in Grades R – 3 (LOLT)</td>
<td></td>
</tr>
<tr>
<td>Language of learning in Grades 4 – 7 (LOLT)</td>
<td></td>
</tr>
<tr>
<td>Languages used most frequently in the maths classroom R – 3</td>
<td></td>
</tr>
<tr>
<td>Language used most frequently in the maths classroom 4 – 7</td>
<td></td>
</tr>
<tr>
<td>Grade at which learners switch LOLT (Language of Learning and Teaching) in mathematics.</td>
<td></td>
</tr>
<tr>
<td>Language used for mathematics assessment in Grades R - 3</td>
<td></td>
</tr>
<tr>
<td>Languages used for mathematics assessment in Grades 4 - 7</td>
<td></td>
</tr>
</tbody>
</table>
### Step 2: Evaluating the language policy in your school

Read the following checklist and indicate in which category the statements apply in your school:

<table>
<thead>
<tr>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
</table>

**Language practices in your school**

- It is emphasised that proficiency in English is important and is essential for examinations and access to continuing education
- Account is taken of the value of the pupils' primary languages in their acquisition of Ordinary English (OE) and Mathematical English (ME).
- Bilingualism and multilingualism amongst pupils, staff and parents, and in the local community, are seen and used as positive assets
- Staff take into account the oral and written language skills of their pupils when planning and organising classroom activities

**Provision made for pupils not yet fully proficient in English include:**

- Opportunities to develop oral skills in OE & ME through working in pairs or small groups;
- Opportunities for learners' to use their primary language as a resource for learning mathematics;
- Use of illustrations, diagrams, charts and tabulations, and practical demonstrations and activities to support the learning of ME;
- Opportunities for their knowledge and skills in maths to be tested through the medium of their first language as well as through English;
- Use of texts which contain repetition, visual cues and translations into learners' primary language.
## APPENDIX F

RUBRIC TO ASSESS LANGUAGES SPOKEN DURING A LESSON

<table>
<thead>
<tr>
<th>Teacher’s use of language when giving instructions</th>
<th>All English ✓</th>
<th>Mainly English</th>
<th>Mainly isiXhosa</th>
<th>Mainly isiXhosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher’s use of language when explaining concepts</td>
<td>All English ✓</td>
<td>Mainly English</td>
<td>Mainly isiXhosa</td>
<td>Mainly isiXhosa</td>
</tr>
<tr>
<td>Learners’ use of language in whole class</td>
<td>All English ✓</td>
<td>Mainly English</td>
<td>Mainly isiXhosa</td>
<td>All isiXhosa</td>
</tr>
<tr>
<td>Learners’ use of language during group discussions</td>
<td>All English</td>
<td>Mainly English</td>
<td>Mainly isiXhosa</td>
<td>All isiXhosa</td>
</tr>
<tr>
<td>Use of language during teacher-learner talk and learner-teacher talk</td>
<td>All English</td>
<td>Mainly English</td>
<td>Mainly isiXhosa</td>
<td>All isiXhosa</td>
</tr>
<tr>
<td>Learners’ use of language when reporting back to whole class</td>
<td>All English</td>
<td>Mainly English</td>
<td>Mainly isiXhosa</td>
<td>All isiXhosa</td>
</tr>
</tbody>
</table>

Comment

___________________________

Did the teacher teach procedures for problem solving and sense making? Comment.
LWIMI NDINI!

Lwimi ubalulekile
Lwimi uyimfuneko
Ulimanya kumama ebusa
Kumnandi ukhululekile

Kwizifundo uyachebelela ngolwakuni
Guququ kungena isibhulu uyoyiswa
Lixhala kunzima nokuya esikolweni
Wabhmka kiatgshna semetyholweni lulwimi

Khangela xa kujikwe ngemviwo
Hay’bo ayiseso isibhule, sele isislungu
Waxakeka, wabhideka wabhuduzesa
Yoo lulwimi olutheni olo lwenza bamicakuva bekuzala

Yimcasa yalo?
Sisongo sako?
Yimvkalo yalo?
Luqhagamshelwano lwesizwe ngeziz kusimina?

Translation

Do you know how challenging it is
To learn something without your mother tongue
It is so sad yet beautiful
Especially when it is time to reap the fruits
It is like ploughing hard soil during droughty season
Where you have to find water to make the soil soft
Where you have to look thoroughly after the plant
And make sure you remove all the weeds
And make sure not a single bird nor animal destroys your plants
Knowing that at the end you want to end poverty
To learn a language is so difficult from the beginning
But at the end of the tunnel you will get a little light
Because you can easily communicate with the outside world.

Akubhuhlungu ngako ukuynqwenela ukwazi ube ungakwazi ukwazi
Ngoba kaloku kuthi khuthethwa nje kube kumnyama kuwe
Kuthi kuhlekwa ube ungazi nehlekwayo
Kuthi kusithiwa phakama ube uhlala phantsi
Kuthi kusithiwa bhala ube usitya usiba
Cinga ke xa ufundiswa yonke into ngolwimi ongalaziyo
Kukungcungcutheka, nobuhlungu bentliziyo ngaphakathi
Ibangela ukuba ufune ukusincama esosikolo
Ufane uncekelele kuba unoloyiko lwabazali

Translation

It is very painful to long for knowledge
When what is spoken remains obscured from you
You see people laughing but you do know what they are laughing at
While you are asked to stand and you sit down
While you are told to write and you eat your pen
Think what it is like to be taught everything in the language you do not know
You proceed with a painful heart
You end up not liking school
You only go because you are afraid of your parents

Language! Language! Language!

What am I?
I am the tool to reach your destiny
An eye opener to the ignorant
I am language, that’s what they call me.

I am a bundle; I am a package; I am enormous
I serve different nations I am a problem solver
The world depends on me, even our President.
I am language, that is what they call me.

All institutions, starting at home make use of me
Others operate in silence using me
They may not be vocal but can read what they say
Schools use me as vehicle to communicate ideas
Moulding the young minds for better future
I am language that’s what they call me

I am the stepping stones towards the future
I can turn ripples into waves!
I am proud of myself
Please! Make use of me
I am a director! What can you do without me?
I am language that’s what they call me

Ulwimi Lwakokwethu
Ykwunu jakijy susxhiba
Isixhoba sokuvalisa izimbo
Izimvo ezibonakalisa ukucinga
Lumnandi ke ngokungongwa

Ngolwimi ke siyafund
Izifundo siziqonde ngokulula
Ngolu lwimi ke syabala
Siyakwazi ke nokuthenga

Thina ke siyazingca
Ngolwimi lwethu isiXhosa
Ngolu lwimi siphanda ulwazi
Ukuze kuphuhle iinzululwazi

Sithi phambili ngolwimi lwakowethu
Bhalani babhali ngolwimi lwethu
Bhalani neencwadi zezibalo
Ukuze amaXhosa azidle ngalo

Translation Language Seed

You are a seed that lands on a soul
As heritage and teaching it grows
It grows into a baby soul
And we all know you
As a mother tongue

How happy we are
To be a Rainbow Nation
And have eleven languages
But how to use you as different as
Makes us shy and lets us feel humiliated
You make us feel less popular
We don’t hear nor understand others
We can’t write nor spell words
We can’t sometimes translate
Because you are a language but
Not a mother tongue

Ukubaluleka kolwimi Umbongo

Ngubani na owazalwa engalwimi?
Ngubani na owasalwa engasiwa?
Wonke ubani wanconca ulwimi kunina
Wonke ubani wazalwa esaziwa.

Emzantsi Afrika sinolwimi ngeelwimi
Wonke umntu unamasiko nezithethe zakowabao
Kubalulekile ukwasi nokuqonda
Xa ungumnutu kubalulekile uthethe, ubhale.

Sineziduko ngenxa yeelwimi zethu
Isizwe sakheka lula xa umntu ezazi ungubani
Ilizwe liba seluxolweni xa ulwazi ulwimi
Abantwana bethu beva lulu xa sibabiza

Kuwimi esiluthethayo kuqandusela ulwazi
Ulwazi ke luguqithisela kwingqiqo
Ingqiqo iqandusela kwimpucuko
Impucuko yakha umnut nesizwe

Unxibelewano nemvana ngundoqo
Lungekho ulwimi ngekhe kulunge
lintlanga negeenthlanga zivana ngolwimi lwazo
Ubuzwe nobuntu yimveli yakwaNtu

Translation

Who was born without a language?
Who was born unknown?
Everyone has a mother tongue
Everybody was born known
In South Africa we have different languages
Everybody has their own cultures and customs
It is important to speak and write

We have different clans because of our languages
The nations can be built easily if everybody knows himself/herself
The nation is at peace if the language is known
Our children respond easily when they are called

Knowledge is created because of the language we speak
Knowledge passes it to thinking skills
Civilization comes through perception
Civilization moulds the person and the nation

Communication and peace are the main keys
Without a language nothing will come right
All the nations understand each other through their own languages
Nationality and humanity are the roots of the legendary ancestors of the Bantu race

Big eyes of a child ask
Teachers to help him understand
He cannot hear you although his ears are open
If he can hear you he cannot answer you

Please make a plan
Don’t ignore him
Give his friend a chance, explain to him
Code-switch the language if you can

He wishes to understand
Please place him in the light
Open the dictionary, show him how to use it
Only the eyes of a child can beg the teacher

This child is withdrawn
He cannot open his mouth
Nor listen with understanding to what is said by a teacher
He wants to understand

Only the eyes can tell
If he understands the meaning of the words
Only if he does can he open his mouth,
And be free to question and talk in class

Code-switch the language if you can
APPENDIX H
EXAMPLES OF GRADE SEVEN WORD SUMS

GRADE 7—WORDSUMS

Granny was coming to visit for six weeks. She wanted to wear a different outfit each day. How many blouses must she pack if she has three different coloured skirts?

Our principal wants to buy pens for the 782 pupils in the school. The pens are packed in boxes of 12. How many boxes must he order?

If one box costs R5, how much will the boxes cost him?

Three basketball players came to our school. Toto was 2.3 metres tall, Junior was 1.9 metres tall and Ali was 2.2 metre tall. Who was the tallest?

How much taller was Toto than Junior?

They lay on the floor, feet to head, and we drew a line as long as the three of them. How long was our line?

A tree is 13mm high in the original photograph. After the photo had been enlarged, the tree was 78mm high. How many times had the photo been enlarged?

Our teacher bought 110 metres of material to make curtains for the hall. If she cut fifty curtains, how much material was used for each curtain?

If they decide to share the money so that they all end up with the same amount, how much will each person get?

During the month, Mpho and eight of his friends ordered 24 pizzas. They each ate the same amount. How much did they each eat?

Each pizza costs R8. How much did they pay for the 24 pizzas altogether? They shared the costs between them. How much did each person have to pay?

Dad’s car takes 62 litres of petrol to fill it up. If petrol costs R2.10 a litre, what does it cost to fill up dad’s car?

Dad has R400. How many times can he fill up his car?
APPENDIX I

TEMPLATE FOR REFLECTIVE WRITING

INTRODUCING EXPLORATORY TALK IN THE CLASSROOM

Name: ___________________________ School: ___________________________

GRADE: ________________________ Topic: ___________________________

Describe an instance of exploratory talk that developed in your classroom. If possible give a transcription.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What characteristics of the talk identify it as being exploratory?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Reflection on exploratory talk in your classroom:
APPENDIX J
RUBRIC TO ASSESS PROBLEM SOLVING ACTIVITIES IN THE CLASSROOM

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arrangement of learners</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learners are seated in groups around tables, or they are seated in pairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Worksheets provided to learners</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learners have worksheets on which the problem sums are printed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Learner participation and interaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All learners are participating and interacting with each other throughout the lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learner interaction is meaningful and structured</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learners are actively engaged in completing tasks and activities throughout the lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Classroom atmosphere</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher creates a classroom atmosphere in which learners feel free to participate and respond to questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instructions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructions are clear and understood by the learners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher monitors groups or pairs in a constructive manner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL (Out of 40)**