

**AN INVESTIGATION OF LEARNERS' HOME
LANGUAGE AS A SUPPORT FOR LEARNING
MATHEMATICS**

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DECLARATION

I declare that the report is my own unaided work. It is being submitted for the degree of Master of Mathematics Education by coursework and research at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

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ABSTRACT

The report presents an investigation on how learners' home language can be used as a support for learning mathematics. This qualitative case study was conducted in Phelindaba Primary School wherein learners use English as the language of learning and teaching which is not their home language. This school worked in collaboration with the Home Language Project to facilitate the learning of mathematics using the learners' home language as a resource. The study revealed that when learners use their home languages they interact better with their peers, the teachers and their tasks. Learners used home languages to achieve conceptual understanding, procedural fluency, adaptive reasoning and strategic competence, which would in turn develop their productive disposition

TABLE OF CONTENTS

	PAGE
CHAPTER 1: INTRODUCTION	6
CHAPTER 2: LANGUAGE, LEARNING AND TEACHING	10
CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY	27
CHAPTER 4: DATA ANALYSIS	42
CHAPTER 5: SUMMARY AND FINDINGS	61
REFERENCES	67
APPENDIX A	73
APPENDIX B	80

LIST OF TABLES

TABLE 3.1	34
TABLE 4.1	47

CHAPTER 1

INTRODUCTION

The report presents an investigation into the use of the home language as a support for learning mathematics at Foundation Phase (Grades 1-3). In this chapter, I discuss the purpose of the study, research questions and the rationale for undertaking the study. In the rationale, I present an overview of the debates on the use of learners' home language as a resource or a hindrance to learning. Since this study was conducted in a school that was involved in Home Language Project (HLP), a brief description of this project is provided later in the chapter.

The purpose of the study

The main purpose of this study was to investigate how the learners' home language(s) can be used to support the teaching and learning of mathematics in a class of multilingual learners. The study was guided by the following questions:

- a) What skills does the Home Language Project privilege and make available to both learners and teachers?
- b) How do teachers use the learners' home languages as they mediate in the classroom?
- c) How do learners use their home languages when they interact with mathematical tasks?
- d) What mathematical practices are carried out by the use of the learners' home languages?

Why this study?

It is widely accepted that language is important for learning and thinking. What is still under constant debate and investigation in both the public domain and in research is which language is most appropriate for learning subjects such as mathematics especially in the South Africa multilingual context.

There are presently two opposing views in the public domain in South Africa. The one view is that in a multilingual country like South Africa, English is the most practical language of learning and teaching. This view maintains that learners in multilingual classrooms do not

necessarily share the same home language and using their home language can lead to complexities of separating them into language groups. The implication of this is that finding mathematics teachers who are fluent in those languages would be necessary. Proponents of this view also argue that given the international nature of English it makes sense that all learners in South Africa are taught in English so that they are at the same level with learners from other countries. For them English is the future, a language that represents progress, opportunity and modernity. The ability to speak English has become a new status symbol. Parents want their children to gain access to the socioeconomic benefits for their children that come with being competent in English (Gules, 2005). African languages are seen as having little or no relevance to learning except to help them construct a cultural identity.

The opposing view maintains that all children must be taught in a language with which they are fluent because students learn better in their own languages. Proponents of this view also raise political and cognitive arguments to support their view. They maintain that the low performance of most learners in previously disadvantaged schools is because they are learning in a language that they are not fluent in. The concern here is that “as mother tongue withers, conceptual thoughts run the risk of dying out too” (Nicol, 2004:17). In fact, the poor matric results and the general lack of academic skills and intellectual growth among blacks at high school and tertiary levels have most often been attributed to the use of English (Heugh, 1995 and Luckett, 1995.)

Arguments from the political perspective include the fact that most schools use the issue of language as a way to exclude learners from other home language backgrounds; as a result, language is used as a political tool to keep classes smaller and to limit the resources available to speakers of specific languages only. Khumalo (2005) argues, “English language instruction is an ironic euphemism for the blackness of a school”. He maintains that there are more English medium schools in certain areas than there are for African learners. African learners are compelled to travel long distances for their schooling. This scenario does not reflect equal education for all, but rather a mockery of equal education (Khumalo, 2005).

The Minister of Education, Naledi Pandor, also raised a concern on this issue; she argued that:

The time has come to make learning of an African indigenous language compulsory in all our schools. We need to develop a language policy that vigorously promotes

South African indigenous languages in all our schools (South African Information reporter, 2005:1)

Despite the minister's speech and the existing language policies, the debates on which language is appropriate for learning are still looming. In research, this debate can be interpreted as a tension between home language as a resource for learning mathematics and the learners' home language as a hindrance for learning mathematics.

This study offers new insights into problems of language and the learning of mathematics. The investigation will further increase knowledge of the study and contribute to new perspectives. The study focused on the learners' use of their home language as a resource in mathematics learning. As Moschkovich (2002) argues, one of the goals of mathematics teaching for multilingual learners should be to support all students, regardless of their fluency in English. She suggests that teachers can move towards this goal by recognizing the resources that multilingual learners use to express mathematical ideas.

Why the Home Language Project?

The school where the study was conducted worked in collaboration with Home Language Project (HLP) to facilitate the learning and teaching of mathematics using learners' home language as a resource. The HLP initiative is in line with the new language policy, which encourages schools to accord learners the opportunity to learn in their home languages. The policy states that:

Since language , as the fundamental instrument of learning and teaching , is at the heart of all education , learners should be strongly encouraged to use the their primary language as their main LoLT at all levels of schooling . In addition, all learners must have the opportunity to learn additional languages to high levels of proficiency (Language in Education Policy, 1997:4).

The Home Language Project (HLP), started in 2001 as an initiative by parents and governing bodies from six Johannesburg schools. The aim of the HLP is to assist learners whose home language is not the language of learning and teaching (LoLT) to use their home language as a resource for learning and to achieve bilingualism. The project provides home language support in a group of schools using English as the LoLT. The overarching goal of the HLP is to promote the ongoing learning of African home languages alongside the formal language of learning and teaching in schools where the LoLT is English or Afrikaans. The purpose is to enable African

learners to grow with their own languages, to maintain it as a cognitive and linguistic frame of reference and to value it as a fundamental part of their cultural heritage.

CONCLUSION

The discussions in this chapter highlighted the fact that the issue of what language is appropriate for teaching and learning mathematics is a contested one. While there has been much work in the area of multilingualism and mathematics education in South Africa, most of this work has focused on the use of code switching in the teaching and learning of mathematics. This study will contribute to this growing area of study by specifically considering how the learners' home language can be used to support mathematics learning and teaching.

CHAPTER 2

LANGUAGE, LEARNING AND TEACHING

This chapter begins by describing the theoretical framework that guided the study. This is followed by a review of literature, which is guided by the current debates on language and learning. In view of the fact that the study will be focusing on the learning of mathematics, a discussion on what competencies are essential for learning mathematics will be highlighted. These discussions will provide a framework that was used as a context for the analysis of this study.

THEORETICAL FRAMEWORK

Socio-cultural perspective

This study is informed by Vygotsky's theory of socio-cultural development. The fact that development occurs in and through socially mediated activity and language plays a key role in mediation (Vygotsky, 1962). Vygotsky documented the relationship between language and thought. He believed strongly in the importance of language in children's learning.

To Vygotsky, a clear understanding of the interrelations between thought and language is necessary for the understanding of intellectual development. Language is not merely an expression of the knowledge the child has acquired. There is a fundamental correspondence between thought and speech in terms of one providing resource to the other; language becoming essential in forming thought and determining personality features (Thomas, 1993 cited in Schutz R, 2004:2)

Thought undergoes many changes as it turns into speech. It does not merely find expression in speech; it finds its reality and form (Thomas, 1993 cited in Schutz, 2004). Thought is not merely expressed in words; it comes into existence through them. Words play a central part not only in the development of thought but also in the historical growth of consciousness as a whole. A word is a microcosm of human consciousness (Thomas, 1993 cited in Schutz, 2004).

Vygotsky maintained that the speech structures mastered by the child become the basic structures of his thinking. He furthermore argued that language and thinking can only develop if there is a social interaction. Once the child realizes that everything has a name, each new object presents the child with a problem situation, and he solves the problem by naming the object (Schutz, 2004). When he lacks the word for the new object, he demands it from adults. The early word-meanings thus acquired will be the embryos of concept formation. This implies that a child's home language or the language that is acquired in the child's immediate environment is crucial for concept formation and thus learning.

Vygotsky further regards language as the cultural tool that enables dialogue with others. He believed that this life long process of development was dependent on social interaction and that social learning actually leads to cognitive development. This phenomenon he calls the Zone of Proximal Development (ZPD), which he defined, as the distance between the actual level of development and the level of potential development (Vygotsky, 1978). In the classroom, this social interaction can be between the teacher and the learner or between learners.

Fundamental to Vygotsky's ZPD is his assertion that every function in the child's development appears twice: first on social level or between people (interpsychological) and later on individual level (intrapsychological). He believes that this development takes place through a form of apprenticeship learning through interaction with teachers. This implies that learning is social and not a solely individual process. Learning takes place when understanding and knowledge are jointly constructed and guided by the teacher into a common understanding and a common language to express (Mercer, 1995).

When children enter school, the teacher confronts them with tasks, in order to guide their progress towards formal learning. These tasks help the children acquire motives and methods for mastery of the adult world, as mediated by the teacher (Hedegaard, 1990). Mediation refers to tools and signs (such as language) that mediate all human activity. In school, this process refers to a successful mastery of a task attended jointly by the teacher and the learner (Macdonald, 1994). Teachers use this technique to facilitate or mediate lessons to ensure maximum participation of all learners. In this apprenticeship, children actively engage in cultural practices in which the teacher models, guides and help regulate performance. This

interaction is crucial for promoting progress through the ZPD, facilitating appropriation of cultural artifacts and practices (Thomas, 1993 cited in Schutz R, 2004:2).

In this interaction, the use of learners' home language becomes the best medium for communication in the mathematics classroom. The use of home language gives learners an opportunity to participate in a range of discourses that are essential for learning mathematics (Setati, 2003). Learners can freely engage in both conceptual and procedural discourses because they are using a language in which they are proficient. The use of learners' home language can act as a mediating tool for teachers because it enables them to get a deeper understanding of their learners' problems. Research indicates that using the learners' home language adds to the child's ability to communicate in the second language (Brice,2001). Vygotsky (1962) stressed that being able to express the same thought in more than one language enables a child to compare and contrasts two language systems and this allows a greater cognitive and metalinguistic awareness. Studies by Setati (1996), Adler (2001) and Moschkovich (1996; 1999 and 2002) have shown that the use of home language in the teaching of mathematics provides a support needed while learners continue to develop proficiency in the LoLT.

Bell (1978) also highlighted the importance of language (though he did not refer to home language) in learning. He argues that:

Teaching and learning are vastly facilitated through the use of language. Not only is language used by teachers to communicate information to students, language is necessary for the complete formulation of most concepts and principles. In mathematics classrooms, one of the primary ways for students to demonstrate knowledge and understanding of mathematical ideas is through the use of language to express their conceptions of the ideas (Bell 1978: 140).

It is clear that language is critical for the learning of mathematics. We talk with the others to negotiate meanings, to explain our solutions, to clarify misunderstanding and to justify our solutions. Communication in the classroom allows learners to verbalize their mathematical ideas and clarify their thoughts (Mercer, 1995). All mathematical ideas, interpretations, reasoning and thoughts are filtered through communication in the classroom. As students communicate their ideas, they learn to clarify, explain, refine and consolidate their thinking (Sfard, Neshier, Streetland, Cobb & Mason, 1998). In short, mathematical conversations are

believed to be good for mathematical thinking, reasoning, conceptualizing and solving problems (Sfard et al, 1998).

Vygotsky does not only emphasize the importance of language and social interaction for learning, he sees the social history of the child as crucial for shaping learners' thinking which is crucial for learning. That is, cognitive skills and patterns of thinking are not primarily determined by innate factors, but are the products of activities practiced in the social institutions of the culture in which the individual child grows up. Consequently, the history of the society in which the child is reared and the child's personal history is a crucial determinant of the way in which that child thinks. First, through culture, children acquire much of the content of their thinking, that is, their knowledge. Second, the surrounding culture provides a child with the processes or means of their thinking – what Vygotskians call the tools of intellectual adaptation. In short, according to the social cognition learning model, culture teaches children both what to think and how to think (Vygotsky, 1962). The implication is that using the child's home language, which forms part of culture, is required to comprehend meaning or participate in an activity.

Culture is also a critical determinant in shaping how learners speak and interpret words. Meanings of words are determined by the uses of the words within a linguistic and cultural setting, and these settings are not the same in any two cultures. For instance, learners who are using English as their second language need to learn words in English as well as the cultural background that gives words their English meaning (Meyer, 2000). To fully function in a particular language, one not only needs to understand the mechanics, such as the grammar, but also to apply that language across various contexts, audiences, and purposes (Mei-yu, 1998). It is through meaningful interaction with others as well as functional use in daily life that children develop competence, fluency, and creativity in language. As a result, teaching learners in their home language is critical for meaningful interaction with others. This implies that learning that takes place in an environment that accommodates learners' home language will awaken a variety of internal development processes that a child has acquired in his or her sociocultural environment (Vygotsky, 1962).

Zevernegen (2001) echoes the same view; she contends that when students enter the school context their “out of school” language practice which becomes embodied in their ¹habitus.. As a result, students whose linguistic background is different from the one used in the classroom are likely to be marginalized by those who are proficient in the required language. She further argues that where there is a great continuity between the home and school, there is a greater chance of success in school mathematics. “Classroom interactions are imbued with cultural components that facilitate or inhibit access to the mathematical content” (Zevernegen, 2001: 204).

LANGUAGE AND MATHEMATICS

The relationship between language and mathematics

The relationship between language and mathematics has been given attention by researchers such as Pimm (1987), Pirie (1998), Torbe and Shuard (1982) and Zevernegen (2000). They argue that mathematics is like a language and learning it is much more like learning a language. Some writers prefer to consider mathematics as an activity rather than as a means of communication (Austin and Hawson, 1979). Pimm (1987) prefers to use the notion of mathematics as a language metaphorically to ascribe many characteristics of language to mathematics while avoiding assigning it the status of a language. He describes mathematics as a language that uses words from ordinary language but takes on different meanings when used in the mathematical context. Pimm (1987) gives examples of words to highlight the complexity of this language. He refers to words such as *face*, *prime*, *mean*, *right*, *rational*, *root* and *mass* that have different meanings in mathematics and in ordinary language.

Zevernegen (2001) also explored other possible difficulties associated with the language of mathematics. She gives an example of the use of the prepositions *to*, *by* and *from* in the sentences: “the temperature fell *to* 10 degrees”, “the temperature fell *by* 10 degrees” and “the temperature fell *from* 10 degrees” and the effect of omitting the preposition “the temperature fell 10 degrees”. The use of these prepositions can signify an increase or a decrease in the temperature, which may require learners to symbolize it by means of addition or subtraction

¹ Pierre Bourdieu (cited in Zevernegen, 2001) defines it as a set of dispositions, which generate practices and perceptions; it provides the lens for interpreting and acting.

signs. The differences between the two languages (the language of mathematics and English) are a possible obstacle to the understanding of mathematics.

Zevebnegen (2001) furthermore highlighted difficulties posed by homophones (words that sound similar). Words such as sum/some and whole/hole along with words which are slightly different in sound such as off/of, sixty/sixteen and tens/tenths are possible hiccups in mathematics. These words tend to pose problems for learners particularly when learners are not very fluent in English. To master such words, learners need an excellent reading and interpretation skills to enable them to decipher the specificity of the mathematics signifier (Zevebnegen, 2000)

Mathematics is also well known for its extensive use of symbols. It employs symbols that are different from the ordinary spoken language. As Pimm (1987), aptly explain, we write “12-4” and read it as “four from eight”. The written order “left to right” is the opposite of the spoken order (Pimm, 1987:3). The same applies to symbols within mathematics; they are interpreted differently in different contexts for example: 43 is $40 + 3$ in arithmetic, but $4xy$ can be interpreted as 4 multiply by x and multiply by y in algebra. In same way $ab = ba$ and $32 \neq 23$. While 2.57 is referred to as two point 57 and $xy.z$ is often referred to as xy multiplied by z .

Torbe and Shuard (1982) have noted that the forms of language, which pupils experience in mathematics lessons, are often insufficiently varied to allow them to develop for themselves rich forms of language in which to express their mathematical thinking. They further indicate that pupils may consequently have considerable problems in communication and this may have considerable problems in developing thinking skills. In short, they imply that lack of suitable language is a grave handicap to the internal monologue, which forms the basis of thinking for both mathematics, and in other curriculum areas. The role which mathematics plays in communicating ideas and the role of the language, which is used in communicating mathematics, are inextricably bound together.

Anstrom (1997) further elaborates this argument when he contends that:

Command of mathematical language plays an important role in the development of mathematical ability. The importance of language in mathematics instruction is often overlooked in the mistaken belief that mathematics is somehow independent of language proficiency. However, particularly with the increased emphasis

placed on problem solving, command of mathematical language plays an important in the development of mathematical ability (Anstrom 1997: 25).

Ball & Bass (2003) in the same way, acknowledge the importance of the mathematical language for learning mathematics. They contend that this language is crucial for mathematical reasoning and for communicating mathematical ideas, claims, explanations and proofs. The mathematical language is viewed as the medium through which mathematics is enacted, used and created. They furthermore maintain that the mathematical language is central to the construction of mathematical knowledge. Communicating mathematically is viewed as a resource in which mathematical claims; proofs and explanations are developed, made and justified.

From the arguments alluded to above, it is evident that students must come to learn mathematics as a language as well as a discipline of knowledge (Zevernbegen, 2001). Both the language of learning and mathematical proficiency is required for effective learning. The question to ask is what it means to learn mathematics in a language that is not your home language. According to Setati (2002), communicating mathematically in a multilingual classroom involves the following interactions:

- a) Between ordinary English and mathematical English
- b) Formal and informal mathematics language
- c) Procedural and conceptual discourse
- d) Learners' main language and the LoLT.

The classroom interactions that Setati has highlighted indicated the complexity of learning mathematics in a language that is not your home language. These complex interactions are caused by the fact that multilingual learners are forever faced with two major obstacles i.e. first mastering English as language of instruction prior to mastering other means of communicating mathematically. English is both a target and the medium of instruction for most South African learners. These learners are not only learning English as a new language, but are expected to learn in and through it as well. The construction of the new curriculum knowledge goes hand in hand with the development of the second language (Gibbons, 1998). Learning, for such students, implies putting double the effort in reading, writing, understanding and interacting with their mathematical tasks.

Multilingualism and the learning of mathematics

Multilingualism refers to the alternate use of two or more languages. A multilingual person therefore is anyone who is able to more than two languages for some or all the skills of speaking, listening, reading and writing. A majority of South Africans whose main language is neither Afrikaans nor English are multilingual (Setati 2004).

Research on the relationship between language and mathematics has moved on to consider issues of bi/multilingualism in learning of mathematics. Researchers in this field are concerned with the learning of mathematics where the learners' home language is not the LoLT. Learning mathematics in learners' second or third language is not only common in the South Africa. Many classrooms around the world, in both developed and developing countries are experiencing this phenomenon. Multilingualism is becoming a norm rather an exception (Secada, 1992).

This phenomenon (multilingualism and mathematics) initiated debates in mathematics education research about whether the learners' home languages are a resource or a hindrance to learning mathematics. Such debates can be traced back to the early 1950's. Early researchers such as Thompson have noted, "There can be no doubt that the child reared in a bilingual environment is handicapped in his language growth. "One can debate this issue as to whether speech facility in two languages is worth the consequent retardation in the common language realm" (Thompsons, 1952: 367 cited in Hakuta and Garcia, 1989). This view was also supported by the empiricists; they maintain that bilingualism was a mental burden that caused lower levels of intelligence (Hakuta and Garcia, 1989).

However, research in the last decade has shown a considerable change in the understanding of bilingualism. Researchers such as Cummins & Swain, (1986); Saville-Troike (1991) and Anstrom (1997) maintain that unitary cognitive academic proficiency underlies all language performance, and may be expressed equally through either first language or second language. This cognitive academic performance is developed primarily through the first language in the early years, and may then be transferred to second language later on (Bell, 1999). Saville – Troike (1991) noted that:

When students begin learning a second language, they do not start learning all over again , but interpret meaning in terms of what they already know - not just about

language, but about context in which it is being used, and about strategies for social interaction. This means that the process of second language learning is heavily dependent on prior experience and apparently also on the nature and the level of first language development.

The implication is that if a learner uses his or her home language for several years and then moves into the second language they would perform better academically than if they start with the learning of a second language from the beginning. Cummins and Swain (1986) concur with Saville –Troike when they argue that to achieve full first language and cognitive development, the home language needs to be used as the medium of instruction at least for the first few years of primary school at a minimum. Without this, entry to second language education may be mentally underdeveloped, which disadvantages not only their language acquisition, but also their academic success. The argument is that home language is imperative to achieve higher levels of mental maturity (Cummins & Swain, 1986).

Clarkson (1992) whose study was conducted in Papua New Guinea argued that the influence of the learners' home language is cognitively important right through primary school. He argues that the use of learners' home languages could be used to good effect in the classroom to access the mathematical ideas of local cultures in the local language, without the fear of disadvantaging learners. However, Setati & Adler (2001) noted that while research on the relationship between learners' first language and learning has drawn much criticism because of its cognitive orientation, it is supportive of the maintenance of learners' home languages in their mathematics learning.

Debates on multilingualism and the learning of mathematics

Setati (1998; 2003), Adler (1998, 2001) and Setati & Adler (2001) argued that multilingualism per se does not impede the learning of mathematics. They maintain that home language can be used as a useful resource for learning mathematics. Setati & Adler (2001) recommended code switching as a valuable resource for learning mathematics. They further highlighted the complex journey that second language learners take when they learn mathematics in a language that is not their home language. The journey is from spoken to written language, from home language to English and from informal language to formal mathematical language. For the first language learners the journey excludes the movement from home language to English. Code switching was noted as a means through which mathematics teachers and learners can use to navigate the journey.

Setati (1996) has furthermore shown how a teacher uses code switching to cope with the dual task of teaching both mathematics and English at the same time. She highlighted how code switching was used for facilitating learners' understanding of concepts, encouraging participation and familiarizing learners with the language of evaluation (English). In her later work (Setati, 2003) maintained that code switching is also one of the ways in which a teacher can encourage conceptual discourse, by allowing learners to speak informally about their mathematics: explaining, exploring and arguing about their interpretations and ideas. This talk is an important technique for learners to develop ideas in a comfortable environment.

Dawei (1983, cited in Yushua, 2004) also investigated the effect of teaching mathematics (in English) to students that have English as their second language. He focused on Punjabi, Impure, Italian and Jamaican learners who grew up in England. The results showed that first language competence was an important factor in the children's ability to do mathematical reasoning in English as a second language.

Chan (1982, cited in Yushua , 2004), in his investigation on the difference in discourse patterns between bilingual and monolingual Mexican-American mathematics students observed that where English was the only language used for teaching and learning, students were unable to engage in both procedural and conceptual discourse. Setati (2003) found the same in South African classrooms, while Rakgokong (1994) whose study also involved primary school children in multilingual classrooms in South Africa maintains that using English only as a LoLT has negative effects on learners' meaning making and problem solving ability.

Another study by Varughese and Glencross (1996) found that students at university who were learning mathematics in English, which was not, their home language had difficulty in understanding mathematical terms such as *integer*, *perimeter* and *multiple*.

Ferro (1983 cited in Yushua, 2004) explored the influence of language on the mathematical achievement of CapeVerdean students. Three basic patterns of instruction were considered: teaching entirely in English, teaching in some mixture and CapeVerdean and English and teaching in some mixture of Portuguese and English. The findings in this study indicated that students who have CapeVerdean as a native language and are taught in CapeVerdean /English achieved relatively higher than those taught either in English only or in Portuguese /English.

Moschkovich (1996, 1999, and 2002) whose work focuses on Latino bilingual mathematics learners argues that learners bring into the classroom different ways of making meaning in the mathematics classroom. In her analysis of the discourse that took place in the classroom, she noted the importance of supporting learners by “revoicing or modeling” their utterances. She argues that “revoicing” learners’ incorrect English utterances and modeling learner contributions enabled the teacher to get a deeper understanding of the mathematical discourses that students bring into the classroom. Moschkovich maintains that if we focus on students’ failure to use technical terms, we might miss how students construct meaning for mathematical terms or uses multiple resources such as gestures, objects or everyday experiences to communicate mathematically. She emphasizes the importance of valuing learners’ first language and mathematical discourses.

Gorgorio and Planas (2001) explored the role of language as a social tool that is crucial for the construction of mathematical knowledge in a multilingual classroom. They considered language as a wide notion where social, cultural, linguistic, emotional and cognitive tools are intertwined. They argue that teaching and learning should be a continuity between home and school or else new meaning or new words learnt in the school can turn into a wide variety of cultural conflicts and disruptions of the learning process.

On the other hand, there are other researchers such as Lim (1998 cited in Yushua, 2004) who do not view the use of home language as a resource for learning mathematics. They argue for the continued use of English as the LoLT in multilingual contexts and maintain that efforts should be made to improve English language proficiency of the learners. Lim studied the relationship between language and mathematics among Korean–American students and found that bilingual students’ success in problem solving is inextricably interwoven with their level of proficiency in English and other factors that relate to English proficiency. He recommended greater exposure to the language of the classroom (English) and the language of mathematics. Lim’s findings and recommendations resonate with those by Howie (2001), who argues that the solution to improving South African second language learners’ performance in mathematics is to develop their English language proficiency. Like Lim, Howie (2001) maintains that proficiency in the English language is related to performance in mathematics.

Barton and Neville-Barton (1988) investigated the dynamics of learning mathematics at the university level for students who do not have English as their first language. They reported that second language learners experienced 10% disadvantage in overall performance through lack of understanding text. They furthermore argued that technical mathematical discourse rather than English as an additional language is more important for mathematics learning. While this suggestion is relevant, it ignores the fact that mathematical discourses are embedded in the language that is used for learning and teaching mathematics. Thus, the mathematical discourses cannot be separated from the language of learning. Learning mathematics in a second language is an enormous challenge for both teachers and learners.

It is without doubt that language is essential for learning mathematics. It represents a powerful tool to promote collective and individual reasoning (Mercer, 2000). Therefore, would it not be fair to afford all learners the opportunity to use their home language in order to engage in different types of discourses in the mathematics classroom?

Assessment of mathematics in multilingual contexts

The term assessment refers to all those activities undertaken by teachers and their students in assessing themselves to provide information to be used as feedback to modify teaching and learning activities (Black and Wiliam, 1998). During assessment, teachers use pen and pencil tests, oral tests and classroom discussions to evaluate learners' comprehension. These activities require a good command of both the language of learning and knowledge of the subject matter. Baker (cited in Bell, 1999) maintains that learners in second language education lag behind their peers in areas such as Mathematics and Science. The reason being that their language skills are insufficiently developed to enable them to think mathematically.

Anstrom (1997) maintains that procedures used in schools disadvantages learners when conducted in a second language. He argues that:

All too often, second language students are asked to participate in tests that make unfair assumptions about their English language proficiency in order to assess their content knowledge. Furthermore, [...] second language students when measured against their native English-speaking peers, may fail to meet mainstream goals (Anstrom, 1997: 35).

He furthermore suggests that schools should make an effort to assess content knowledge rather than language proficiency. However, this not possible because “mathematics

education begins in language, it advances and stumbles because of language, and its outcomes are often assessed in language” (Durkin, 1991: 3). The learning of content knowledge in mathematics cannot be cut off from language of learning because it is the media through which reasoning and thinking takes place. As a result, separating content knowledge from the LoLT may not be possible because the two “languages” are interwoven.

Moschkovich’s (2001) study highlights how second language learners can be assessed to properly reflect their understanding and proficiency in mathematics. She maintains that learning mathematics is more than just mastering the technical terms but involves different ways of talking about mathematical objects and points of view of mathematical situations that students bring to classroom discussions. She suggested a shift from focusing on how learners master the mathematical terms to understanding their mathematical discourses. In other words, the use of learner’s home language should be valued in the mathematics classroom. As she aptly puts it, one of the goals of mathematics teaching for multilingual learners should be to support all students, regardless of their fluency in English. She suggests that teachers can move towards this goal by recognizing the resources that multilingual learners use to express mathematical ideas (Moschkovich, 2002). In other words, assessment in mathematics should accommodate different discourses that learners bring into the classroom. All learners should be given an opportunity to express themselves (both in writing and in talking) in a language they are comfortable with.

Pirie’s (1998) study also indicates that there are connections among learners, their languages and their mathematical understanding. She argues that it is through their (learners’) language that they express their current mathematical understanding, and our understanding of them is limited by ways in which they try to express this understanding. She suggests that teachers should try to access the language that learners use and not make superficial judgments about how students understand mathematics.

The discussion above suggests that language, particularly learners’ home language is imperative for meaning making in mathematics. Language is embedded in almost every part of mathematics. So using a language that is familiar to learners is a catalyst towards better understanding of mathematics.

COMPETENCIES ESSENTIAL FOR LEARNING MATHEMATICS

Kilpatrick, Swafford and Findell (2001) have recommended five strands for learning mathematics successfully. They argue that these five interwoven and interdependent strands are essential for developing proficiency in mathematics. These skills would enable learners to cope with the mathematical challenges of daily life and to continue their study in high school and beyond.

The five strands are as follows:

a) Conceptual Understanding

Conceptual understanding refers to an integrated and functional grasp of mathematical ideas. Learners with a conceptual understanding know more than isolated facts and methods. Such learners can organize their knowledge into a coherent whole, which enables them to learn new ideas by connecting those ideas to what they already know. Learners with a good conceptual understanding can explain methods to themselves and correct them if necessary (Kilpatrick et al 2001). A significant indicator of conceptual understanding is being able to represent mathematical situations in different ways and knowing how different representations can be useful for different purposes. The degree of students' conceptual understanding is related to the richness and extent of the connections they have made. Connections are useful when they link related concepts and methods in appropriate ways. Knowledge that has been learnt with understanding provides the basis for generating new knowledge and for solving new and unfamiliar problems. When students have acquired the conceptual understanding they see connections among concepts and procedures and give an argument to explain why some facts are consequences of others (Kilpatrick et al 2001). Learners with a conceptual understanding avoid critical errors in solving problems, particularly errors of magnitude. Such students have less to learn because they see deeper similarities between unrelated superficially unrelated situations (Kilpatrick et al 2001).

b) Procedural fluency

Procedural fluency refers to knowledge of procedures, knowledge of when and how to use them appropriately and the skill of performing them flexibly, accurately and efficiently. It also supports the analysis of similarities and differences between methods of calculating. This includes mental methods for finding certain sums, differences, products or quotient as well as methods that use calculators, computers or manipulate material such as blocks, counters and beads. Connected with procedural fluency is knowledge of ways to estimate the results of a procedure (Kilpatrick et al 2001).

Both the procedural fluency and conceptual understanding complement each other. Understanding makes learning easier, less susceptible to common errors and less prone to forgetting. Learners who can perform a procedure without understanding are likely to forget with time and without sufficient procedural fluency, students might have a problem in deepening their understanding of mathematical ideas or solving problems (Kilpatrick et al 2001).

c) Strategic competence

Strategic competence refers to the ability to formulate mathematical problems, represent them and solve them. This strand is also known as problem solving and problem formulation in the literature of mathematics education and cognitive science (Kilpatrick et al 2001). They should know a variety of solution strategies as well as strategies that might be useful for solving a specific problem.

Representing a problem situation requires that students built a mental image of its essential components. This process becomes what Kilpatrick et al refers to it as “an avoidance of number grabbing method where students select numbers and prepares to perform arithmetic operations on them”. To represent the problem better students must first understand the situation, including key features. They then need to generate a mathematical representation of the problem that captures the core mathematical elements and ignores the irrelevant features (Kilpatrick et al 2001).

Strategic competence comes into play in every step in developing procedural fluency in computation. Part of developing strategic competence involves learning to replace complex procedures by more concise and efficient procedures than those cumbersome procedures that might at first have been helpful in understanding operations. Students develop procedural fluency as they use strategic competence to choose among effective procedures. They also learn that solving challenging mathematics problems depends on the ability to carry out procedures readily and, conversely those problems solving experience helps them to acquire new concepts and skills (Kilpatrick et al 2001).

d) Adaptive reasoning

Adaptive reasoning refers to the capacity to think logically about relations among concepts and situations. Learners use adaptive reasoning to navigate through many facts, procedures, concepts and solutions methods to see that they all fit together in some way, that they make sense (Kilpatrick et al 2001). Adaptive reasoning does not only include informal explanation and justification but also intuitive and inductive reasoning based on pattern, analogy and metaphor. Inductive reasoning, analogy, metaphors and mental and physical representation are “tools to think with” often serves as sources of hypothesis, sources of problem solving operations and techniques and aids to learning and transfer. Research suggests that children are able to display reasoning ability under three conditions i.e.

- Ability to justify ones works (to provide sufficient proof). Proof is a form of justification, but not all proofs. Students need to be able to justify their work and explain ideas in order to make their reasoning clear, hone their reasoning and improve their conceptual understanding.
- Students need to be able to use new concepts and procedures for some time and to explain and justify them by relating them to concepts and procedures that they already understand.
- Adaptive reasoning interacts with other strands of proficiency, particularly during problem solving. Learners draw on their strategic competence to formulate and represent a problem using heuristic approaches that may provide a solution strategy , but adaptive reasoning must take over when

they are determining the legitimacy of a proposed strategy(Kilpatrick et al 2001).

a) Productive Disposition

Productive disposition refers to the tendency to see mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics (Kilpatrick et al 2001). Developing this strand requires frequent opportunity to make sense of mathematics, to recognize the benefits of perseverance and to experience the reward of sense making in mathematics (Kilpatrick et al 2001). In short, a good attitude towards mathematics is imperative for acquiring the five mathematical strands.

CONCLUSION

In this chapter, I have indicated how language can be used as a tool for mediation, interaction, promoting the ZPD, self-regulation, mathematical proficiency and for cognitive functions. I have furthermore highlighted existing debates on the use of learners' home language as a resource or a hindrance to learning mathematics. This was followed by a brief discussion on skills essential for learning mathematics. From the discussions above, it is clear that giving learners an opportunity to use their home languages as a support for learning mathematics is essential for effective communication and participation in the classroom.

In the next chapter, I describe the research design and methodology used in this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

This is a critical case study (Cohen and Manion, 1994) that focuses on one carefully selected Grade 3 class of mathematics learners. The study describes and explains how home language was deliberately used to support the learning of mathematics in a Grade three class. This chapter describes the research design and methodology used in the study, which includes a discussion on how rigour and ethics were attended to in the study.

Why case study?

The purpose of a case study is to probe deeply and to analyze intensively the multifarious phenomenon that constitutes the life cycle of the unit with the view to establishing generalizations about the wider population to which that unit belongs. (Cohen& Manion, 1994: 106)

Case study was relevant for this study because it provided an in-depth approach into investigating how the learners' home language is used as a support for mathematics learning in a purposely selected grade three class of additional language learners. Case studies are known for their holistic understanding of a particular bounded system rather than discovering, through deduction, universal, generalizable truths (Creswell, 1998). Case studies enable in-depth probing and analysis into how particular teachers and learners use home language to support their understanding and learning of mathematics

Description of the school

Phelindaba Primary School is an ex-model C² school where the LoLT is English. The school starts at Grade one level up to Grade seven. There are 1064 pupils in the school in which 3, 4% of the pupils are coloureds; 0, 56% are whites; 0, 65% are Indians and 95, 4% are Africans³. The teaching staff comprises of 44% Africans, 15% coloureds, 15% Indians and 26% whites. The language of learning and teaching in the school is English even though a majority of learners do not have English as a home language. Almost 70% of the learners in the school have IsiZulu as

² These are schools that were previously white during the apartheid education system.

³ Africans refers to persons whose native language is Isizulu, Setswana, Sepedi, Sesotho, IsiXhosa, Xitsonga and Tshivenda. I use this category purposely in this study to exclude coloured and Indians.

their home language thus IsiZulu is offered as a second language subject from Grade three to Grade seven. In addition to this, all the learners in the school have to study English as a subject.

The school has been involved with the HLP since 2004. The HLP is an independent scheme that has its own teachers and works with a selection of schools in Johannesburg. The HLP teachers visit the Phelindaba School on Thursdays to assist learners with reading proficiency in their different home languages and to support both the mathematics teacher and learners with mathematics. This initiative started with one Grade two class that is presently doing Grade three. This Grade three class was selected for the study because they have using their home language for reading and writing skills for the past two years in preparation for mathematics.

Sample

This study used purposive sampling. “In purposive sampling researchers hand pick the cases to be included in the sample [...]. In this way they build up a sample that is satisfactory to their needs” (Cohen and Manion, 1994: 89). For this study, I needed a class in which learners learn mathematics in a language that is not their home language. Furthermore, given the focus of the study, it was important to get a class in which the learners’ home languages are recognized and valued as a resource in the teaching and learning of mathematics. I therefore identified a school that participates in the Home Language Project, which aims to promote the learners’ fluency in their home languages and the use of those languages for learning.

There were 40 learners in the class and seven home languages were deliberately used as a support for teaching and learning mathematics on Thursdays. In total there were 21 IsiZulu speaking, four Sesotho speaking, two Sepedi speaking, four Tshivenda speaking, three Xitsonga speaking, four Setswana speaking and two IsiXhosa speaking learners in this class.

Three teachers conducted the Thursday mathematics lesson (one mathematics teacher from Phelindaba Primary and two HLP teachers). The mathematics teacher is not proficient in all the seven home languages that learners use during the mathematics lesson on Thursdays. As a result, the two HLP teachers who are proficient in all the seven African languages assist learners with reading mathematics tasks in their home languages.

DATA COLLECTION

Data was collected over ten consecutive Thursdays and was done through lesson observations as well as learner and teacher interviews. All lessons observed were video-recorded and interviews were tape-recorded

Piloting

The first three Thursdays were used for piloting purposes so that the teachers and learners could get used to the presence of the researcher and the video in their class. It also gave me an opportunity to test the video recorder I was using, to ensure that it worked properly and that the material recorded is audible enough to enable analysis. I also used the three days to acquaint myself with how the lessons were structured, the timetable of the school, the mathematics teacher, the HLP teachers and the learners in the class/school.

Lesson observations

In total ten one-hour lessons were observed and video-recorded. The lesson observations focused on how teachers and learners used different home languages to enable a range of mathematical practices essential for supporting the learning of mathematics. Of the ten lessons, the fifth lesson was selected for data analysis.

Why this lesson?

The lesson was not different from the other lessons except for its richness in terms of the mathematics that the learners were dealing with and also the language demands embedded in the task given to them. The task given to learners on the fifth lesson focused on rainy days, this everyday experience was common to all learners.

INTERVIEWS

The research interview is a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information (Cannel and Kahn 1968 cited in Cohen and Manion, 1994). The aim of these interviews was to provide data on how the use of learners' home language enabled learners' mathematical proficiency.

Teacher interviews

The mathematics teacher together with the HLP teacher was interviewed separately to reflect on the lessons observed. Semi-structured interviews were used to probe the teachers about their views on the success of the lessons and the role that the home languages played in learning and teaching mathematics. The idea was to interview all the teachers who were involved in the lessons observed. This was, however, not possible as one of the HLP teachers was not available on the day of the interviews. These interviews enabled me to answer the following questions:

1. What reasons do teachers give for the way they use the learners' home languages?
2. What do they perceive to be the benefits of these practices?
3. What makes their Thursday lessons different from their regular mathematics class?
4. What skills do the Home Language Project privilege and make available to both learners and teacher?

Learner interviews

Three learners from different home language groups were interviewed to explore how the deliberate use of home language aided their learning in mathematics. The three learners were selected because they seemed to be more active during the lessons observed.

The aim of these interviews was not necessarily to assess the learners' competency in mathematics but to probe how home language enabled the learning of mathematics. These interviews were conducted after the fifth lesson had been observed. The questions focused on how learners argue, verbalize their thoughts, solve mathematical problems and explain solutions to the mathematical tasks given. These interviews enabled me to answer the following question: What mathematical practices were carried out by the use of the learners' home language?

DATA ANALYSIS

Marshall and Rossman (1989 cited in Burton, 2000) maintain that data analysis is a process of bringing order, structure and meaning to the mass of collected data. In order to bring order, structure and meaning into the data collected. In this study all recorded data was transcribed

and transcripts of the lesson were categorised using Kilpatrick et al's (2001) strands of mathematical proficiency:

- Procedural fluency
- Conceptual understanding
- Adaptive reasoning
- Strategic competence
- Productive disposition

The five strands were further divided into sub-categories:

Why subcategories?

Mathematical proficiency cannot be achieved in isolation. Teachers and learners need to interact to make this possible. These interactions act as a catalyst for shaping the five the strands of mathematical proficiency. To enable better categorization of these strands, subcategories such as *displaying*, *challenging*, *evaluating and reinforcing* of each strand were developed. Each subcategory and its code are indicated and described below. The definitions of the subcategories were adapted from Kilpatrick et al's definitions.

The five strands of mathematical proficiency, their subcategories and the codes.

1. Productive disposition

- *Displaying productive disposition (DPD)*: this includes all interactions that indicate how the teachers or learners see mathematics as sensible, useful or worthwhile. (A good attitude is essential for acquiring this strand.)
- *Reinforcing productive disposition (RPD)*: An act of motivating or encouraging learners to see mathematics as sensible, useful or worthwhile.
- *Challenging productive disposition (CPD)*: Questioning or probing of learners on how they view mathematics.
- *Evaluating productive disposition (EPD)*: The teacher assess if learners see mathematics as sensible, useful or worthwhile.

2. Adaptive reasoning

- *Displaying adaptive reasoning (DAR)*: This activity indicates the capacity for logical thought, reflection, explanation and justification.

- *Reinforcing adaptive reasoning (RAR)*: This is an act of motivating or encouraging learners to reflect, explain, and justify their responses.
- *Challenging the adaptive reasoning (CAR)*: This occurs when the teacher or learners probe or question other learner's responses, explanations and justification given or when learners challenge each other's ideas.
- *Evaluating adaptive reasoning (EAR)*: this is done by the teacher to assess if learners can reflect, explain and justify their answers.

3. Conceptual Understanding

- *Displaying conceptual understanding(DCU)*: this indicates the capacity to comprehend mathematical concepts , operations and relations
- *Reinforcing conceptual understanding(RAR)*: Motivating learners to use their capacity to comprehend mathematical concepts , operations and relations
- *Challenging conceptual understanding (CAR)*: This is either a learner-to-learner interaction or teacher to learner interaction. It occurs when there is questioning or probing of the ability to comprehend mathematical concepts, operations and relations is done.
- *Evaluating conceptual understanding(EAR)*: The teacher assesses how learners comprehend mathematical concepts , operations and relations

4. Strategic competence

- *Displaying strategic competence (DSC)*: this indicates the ability to formulate, represent and solve mathematical problems. Learners need to know a variety of solution strategies as well as which strategies might be useful for solving a specific problem.
- *Reinforcing strategic competence (RSC)*: This interaction indicates how the teacher encourages learners to formulate, represent and solve mathematical problems appropriately
- *Evaluating strategic competence (ESC)*: This is where the teacher assesses if learners can formulate, represent and solve mathematical problems appropriately.
- *Challenging strategic competence (CSC)*: This is either a learner-to-learner interaction or a teacher to learner interaction. The teacher or the learners

question or challenge how others have formulated, represented and solved mathematical problems.

5. Procedural fluency

- *Displaying procedural fluency (DPF)*: These are skills of carrying out the procedures flexibly, accurately and appropriately.
- *Reinforcing procedural fluency (RPF)*: In this case, the teacher encourages or motivates learners to carry out the procedures flexibly, accurately and appropriately.
- *Evaluating procedural fluency (EPF)*: This where the teachers is assessing if learners are carrying out the procedures flexibly, accurately and appropriately.
- *Challenging procedural fluency (CPF)*: This is either a learner-to-learner interaction or teacher to learner interaction. The aim is to question or probe if learners can carry out procedures flexibly, accurately and appropriately.

As indicated earlier, categories and subcategories were developed to identify which mathematical strand or language dominated the utterances in the classroom. These categories enabled a rigorous working through the data. All utterances in the lesson were categorised, additional categories were included to accommodate utterances that could not be categorized in Kilpatrick et al's strands. The additional categories include reading of the task, giving instruction and learner response.

Table 3.1 below shows how data will be organised according to the categories. In the last column of the table, the number of occurrences per strand is indicated. The number of occurrences in the transcript could be an expression, a sentence or an activity that occurred during the mathematics lesson. There are instances where utterances were categorized more than once because the four strands i.e. procedural fluency, adaptive reasoning, conceptual understanding and strategic competence are interwoven and interdependent.

For example the following response from the learner, has been categorised four times.

MT: Tell us how you got your answer, right or wrong, in English please.

L4: But we know it is right, because there are 25 days in December, but in the other months, they are less than 25.

The explanation given by L4 can be categorised into four different strands:

- a) This learner is explaining or justifying his answer (adaptive reasoning), she argues that in December has 25 rainy days and on the other months there are less rainy days.
- b) The learner is displaying procedural fluency: “*there are 25 days in December*”, she counted and compared December with the other months and realised that it had more rainy days.
- c) She used a strategy to solve the problem: she realized that other months had less than 25 days.
- d) She understood the concepts (conceptual understanding) used that is why she can explain and give reasons for the procedure and strategy used.

TABLE 3.1: LANGUAGE ACCORDING TO CATEGORIES

Category	Subcategory	Language used	Number of occurrences in the transcript	
Productive Disposition	Reinforcing productive disposition	Home language		
		English		
	Evaluating productive disposition	Home language		
		English		
	Challenging productive disposition	Home language		
		English		
	Displaying productive disposition	Home language		
		English		
	Adaptive reasoning	Evaluating adaptive reasoning	Home language	
			English	
Challenging the adaptive reasoning		Home language		
		English		
Displaying adaptive reasoning		Home language		
		English		
Reinforcing the adaptive reasoning		Home language		
		English		

Conceptual understanding	Evaluating the conceptual understanding	Home language		
		English		
	Challenging the conceptual understanding	Home language		
		English		
	Displaying conceptual understanding	Home language		
		English		
	Reinforcing the conceptual understanding	Home language		
		English		
	Strategic competence	Evaluating the strategic competence	Home language	
			English	
Challenging the strategic competence		Home language		
		English		
Reinforcing the strategic competence		Home language		
		English		
		Home language		
Displaying strategic competence		English		
		Home language		
Procedural fluency		Evaluating the procedural fluency	Home language	
	English			
	Challenging the procedural fluency	Home language		
		English		
	Reinforcing procedural fluency	Home language		
		English		
Displaying procedural fluency	Home language			
	English			
Giving instructions		Home language		

		English	
Reading		Home language	
		English	
Learners' responses to the teacher.		Home language	
		English	

The use of the above categories and subcategories enabled me to focus on how language was used rather than on other forms of classroom activities that are not related to the study. This furthermore enabled me to provide answers to the following research questions:

- How do teachers use learners' home language as they mediate in the classroom?
- What mathematical practices are carried out by the use of the learners' home language?
- How do learners use their home language when they interact with mathematical tasks?

RELIABILITY AND VALIDITY

Reliability and validity are two concepts used in quantitative research for assessing and evaluating the design of the study and analyzing the results. In qualitative research, validity and reliability are conceptualized as trustworthiness, rigor and quality (Seale, 1999). The reason being that credibility in quantitative research depends on instruments construction whereas in qualitative research the researcher is the instrument. As a result, reliability and validity in qualitative research depends on the ability and effort of the researcher to make the study trustworthy, dependable and credible. Maxwell's categories of validity in qualitative research encompass how the quality of any qualitative study can be ensured. I will therefore use Maxwell's (1992) typologies to establish the quality, trustworthiness and rigor in my research.

VALIDITY

a) Descriptive validity

This category refers to the accurate description of the informants' actions or utterances during an interview or observation (Maxwell, 1992). In this study, descriptive validity was ensured by

highlighting all activities taking place in the classroom, i.e. when learners raise their hands, when the learners are quiet, when the teacher writes on the board, when the interviewee points at the worksheet and many others. All utterances recorded in the video camera and tape recorder were carefully viewed and every action and every word was transcribed without attaching any meaning to it. Activities were seen as physical and behavioral events rather than in terms of meaning for the actor or others involved in the activity (Kaplan cited in Maxwell, 1992: 286).

b) Interpretive validity

Interpretive validity is concerned with phenomena not on the basis of the researcher's perspective and categories, but to the people engaged in and with them. Interpretive validity seeks to encompass what is broadly termed the participants' perspective (Maxwell, 1992:286). To acquire interpretive validity in my study, I interpreted learners' concepts using their own language. To further validate my study, learner and teacher interviews were conducted to enable me to understand how and why they interpreted concepts the way they did and to further understand the meaning they attach to their classroom practices.

c) Theoretical validity

Theoretical validity addresses the theoretical construction that the researcher brings to, or develops during the study (Maxwell, 1992:291). In this study, I used Kilpatrick's strands of mathematical proficiency to formulate categories and interpret how the use of home language supported learners and teachers in promoting mathematical proficiency. The socio-cultural theory (perspective) was employed for understanding why and how home language enabled learners to interact with the teachers, their peers and tasks. The use of these theories guaranteed validity.

Theoretical validity closely matches what is generally known as construct validity and internal validity (Maxwell, 1992). According to Yin (1994), construct validity can be used in qualitative research for judging the quality for any qualitative research. Yin (1994) suggests three tactics to increase the construct validity i.e. using multiple sources of evidence, establishing a chain of resources and have a draft reviewed by key informants.

Construct validity was achieved by observing ten different lessons on different weeks to investigate how the use of home language enabled the learning of mathematics on different mathematical tasks and different lessons. All the ten lessons were carefully viewed and analysed to acquire valid information on how learners and teachers used home languages as resource. The lesson selected was typical of the other lessons observed.

Data was collected from multiple resources: All lessons were video recorded, two teachers were interviewed and three learners from different language groups were interviewed to ensure validity. Comparisons of literature and extensive use of the transcripts was used to justify claims and to guarantee validity.

d) Generalizability

Generalizability refers to the extent to which one can extend the account of a particular situation or population studied. In qualitative research, generalisability usually takes place through the development of a theory that not only makes sense of the particular persons or situation studied, but also shows how the same process, in the different situations, can lead to different results (Maxwell, 1992:298). In the study conducted, the findings could not be generalised to all grade three learners in South African or in the school. However, my study can be transferred to other situations where home language is used as a support for learning mathematics. The use of detailed description of information provides sufficient information to enable readers to judge the applicability of findings to other settings that they know (Seale 2002). The report has presented a detailed description of how data was collected and analyzed; this will enable the reader to assess if this study is transferable.

The study will furthermore contribute to this growing area of study by specifically considering how the learners' home language can be used to support mathematics learning and teaching.

RELIABILITY

Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions,

formulate theories, or make claims about the generalizability of their research (Yin 1994). The concept of reliability is generally used in quantitative studies. In qualitative studies it is not possible for any two researchers to yield the same results of the data observed unless the tool of analysis (categories) has been clearly defined. In this study, categories and subcategories have been clearly defined. To further ensure reliability another researcher was given the transcript and the tool of analysis to check if they will come up with the same results.

ETHICAL CONSIDERATIONS

Ethics in educational research are about process and power. There are processes that any researcher has to adhere to; to ensure that their research is carried out with respect of the rights of individuals involved in the study. At the same time, education researchers have to be conscious of the power relations that exist between the researcher and the researched. The discussion below focuses on how I attended to ethical process and issues power in the study.

Obtaining Ethical Clearance

In this study, negotiations to undertake the study at Phelindaba primary school were first held with the principal and the relevant teacher since the school was already involved with the HLP. It is only after obtaining permission from the principal that ethical clearance was sought from the Gauteng Department of Education (GDE), the administrative authority of the school and the University of the Witwatersrand human research ethics committee (non-medical), which deals with clearance of research involving human subjects. Ethics committees are mainly interested in protecting the right of the potential participants who may not be able to give informed consent such as children or adults with psychological or psychiatric difficulties. Included in the appendix are consent letters for teachers, learners and parents or guardians, which were submitted together with the research proposal for clearance. Also included in the appendix A are clearance certificates from the Gauteng Department of Education (GDE) and the University as well as the letter of permission from the principal.

I sought permission from the parents and children after obtaining clearance from the school, the GDE and the University. All learners involved in the study had consent forms signed by their parents or guardians. Requesting participants to sign consent forms was done to ensure that the participants are not exposed to emotional injury, invasion of privacy or physical or psychological stress (Frankfort –Nichmias and Nachmias cited in Cohen and Manion, 1994).

According to Cohen and Manion (1994) four important procedures are important for the process:

a) Competence

Competence implies that the responsible and mature individuals will make correct decisions if they are given relevant information (Cohen and Manion, 1994). In this study, I have ensured that all the participants given consent forms to sign were also given the information letters on the study. The two HLP teachers and the mathematics teacher received the copies. Given the fact that the learners in the school are all under the age of 18 it was a requirement that parents as well as learners signed the consent forms.

b) Voluntarism

Voluntarism entails applying the principle of informed consent and thus ensuring participants freely choose to take part (Cohen and Manion, 1994). The participants in this study were not obliged to participate. They were also informed that they were free to withdraw consent and to discontinue participation at any stage in the study. Teachers were guaranteed the fact that their non-involvement in the study would not jeopardize their position the school. This was done in order to eliminate the possibility of teachers feeling coerced and or manipulated.

c) Full information

The information given to potential participants ought to include anything, which could bear on their decision to participate (Burton, 2000). In this study, the participants were informed about the purpose of the study. Learners were also informed that this study would not by any means affect their year mark or continuous assessment at school. It was also crucial that learners and parents understood that this study was not part of the school curriculum.

d) Comprehension

Comprehension refers to the fact that participants fully understand the nature of the research project even when procedures are complicated and entail risks. In this study, learners were made aware that a video recorder and tape recorder would be used in their lessons and that if this makes them uncomfortable, they may withdraw from the study. It was important that all participants and parents of the learners understood the procedures to be taken in the study.

Learners and teachers were given an opportunity to ask questions for any clarifications and to indicate if they did not want to take part in the study.

Anonymity and confidentiality

The essence of anonymity is that information provided by participants should in no way reveal their identity. Participants in this study were video recorded and tape-recorded during interviews. If by any means the video-recorded information is to be used in conferences, their faces will be hidden from public viewing. The participants were assured that their anonymity would be protected; any reference to personal information will be removed to avoid guessing their identity. Pseudo names have been used in this report and any in publication emerging from this study.

Issues of power

Power relations often pose problems in any qualitative study. The presence of the researcher and the use of a video recorder can have negative implications on the lesson observed, since this is an unusual practice from their daily routine.

To avoid this uncomfortable scenario, a meeting with the informants was organised prior the data collection period. The aim of this meeting was to try to understand what they do on Thursdays. I furthermore visited school informally without the video recorder; this is where I got the opportunity to intermingle with the learners and teachers informally. During the data collection, I already knew who my informants were.

CONCLUSION

In this chapter, I have described how and where data was collected, this was followed by a description of how data was analysed. An explanation on how data will be categorised and coded supported the information on how data was analysed. A research without a discussion on how rigour and ethical issues were attended to would be incomplete, hence a discussion on that.

In the next chapter, I used the above mentioned methodology to analyse my data.

CHAPTER 4

DATA ANALYSIS

INTRODUCTION

This chapter presents an analysis of data collected in the study. As explained in Chapter 3, data was collected through lesson observations as well as teacher and learner interviews. All lessons were video-recorded. In total, ten lessons were observed and the fifth lesson was selected for analysis of data. I begin this chapter by describing how the lesson was conducted and this will be followed by an analysis of the mathematical demands of the task that was given on the fifth lesson. Tasks are crucial in the teaching and learning of mathematics. This task analysis makes visible the learning opportunities made available to learners. To present an in-depth analysis of the lesson, I used the categories and subcategories explained in Chapter 3 for analyzing the transcript.

HOW THE LESSON WAS CONDUCTED?

During the selected lesson, learners were grouped according to their respective home languages. They were encouraged to begin by reading the tasks in their home languages then moved to the English version and back to the home language version. The aim in this session was to ensure that there was reading with understanding for both the English and home language version of the task.

Subsequent to reading, learners would use their rough work papers for writing their solutions as they interacted with their home language teachers and their partners. The mathematics teacher used these group discussions to allow learners to express themselves freely about the tasks given. Since different home languages were used during this part of the lesson, learners got the opportunity to solve, discuss, argue and explain to their peers. The group discussions would be followed by reflective discussion in the public domain. This is where individual groups get an opportunity to reflect what was initially discussed in their different language groups. These open classroom discussions were conducted in English to accomplish a

common knowledge using a common language. It is in this session where all learners listen to others reason, explain their procedural skills, the strategies they used and their understanding.

During the interview the mathematics teacher explained how the Thursday lesson was conducted:

Researcher (R): On Thursdays your lessons are conducted in English and Home language, why that?

Mathematics Teacher (MT): Because now, we'd like to teach the children in English and in their home language.

R: Why home language?on the other days, I mean on Mondays , Tuesdays , Wednesday and Fridays you use English when you teach,why Thursday?.

MT: It's a project, where we 'like to have... see how learners perform in Mathematics when they are learning in two languages because using two languages may improve their so they will excel in two languages.

R: What is so different about this class or lesson when compared with your regular classes?

MT: I noticed that the children in this lesson become free because we give them the opportunity to express themselves in their home languages and they become free to speak in their home language.

As can be seen in the excerpt above, the mathematics teacher explained that learners speak freely when they use their home languages.

The two Home Language Project teachers (HLPT) assisted the mathematics teachers and learners with the reading of learners' home languages. The following interview extract indicates how they facilitated the learning of mathematics by reading the tasks with the learners.

R: I have seen you moving from desk to desk when learners are busy, what do you do?








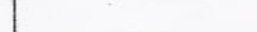




HLPT : What we normally do is to make sure that the kids understand what they are doing , we make sure their reading in mathematics is okay. By now, we know who is having a problem with reading. For example, we do not pair our learners with the same learning ability. If they are weak, we make sure that we change their seating, so that they are seated with the right partners.


The HLPT indicated that in instances where learners did not understand what has been written in the task; they intervened by re-reading the sentence with the learners until everything was understood. As they move from desk to desk, they identified learners who were struggling with their reading. Weaker students were given more attention. Paired reading was encouraged during the lesson. Learners were also encouraged to read until they understand before moving to the English version.

THE TASK GIVEN IN THE FIFTH LESSON

The task given to the learners was titled “the rainy days”. Learners were given a pictograph, which shows the number of rainy days in each of the month. The task was prepared in a variety of languages: English, IsiZulu, Sesotho, Setswana, Sepedi, Xhosa, Xitsonga and Tshivenda. The learners were given the task in two languages: English and their home language. The two version were indicated from question one to question six, question seven to twelve the questions were written in English only. The subsequent questions need more or less the vocabulary as the previous questions. Translations in these questions are not necessary. Below I give the version that was given to the Sepedi group. This version has the pictograph presented in Sepedi and is followed by questions in Sepedi and then in English. The translations of the months of the year were written as indicated in the task below. The other home language versions have been attached in appendix B.

Matšatši a pula
Lebelela tšhupamabaka ye o arabe dipotšišo.

Pherekgong 	Dibokwane 	Hlakola 	Moranang 
Mopitlo 	Phupu 	Mosegamanye 	Phato 
Lewedi 	Diphalane 	Dibatsela 	Manthole 

 = Matšatši a pula

1. Na ke kgwedi efe ye e nago le pula ye ntši?
2. Na ke kgwedi efe yeo pula e sa nego kudu?
3. Na ke dikgwedi dife tše di lekanago ka pula?
4. Na kgweding ya Dibokwane pula e na matšatši a makae go fetiša ka Hlakola?
5. Re fe palomoka ya matšatši a pula kgweding ya Lewedi le Diphalane di hlakane.
6. Na ke kgwedi efe ye nago le matšatši a 20 a pula?

THE ENGLISH TRANSLATION

Questions

Look at the calendar. Answer the questions.

1. Which month has the most rain?.....
2. Which month has the least rain?.....
3. Which months have the same amount of rain?.....
4. How many more days does it rain in February March?.....
5. How many days does it rain in September and October altogether?
6. Which month has 20 days of rain?.....

English only questions:

7. How many more days does it rain in May than September?.....
8. Which three months together have the fewest rain?.....
9. Are there more or fewer days in May than in October?.....
10. Are there more or fewer rainy days in January than in December? What is the difference between them?.....
11. Which 3 consecutive months have the least rain?.....
12. Which 2 consecutive month have the least?.....

THE MONTHS OF THE YEAR IN ENGLISH

- | | | | |
|--------------|-------------|--------------|--------------|
| 1. JANUARY | 2. FEBRUARY | 3. MARCH | 4. APRIL |
| 5. MAY | 6. JUNE | 7. JULY | 8. AUGUST |
| 9. SEPTEMBER | 10. OCTOBER | 11. NOVEMBER | 12. DECEMBER |

ANALYSIS OF THE TASK

The task above requires learners to analyze and interpret the pictograph. Learners need to understand mathematical words such as *most*, *least*, *same amount*, *many more*, *altogether*, *together*, *fewest*, *fewer and*, *difference* before they can successfully make decisions about the appropriate mathematical procedures to follow. However, some of these words can pose problems to learners because they carry different meanings in ordinary language and in mathematics.

The use of the word “*difference*” in question 10 requires learners to find the difference between the rainy days in December and January. This question requires an understanding of the context in which the word “difference” has been used and to know which procedural skills are required to solve the problem. In ordinary English, this question may be answered by saying, “January is first month of the year and December is the last month of the year”, another answer that is inappropriate is “there were more rainy days in December than in January” or “the number of rainy days are odd and those in December are even”. While these responses may sound mathematical and signal the “*difference*”, they would be inappropriate in this case. Both Pimm (1987) and Pirie (1998) highlighted these possible misinterpretations. According to Pimm (1987), much confusion occurs because learners sometimes interpret mathematical language as if it is ordinary language.

In question five, the word “*altogether*” has been used for indicating a mathematical operation that requires “addition”. Learners have to first understand the meaning of the word in English then make sense of it in mathematics. The challenge in this case is being able to distinguish the context in which this word “*altogether*” has been used. In question eight the word “*together*” has been used for grouping months with fewer rainy days and not to indicate addition. The absence of the prefix “*al*” in “*together*” changes the mathematical meaning of the question. Words such as these may affect learners’ capacity to answer the questions. This complexity may worsen for learners whose language of learning and teaching is not English.

In addition to the above challenges, the use of adverbs in the task may further complicate learners’ understanding. The comparative adverbs such as “*fewer, more, least, most, fewest*” require different mathematical application in different questions. Learners have to know when and how such comparison words were used. They should also be aware that these adverbs are sometimes used to compare two things, while in other instances they are used to compare more than two things. When such words are not properly understood they may also lead to misinterpretations.

Another hurdle to overcome in this task is recognizing how the words “*fewer*” or “*fewest*” and “*less*” or “*least*” have been used in the task. These words are used in the task for classifying months with the minimum number of rainy days. In ordinary English, the word *fewer* is used when talking about measurable quantities and the word *less* is used when

counting or measuring is not possible. As an example, consider the use of these two words in the sentence, "She had *fewer chores*, but she also had *less energy*". In this task, both words (fewer and less) have been used for measuring quantities (number of rainy days). This highlights the mismatch/discontinuity between the language of mathematics and ordinary English. Learners need to decipher through these words in order to understand the meaning of the questions posed.

In short, this task does not only require learners to interpret the pictograph or to compare the quantities only but the learners also need proficiency in both the language of mathematics, ordinary English and their home language . Another important skill for solving problems in this task is the ability to reason logically, to explore and to apply the required mathematical procedure.

ANALYSIS OF THE TRANSCRIPT

As explained in Chapter 3, categories and subcategories were developed to identify which mathematical strand or language dominated the utterances in the classroom. Below is Table 4.1, which shows the different strands of mathematical proficiency and how often they were evident during the lesson. The coded transcript has been attached in the appendix.

TABLE 4.1

The categories	Subcategories	Language used	Number of occurrences in the transcript
1. Productive Disposition	Reinforcing productive disposition	Home language	0
		English	0
	Evaluating productive disposition	Home language	0
		English	0
	Challenging productive disposition	Home language	0
		English	0
	Displaying productive disposition	Home language	0
		English	3

2. Adaptive reasoning	Evaluating adaptive reasoning	Home language	0
		English	1
	Challenging the adaptive reasoning	Home language	1
		English	4
	Displaying adaptive reasoning	Home language	3
		English	8
	Reinforcing the adaptive reasoning	Home language	0
		English	1
3. Conceptual understanding	Evaluating the conceptual understanding	Home language	0
		English	2
	Challenging the conceptual understanding	Home language	2
		English	6
	Displaying conceptual understanding	Home language	8
		English	2
	Reinforcing the conceptual understanding	Home language	0
		English	10
4. Strategic competence	Evaluating the strategic competence	Home language	0
		English	0
	Challenging the strategic competence	Home language	0
		English	0
	Reinforcing the strategic competence	Home language	0
		English	0
		Home language	0
		English	0
	Displaying strategic competence	English	4
		Home language	5
5. Procedural fluency	Evaluating the procedural fluency	Home language	1
		English	7
	Challenging the procedural fluency	Home language	0
		English	7
	Reinforcing procedural fluency	Home language	0
		English	1
	Displaying procedural fluency	Home language	8
		English	12
Giving instructions		Home language	3
		English	4

Reading	Home language	16
	English	10
Learner responses	Home language	0
	English	19

The table above indicates the number of utterances per strand. Categorizing utterances into strands that are interdependent and interwoven is not a straightforward process. The five strands are not a one-dimensional trait; they cannot be achieved by focusing on just one strand (Kilpatrick, 2001). In my analysis of the transcripts, I have individually categorized some utterances as conceptual understanding, procedural fluency or adaptive reasoning but that does not mean that these skills have been acquired independently. However, categorizing strategic competency separately was not possible because this strand was always interwoven in procedural fluency and conceptual understanding. The reason being that part of developing strategic competence involves proficiency in using procedures flexibly and understanding mathematical concepts (Kilpatrick et al, 2001). The two strands are essential for strategic competence, learners had to know when and where to use the procedural to access this proficiency.

Productive disposition is another strand that was difficult to analyze in a single lesson because it involves attitude. However, there were utterances such “I want to be a math star” that displayed productive disposition but this was not sufficient to be categorized as displaying productive disposition. Learners also needed to indicate that they believe that steady effort in mathematics pays off and they need to see themselves as effective learners and doers of mathematics (Kilpatrick et al, 2001). This skill can be acquired after all the four strands have been developed.

Conceptual understanding and procedural fluency in both English and learners’ home languages were dominant in this lesson because the lesson was conducted in both learners’ home language and in English. The reason for this is that the tasks given on that day required more fluency in conceptual understanding and procedural fluency than the other two strands. The utterances that were displayed in home language occurred predominantly during the group discussions, the English utterances took place during the reflective discussions in the open domain.

In the next section, I will highlight how learners used their home languages to display the four strands; this will be followed by how the mathematics teacher reinforced four strands.

HOW LEARNERS USED THEIR HOME LANGUAGES TO PROMOTE THE FOUR STRANDS.

I will use the following vignette to highlight how learners used their home languages to demonstrate the four strands. In this vignette, the three learners were working on question two of the task described earlier, which involved the use of the concept “least”. The three learners are Sifiso, Nhlanhla and Siphoh.

[] represent action taken in the lesson

() represents a translation to English

HLPT: Home language project teacher

MT: mathematics teacher

L: Any learner in the class, (name not allocated)

R: for researcher

[the three learners are reading the question loudly in Zulu, then in English and then in Zulu again]

The group: *Yiphi Inynaga enemvula encane? [they turned to the English version] (Which month has the least rain?) [They turned to home language version and read.]*

Siphoh : *June, July..... agunethi ngo June no July ku ya bhanda (its June and July it does not rain in Winter). ... [The other group members shook their heads]*

Nhlanhla : *masi zi counteni futhi.(lets count again) [They refer to the pictograph to see what has been represented in each, month.]*

Nhlanhla : *Hu August , there is nothing in August*

Sifiso: *but bathe imvula encane, a kuna mvula ngo August, hu July. (but they said the month with the least rain, there is no rain in August)*

Nhlanhla: *encane (the least) a kuna niksho “naught” (its zero).*

Sifiso: *Sifiso pointing to compare at the August and the July pictograph. He eeee hu July one mvula encane(No..... but it is July that has the least rain) [They all agreed on that July is the month with the least rain , Sifiso was insisting on July after the argument with Nhlanhla . Now the whole group writes July on their worksheet].*

The three learners in the vignette, began by reading and deciphering the meaning of the words used in their home languages and then moved to the English version. The home language

version acted as a source of reference in instances where they did not understand the meaning of words in English. They further used their home language version to ensure that they understood what was required in the question.

Sipho's response to the question was "*agunethi ngo June no July ku ya bhanda*" (*its' June and July ,it does not rain in Winter*). Sipho did not refer to the graph to figure out the answer, he used his everyday experience. His answer may not be correct but he understood what was required in the question. The meaning of the word "least" which meant "encane" in Zulu was understood. Sipho could relate the concepts *least* with "nothing". However, his interpretation of the concept "least" was interpreted differently by Sifiso. The different interpretation of the concept "least" heated up the discussion between Sifiso and Nhlanhla. Nhlanhla argued that the month with the least rain is August. "*Hu August, there is nothing in August*" (*its August there is nothing in Augusts*) but Sifiso insisted that "*but bathe imvula encane, a kuna mvula ngo August, hu July .*" (*But, they said the month with the least rain*). Sifiso was implying that there should be a certain amount of rain for the month to be declared the month with least rain. He maintains that the question was stated as: "Hi yiphi inyanga enemvula encane (the month with least rain) and not "hi yiphi inyanga engenamvula" (the month that does not have any rain). He interpreted the concept "least" as something that is present and can be quantified. It can be argued that the meaning he attached to the concepts "least" is influenced by his linguistic background. In ordinary language (both English and Zulu languages) "*encane*" or "*least*" cannot be related to *nothing*. We talk about "*encane*" when there is presence of something. Mathematically, least means the lowest quantity and zero or nothing counts as the lowest quantity.

Both learners understood that the concept "*least*" meant either the lowest or smallest. Their views on this word differed because of the ambiguity attached to the word. In ordinary language, the concept could refer to the month with lowest amount of rain (a portion of rain). Mathematically zero is a number and a concept for nothing. Nhlanhla's argument that "*hakuna niks in August*" (there is nothing in August) was correct. Zero is the smallest value in this case; as a result, the absence of rain should be the least amount. Numerically zero is less than one (Kaplan, 1999).

The discussion between the two learners demonstrated how learners used their home languages to argue, justify their answers, talk about the ideas and interpret mathematical

concepts. Sifiso who interpreted the question as “Hi yiphi inyanga enemvula encane (the month with least rain) and not “hi yiphi inyanga engenamvula”(the month that does have any rain) justified his answer. He displayed an excellent and logical adaptive reasoning for a grade three learner. He might not have understood that zero is also a number for quantifying things but he understood that the concept *least* meant “*encane*” which meant the lowest value. The interaction between the two learners displayed a high level of adaptive reasoning, conceptual understanding and procedural fluency. They used their home languages to put forth what they believed to be valid explanations.

This type of discussion (in their home languages) allowed learners to think together about July and August as possible solutions. They also challenged each other’s ideas; both Nhlanhla and Sifiso expressed their arguments, clarification and explanations. Using their home language enabled a good conceptual understanding. Since these learners have acquired the conceptual understanding, they could see connections among concepts and procedures and they could give an argument to explain why some facts are consequences of others (Kilpatrick et al 2001).

All mathematical ideas, interpretations, reasoning and thoughts in this lesson were filtered through communication in the classroom, which was enabled by the use of their home languages. As these learners communicated their ideas, they learned to clarify, explain, refine and consolidate their thinking (Sfard et al, 1998). In short, these mathematical conversations were good for mathematical thinking, reasoning, conceptualizing and solving problems (Sfard et al, 1998). The use of home language further facilitated the acquisition of metacognitive (self-monitoring and self-regulation) strategies; they understood the instructions given, had necessary language to complete the task, they could assess the complexity of the problem, evaluate the information given and they could argue for reasonable solutions. These skills are crucial for identifying what to reread, when to ask questions and what additional information is required to develop understanding (Manning, 1984). This process is essential for doing mathematical tasks of higher cognitive level (Stein et al, 1996).

Learners in this class also indicated how the use of their home languages supported them in learning mathematics.

Karabo highlighted this during the interview :

R: *Ho bala maths ka Sesotho le Sekgowa hole thusa jwang? (How does learning maths in Sesotho and English help you)*

Karabo : *Ho bala ka Sesotho le English ho re etsa di maths stars (Learning mathematics in Sesotho makes us maths stars)*

R: *Ho le thusa jwang hore le be di maths stars? (How does it make you maths stars?)*

Karabo: *Ha o bala ka Sesotho, o bala ka English o tla ba maths star (If you learn in Sesotho and in English, you become a maths star*

R: *why?*

[Karabo quiet].cause ha o learner ka language ya hao le ka sekgowa o tla tseba (because if you learn in both languages you will understand / know).

R: *jwang? (How ?) [She points at the worksheet]*

Karabo: *Ke qadile ke bala maths ka Sekgowa, ka e fumana e le thata, empa ho na jwale ke etsa ka Sesotho le sekgowa ke e fumane ele easy. (When I started learning mathematics, we were using English only, I found it difficult, but now that we are using both languages, I find it easy)*

Karabo argues that the use of home language facilitated her conceptual understanding. She maintains that she had a problem in understanding concepts, but now that she was using her home language “Sesotho”, she finds mathematics easy. The use of home language has furthermore developed another mathematical strand which Kilpatrick et al (2000) refers to as the “productive disposition”. Karabo has also developed a positive attitude towards mathematics “ke e fumana ele easy ” (I find mathematics easier now). The use of home language has made mathematics more sensible to her (Kilpatrick et al, 2001).

Another learner (Nthabi), also echoed the same view during the interviews.

R: *Language ya hao e ho thusa jwang hore o tsebe mathematics? (How does your home language help you to learn mathematics?)*

Nthabi: *E nthusa hore ke tsebe hore keng le hore e ngolwa jwang? (It helped me to know why and how to write mathematics?)*

R: *Ke bona mole moo exercises ya rainy days. Question ere “Which month has least rain? Ke kopa o ntlalose hore Setwana se ho thusitse jwang hore o tsebe ho araba question e? (In the class you answered your questions very well , how did Setswana help you answer the question 2 “Which month has least rain?”)*

Nthabi : *E nthusitse , ke ile ka re tse nyane .(It helped to know that the question needed “the least”)*

R: *O tsebile jwang hore sentence ena e bua ka tse nyane? (How did know that it meant the least?)*

Nthabi: *Nkao o balla yona. “ Ke pula.....ennye. Ennye ke.....least [She started reading the Setswana version of the worksheet] rain ... the least*

Nthabi highlighted how the use of Setswana aided her conceptual understanding. She indicated how the translated version of the word “least” which meant “ennye” in Setswana facilitated her understanding. She furthermore indicated that the use of home language supported her in “knowing *how* and *what* to write” in mathematics. This is an indication that the use of Setswana facilitated her conceptual understanding (“what”) and her strategic competence (“how”).

Sifiso’s view concurred with that of Karabo and Nthabi as can be seen below:

R: *manje ngoba Monday, Tuesday, Wednesday and Friday ni funda nge English yodwa. U cope kanjani? (On the other days you are learning mathematics in English only, how do you cope?)*

Sifiso: *Kahle (fine)*

R: *Ngicazele? (Can you explain to me?)*

Sifiso: *Masifunda ngamashapes, si funda nje, siqala o ku sebenza asi khulumi. (When we learn about shapes, we just start working we do not talk)*

R: *Manje mani sebenza na bangani beno ni sebezisa yiphi i-language? (When you talk to your peers in the classroom, what language do you use?)*

Sifiso: *Si khuluma i-English ne IsiZulu (We speak English and IsiZulu.)*

R: *I-English nesiZulu. (English and Zulu.)*

R: *Why ni nga khulume IsiZulu sodwa or i-English yodwa (Why not English only or IsiZulu only?)*

Sifiso: *Abanye abunderstandi i-English, masekhuluma IsiZulu siyabaqazela ukuthi kwenzakalani nge English. Angithi ba understander IsiZulu, thina abazi i-English si zo ba tshela u kuthi kwenzakalani nge IsiZulu. (Other learners do not understand English, so we explain to them in Zulu).*

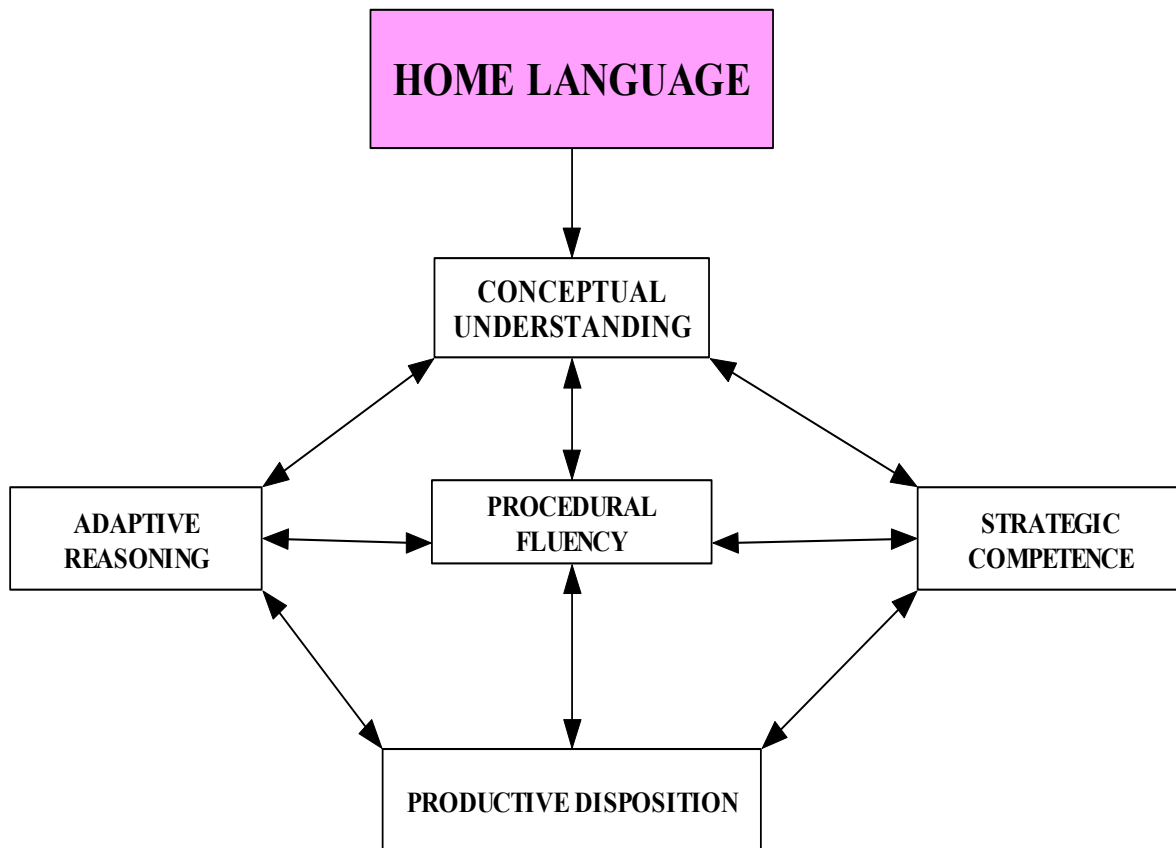
Sifiso did not only view the use of home language as a resource for conceptual understanding only but he also viewed it as a support for explaining English concepts to learners who do not understand English. He maintains that *Abanye abunderstandi i-English, masekhuluma IsiZulu siyabaqazela ukuthi kwenzakalani nge English. (Other learners do not understand English, so we explain to them in Zulu).*

In short, the use of home languages served as an entrance to the four strands (conceptual understanding, procedural fluency, adaptive reasoning and strategic competence) of mathematical proficiency. Because there was an understanding of mathematical concepts (conceptual understanding) used, learners could engage in different procedures required (procedural fluency) and explain or justify why the certain procedure worked (adaptive reasoning). They also displayed reasonable strategic competence, which was essential for solving certain tasks. Since the four interwoven mathematical strands have been achieved, this

implies that the learners would ultimately see the value mathematics (productive disposition), it can be argued that the five strands of mathematical were promoted.

The diagram below summarizes how the use of learners' home language facilitated all the mathematical practices in the lesson:

DIAGRAM 1



In the diagram above, it is indicated that learners' home language played a crucial role in facilitating the five strands. Learners used their home languages

- a) For peer or collaborative discussions,
- b) For meaning making,
- c) For reading with understanding and
- d) For translating English concepts to their home languages and vice-versa.

This classroom practice was essential for promoting conceptual understanding. Conceptual understanding consists of those relationships constructed internally and connected to already existing ideas. It involves the understanding of mathematical ideas and procedures and includes the knowledge of basic arithmetic facts. Learners use conceptual understanding of

mathematics when they identify and apply principles, know and apply facts and definitions, and compare and contrast related concepts. Knowledge learned with understanding provides a foundation for remembering or reconstructing mathematical facts and methods, for solving new and unfamiliar problems, and for generating new knowledge (Kilpatrick et al, 2001). Since there was proficiency in conceptual understanding learners could apply different procedures, they could explain their solutions and they knew when and how to apply different strategies to different problems. The four strands were promoted and these four strands are essential for the development of the productive disposition.

HOW THE TEACHER PROMOTED MATHEMATICAL PROFICIENCY

Subsequent to the group discussions discussed above, the mathematics teacher opened the discussions to the whole class to reflect on what they discussed in their respective groups. This is where English was predominantly used to accommodate different language groups.

A distinguishing feature about this lesson is the manner in which the mathematics teacher managed the class. Her probing skills allowed learners to openly reflect what has been discussed in their respective groups. Communication between the learners and the teacher allowed learners to verbalize their mathematical ideas and clarify their thoughts (Mercer, 1995). She challenged learners by asking questions such as *I want to know why December has the most rain? How can you be sure? How do you know you are right? , tell us how you got your answer right or wrong..... , I want you to convince me why you are right and why is the answer December and not January.* These helped her to assess the work done in different home language groups. All mathematical ideas, interpretations, reasoning and thoughts were filtered through this question-answer process. Learning that took place in this class was jointly constructed by learners and guided by the teacher into a common understanding and a common language to express (Mercer, 1995). The teacher as a “knowledgeable other” (Vygotsky, 1978) has helped them to add meaning into mathematics by first allowing them to use home language in their discussion and incorporating what they have discussed in their respective groups into the public domain (classroom). The technique used by the teacher ensured maximum participation of all learners. She allowed the learners to do as much as they

can on their own using their home languages. She then intervened and provided assistance when it was needed so that the task can be successfully completed.

The following extract highlights how she probed this learner:

MT [reading: reading question 2]Which month has the least rain.

L: August

MT: How can you be sure?

MT: How do you know you are right?

L: I did go to the month June, July when I got to August, found that there was nothing in August.

MT Yes, its got none, its got the least

In the extract, the mathematics teacher is probing this learner to explain or justify “why is August the month with the least rain”. Her questioning “*How can you be sure, how do know you are right*” probes deep into understanding the procedure or strategy used. This type of interaction persuaded this learner to display her adaptive reasoning and conceptual understanding of the concepts *least*. In this apprenticeship, learners were actively engaging in a classroom practices in which the teacher models, guides and helps regulate performance. As they openly verbalize their ideas, the teacher promotes progress through the ZPD (Thomas, 1993 cited in Schutz R, 2004 :).

In the above extract, the teacher guides the class by rephrasing learners’ response, she argued that “yes....., it’s got none, it’s got the least”. The teacher reinforced conceptual understanding by rephrasing learners’ response. She managed the disagreement about the concept *least* by openly explaining it to the classroom. The dialogue, questioning, sharing of ideas and knowledge that took place reinforced conceptual understanding, adaptive reasoning, and procedural fluency and strategic competence. Another example of how the teacher promoted the four strands is indicated below:

MT:[reading the third question]Which months has the same amount of rain?

L: May and June

MT: who says she is right, how did you know it is correct?, it is easy

L: : It is May, June and October.....

[The whole class:[shouting loudly] Yes.....

MT: why do you say it is May , June and October

L: May has 3 rains, June has 3 and October has 3

The teacher is challenging the learner to justify his answer. Her question “Why do you say it is May, June and October” does not only call for adaptive reasoning but she is also expecting

the learner to explain the strategy or procedure used for solving the problem. This learner showed that she understood what was required, she knew which procedure and strategy to use and she could justify her answer: “*May has 3 rains, June has 3 and October has 3*”. The teacher was not concerned with the manner in which they expressed themselves but rather about how they make meaning and explains their solutions. This learner used words that made sense to all involved in the class even though in terms of the English language they would be incorrect “it has 3 rains”. The teacher understood that she meant that there are three rainy days in May June and October, and she accepted the answer and continued with the lesson without focusing on correcting the use of English language. In this way she focused on the development of the learner’s mathematical proficiency rather than language proficiency.

MATHEMATICAL LANGUAGE COMPLEXITIES THAT EMERGED IN THIS LESSON

During class observations, there were several differences in the interpretation of the concept “least”. As an observer, I initially regarded these differences as one of the common mathematical errors that learners make in any mathematics classroom. I did not internalize what it meant to them or to me as mathematics teacher. The two learners in the vignette discussed above had different views about the concept “least” because it carried different meanings in ordinary language and in mathematical language. Sifiso interpreted the concept “encane” (least) as representing a small amount (a certain portion) of rain whilst on the other hand Nhlanhla viewed it as “niks” which is equivalent to zero i.e. a value lower than one. In fact, the conversation between the two learners highlighted the complexity of the language of mathematics.

The concept “least” is an adjective that refers to lowest, smallest or minimal in magnitude (Oxford dictionary). This concept changes its meaning when used in different contexts. For example, it can quantify as in sentence “*he did not care the least bit*”, it can also compare magnitudes as in “*The least amount of fat was used*”. In the first sentence the concept refers to nothing i.e. *there was no care at all*. However, in the second sentence it refers to a portion of fat used. In ordinary language (English), the use of the word in the two sentences above makes sense to the reader. However, this rule does not apply in the African languages. The concept “encane” in IsiZulu , “e nnye” in Setswana, “e nyane ” in Sesotho , or “e ncinci” in IsiXhosa signify a small amount of things that are present. In everyday discourse, the

concept cannot be used when there is absence of something. When there is no rain, the concept “ha ho na pula” in Sesotho” or “a kuna mvula” in Zulu is used. It cannot be used for referring to the least rain “pula e nyane” in Sesotho or “imvula ecane” in Zulu.

In mathematics the contrary is possible, the concept *least* can either refer to the presence or absence of something. For example, if there are three learners in the class, Siphon has 50 cents, Thabo has 25 cents and Lesego has no money at all. Who of the three learners has least money? The answer would be “Lesego has the least money”. The absence of money is numerically quantified as equal to a number zero. However, in ordinary language, this does not make sense because nothingness cannot be quantified. We cannot talk about “0” of something. We use numbers when we quantify things and this excludes zero. It makes sense talk about “four dogs” than to talk about “zero dogs” in ordinary language. Whereas, in mathematics if the number of dogs is zero, then there are no dogs. Zero is the number that precedes the positive one, which means nothing, null, void and an absence of value (Kaplan, 1999).

Sifiso’s interpretation of the concept “least” originates from how the concept is used in their everyday discourse which is mainly in their home languages. Pirie (1998) maintains that learners make sense of concepts and construct their own meaning through a combination of personal experience and cultural tradition. The image of a mathematical concept will always be underpinned with the original everyday language that gave its birth. Zevenbergen (2001) equally argues that when students enter the school context, their out of school language practice, which is influenced by their cultural background (Vygotsky, 1962), provides the lens for interpreting and acting within school context. Some of the learners in this study interpreted the concept according to their linguistic background. Therefore, it was important for the teacher to assist them in unlearning what is already embedded in their language. This may be possible if learners are given the opportunity to talk freely about their interpretation of concepts in a language they are fluent in; this will in turn give teachers an opportunity to identify these errors or misconceptions.

CONCLUSION

The use of home language facilitated conceptual understanding, adaptive reasoning, procedural fluency and some strategic competence. This was possible because learners could read, write and talk in their different home languages in their respective groups. Reading and

translations into their different languages was enabled by the presence of the two HLP teachers. The HLP teacher further prepared these lessons together with the mathematics teacher. This facilitated the smooth running of the Thursday lessons. What is of concern is that it may not be practical to implement these classroom practices in regular classroom. However, when we look at the other side of the coin, this can be achievable in cases where learners can independently read, write and talk in their home languages.

CHAPTER 5

SUMMARY OF FINDINGS AND RECCOMENDATIONS FOR PRACTICE

The purpose of this study was to investigate how the learners' home languages can be used to support the learning of mathematics in a multilingual class of second language learners. The study was conducted in Phelindaba primary school in Johannesburg. In this chapter, I present a summary of the findings of the study; I use the research questions stated in Chapter 1 as headings to guide the discussion of the findings.

What skills does the Home Language Project privilege and make available to both learners and teachers?

The Home Language Project gave both the teachers and the learners the opportunity to engage in skills such as writing and reading in learners' home language. Learners in this class were provided with books and worksheets that were written in their home languages, this gave them the opportunity to talk about what to read, to focus on the sounds and parts of the language as well as meanings.

The teachers furthermore assisted them with reading other resources outside the mathematics classroom. The reading of books from the library, story telling in small groups reflected positively on their identity and culture. One of the HLP teachers indicated that during the interviews:

R: What have you noticed, are there any changes that are learning mathematics in their home language and English.

HLPT : Their attitude towards their home languages has changed . They have accepted it as part of their lives. They also feel that the other learners are missing out, they feel that every child should learn in their home languages.

R: Are there any other benefits?

HLPT : We also go to the library to help the schools with classification of books “ home language books . This where we group our learners for story telling.

The HLP teacher indicated changes that the home language brought; she also indicated how they inculcate the spirit of learning and reading in their home languages. Story telling was another skill essential for their listening skills, this is crucial for classroom discussions. In

fact, these reading sessions are imperative for improving learners' reading skills in both their home languages and English because they read in their home languages and in English.

Learners were also given a list of words that were written in English, the focus on these worksheet was to encourage learners to translate words from English to their home languages. A good vocabulary in any language is crucial for reading with understanding and for writing logical sentences.

How does the teacher use the learners' home languages during teaching?

The mathematics teacher allowed learners to read, discuss, and solve the mathematical tasks in their home languages in their respective groups. As they discussed, the mathematics teacher would move from desk to desk to evaluate their conceptual understanding and procedural fluency. In cases where she did not understand the language used, she would consult the HLP teachers who could read, write and speak in all the seven languages. The learners' use of their home languages facilitated not only discussion but also the depth of the discussions that the learners had. During the whole class teaching, the teacher used English and encouraged the learners to do the same.

The two HLP teachers whose role was to support the learners and the teacher in using the home languages for learning mathematics were at all times available when need arises. In instances where learners did not understand what has been written in the task, the HLP teachers intervened by re-reading and explaining the sentence in the home language with the learners until everything was understood. As they moved from desk to desk, they identified learners who were struggling with their reading. Weaker students were given more attention. Paired reading was encouraged during the lesson. Learners were also encouraged to read until they understand before moving to the English version. Different home languages were used during the lesson. This is where most of the learners got an opportunity to solve, discuss, argue and explain to their peers.

How do learners use their home languages when interacting with mathematical tasks?

Learners used their home languages as a resource for understanding what is required in the task given. They were continuously referring to home language version to make sense of the meaning of words used in the task. Understanding what was required in the task enabled their

proficiency in conceptual understanding, procedural fluency, strategic competence and adaptive reasoning. The learners used the home language as a channel to deepen their understanding of mathematical concepts used; they referred to the home language version wherever there were misunderstandings or misinterpretations.

The use of the home language enabled the learners to express themselves freely. They helped each other in finding the meanings of the words used in the English texts by referring to the home language version. The home language version acted as reference for problems encountered in English and in the language of mathematics. The use of home language facilitated their understanding of complex mathematical terms such as “how many more”, “fewest”, “more or fewer” and many others. For example, the question “How many more days does it rain in February than March” was easily translated to “Hi Nyenyenyani yina masiku mangani ku tlula Nyenaykulu” in Tsonga or “Pula e nang ka Hlakula e feta e nang ka Hlakubele ka matsatsi a makae” in Sesotho. The home language version made explicit to the learners the procedure to follow; the words “...feta... ka matsatsi a makae?” in Sesotho indicated clearly that the task required subtraction. The complexity of both English and the language of mathematics was resolved by the use of the home language version. Another example where conceptual understanding was facilitated by the use of home language was in question five: “How many days does it rain in September and October altogether? The Sesotho version highlighted clearly that learners needed to “add”, it read as “Ka Lwetsi le ka Mphalane pula e na matsatsi a make ha a kopana kaofela.” The direct translation of the phrase “ha a kopana kaofela” is “when added together” and hence the learners understood what they were required to do.

The learners developed their ideas and knowledge collaboratively. They justified their thinking to other group members and this helped in building their confidence. The classroom was converted into a community of inquiry where they would ask questions, develop investigative skills and produce evidence and justifications for their solutions. Knowledge was acquired in the process of self-initiated, personally explored the solutions to the problem. Vygotsky (1962) argues that being able to express the same thought in more than one language enables a child to compare and contrast two language systems and this allows a greater cognitive and metalinguistic awareness. Studies by Setati (1998), Adler (2001) and Moschkovich (1996; 1999 and 2002) have shown that the use of home language in the

teaching of mathematics provides a support needed while learners continue to develop proficiency in the LoLT. Learners in this class used their home languages not only as a support for their language but also as means of exploring mathematical ideas.

What mathematical practices were carried out by the use of the learners' home languages?

The use of home language for reading, translating English words, talking, sharing ideas, disputing ideas, challenging each other's ideas facilitated the four strands of mathematical proficiency. Learners displayed skills of procedural fluency when they were solving tasks. They had knowledge of when and how to use them appropriately and performing them flexibly, accurately and efficiently.

Procedural fluency also plays an important role in developing learners' strategic competence. Students develop procedural fluency as they use strategic competence to choose among effective procedures. They also learn that solving challenging mathematics problems depends on the ability to carry out procedures readily and, conversely those problems solving experience helps them to acquire new concepts and skills (Kilpatrick et al 2001). Learners in this study have displayed a sound skill in procedural fluency, which is crucial for developing strategic competence.

They could connect their understanding of the concepts *least* with zero. This is a significant indicator of conceptual understanding; i.e. being able to represent mathematical situations in different ways and knowing how different representations can be useful for different purposes. The degree of student's conceptual understanding is related to the richness and extent of the connections they have made. Connections are useful when they link related concepts and methods in appropriate ways (Kilpatrick et al 2001).

The other important strand that learners have displayed in their discussion is adaptive reasoning. They could justify their work and explain ideas in order to make their reasoning clear. They could use evidence to critically reason, generate explanations with their data, and defend them orally or in writing. This interaction enabled them to reach a higher level of understanding, which developed their capacity to solve mathematical problems collectively. All mathematical ideas, interpretations, reasoning and thoughts were filtered through

communication in the classroom. As they communicated their ideas, they learned to clarify, explain, refine and consolidate thinking (Sfard, Nesher, Streetland , Cobb & Mason, 1998).

In short, the mathematical conversations they had were good for mathematical thinking, reasoning, conceptualizing and solving problems (Sfard et al, 1998).

RECOMMENDATIONS

As indicated earlier in chapter 2, there are debates from the both the public domain and mathematics education regarding which language is most appropriate for learning subjects such as mathematics especially in a multilingual context such as South Africa. This study has shown that it is possible to integrate learner's home language in multilingual classes. Learners in this study successfully used different home language in their group discussions, reading mathematical tasks, translating words and meaning making. The different group discussions, which were conducted in learners' home languages, enabled them to understand each other's ideas, interpret tasks and solve problems. The reflective discussions that were held gave the teacher the opportunity to assess or evaluate learners' ideas, their understanding and procedural skills.

This implies that the use of home language for supporting the learning of mathematics is possible. However, the following have to be implemented to fully achieve this goal:

1. Learners' home language should be taught as a subject at elementary level to enable them to independently understand all forms of reading material written in their home languages.
2. Mathematical texts should be written in learners' home languages as well as in English to facilitate the understanding of English as a language and to enable learners to make sense of what is expected from them.
3. There should be teacher development programmes to assist teachers on how they can use the home languages as a support. While many teachers are multilingual and have learned through this study that language fluency on its own is not enough. The teacher also needs skills on how to keep the discussions always focused on the mathematics and not English language proficiency.
4. Parents should be informed about the importance of home language for learning, to enable learners to grow with it and embrace it as their cultural identity. Language,

culture of the home and school should be congruent to enable learners to acquire skills that are needed to participate in shared culture of the school.

CONCLUSION

The chapter has outlined how the use of home language can be used as a support for learning. The study was conducted in a grade three class where English was used as the LoLT, but the use of home language has successfully supported and promoted mathematical proficiency. Learners could talk freely about their ideas; they could translate the concepts from their home language to English and interact with teacher and peers. This allowed them to access knowledge and the language used in mathematics thus improving their proficiency in mathematics. Learners who talk about what they learn are easy to teach because they can reflect what they think verbally and this will in turn enable the teacher to identify their misconceptions and or misunderstandings. However, it has been argued that using different languages in a multilingual setting is impossible because the teacher may not be proficient in all the languages used. The success of such a lesson will depend on the proficiency of the learners in their respective home languages. This may not be a problem for the majority of learners in South Africa because they take their home languages as one of their subjects at school. Major problems may be encountered in schools where English is taken as LoLT and learners' home language is not offered as a subject.

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APPENDIX A

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

R14/49 Langa

CLEARANCE CERTIFICATEPROTOCOL NUMBER 50910PROJECT

Support for

An Investigation into the use of Home Language as a

INVESTIGATORS

Ms M Langa

DEPARTMENT

School of Education/Mathematics

DATE CONSIDERED

05.09.07

DECISION OF THE COMMITTEE*

Approved unconditionally

This ethical clearance is valid for 2 years and may be renewed upon applicationDATE 05.01.12CHAIRPERSON 

(Professor C Penn)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof M Setati
School of EducationDECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. I agree to a completion of a yearly progress report.This ethical clearance will expire on 1 February 2007

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

TEACHER CONSENT FORM: Videotaping

I(please print your name in full) a mathematics teacher at, am aware of all the data collection processes in the Home Language Project as listed in the information sheet attached .

I give consent to the following:

- Video recording of my lessons on use of home language in mathematics. I am aware as teacher that I will be the focus of the video recording and thus will appear as part of the video text.

Yes or No (use a cross to indicate your selection)

- The possible future use of the videotext for conference purposes

Yes or No (use a cross to indicate your selection)

SignedDate.....

SignedDate.....

TEACHER CONSENT FORM: Tape recording

I (please print your name in full) a mathematics teacher at, am aware of all the data collection processes in the Home Language Project as listed in the information sheet attached .

I give consent to the following:

- Being interviewed at some point during the study
Yes or No (use a cross to indicate your selection)

- The tape recording of my interview with the researcher
Yes or No (use a cross to indicate your selection)

SignedDate.....

SignedDate.....

PARENT CONSENT FORM: Videotaping

I (please print your name in full) parent / guardian of, am aware of all the data collection processes in the Home Language Project as listed in the information sheet attached .

I give consent to the following:

- That my child be videotaped during the mathematics lesson.
Yes or No (use a cross to indicate your selection)
- The possible future use of the videotext for conference purposes
Yes or No (use a cross to indicate your selection)

Signed (parent or guardian).....
.....Date.....
Signed (researcher).....
.....Date.....



UMnyango WezeMfundo
Department of Education

Lefapha la Thuto
Departement van Onderwys

Date:	20 August 2005
Name of Researcher:	Langa Mampho
Address of Researcher:	8 Berillium Street Wilropark Ext 14 Roodepoort 1724
Telephone Number:	(011) 7176295
Fax Number:	(011) 7176285
Research Topic:	An investigation into the use of home language as a support for learning mathematics
Number and type of schools:	1 Primary School
District/s/HO	Johannesburg North

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

Permission has been granted to proceed with the above study subject to the conditions listed below being met, and may be withdrawn should any of these conditions be flouted:

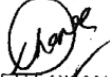
1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*

Office of the Senior Manager – Strategic Policy Research & Development
Room 525, 111 Commissioner Street, Johannesburg, 2001 P.O.Box 7710, Johannesburg, 2000
Tel: (011) 355-0488 Fax: (011) 355-0286


4. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Senior Manager (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher must supply the Senior Manager: Strategic Policy Development, Management & Research Coordination with one Hard Cover bound and one Ring bound copy of the final, approved research report. The researcher would also provide the said manager with an electronic copy of the research abstract/summary and/or annotation.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Senior Manager concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards



ALBERT CHANEE
ACTING DIVISIONAL MANAGER: OFSTED

The contents of this letter has been read and understood by the researcher.	
Signature of Researcher:	
Date:	3 OCTOBER 2005

APPENDIX B

TRANSCRIPT OF THE SELECTED LESSON

Writings in blocks: Work written on the board.

[] represent action taken in the lesson

() represents a translation to English

HLPT: Home language project teacher

MT: mathematics teacher

L: Any learner in the class, (name not allocated)

R: for researcher

The transcript:

[Learners are encouraged to read in their home language and then read in English , and then go back to home language and then back to English . Then solve the problem in any language.]

The HLP teacher (HLPT) has distributed the worksheet to the learners. She wants to verify if all learners got their worksheet.

1. HLPT: Ni tholile amphepha weno nonke (*did get your worksheet all of you*)
2. Li thotse dipampiri tsa lona kaofela (*did get your worksheet all of you*)
3. Ngiyabonga , Dankie (*thank you*)

[The mathematics teacher (MT) is introducing the lesson. She reminds the learners (L1, L2 or L3) about the aim of the Thursday lesson. She then puts three charts on the board. The charts indicate how the lesson will be conducted. This is what was reflected on the board.]

<p>MATHS –LANGUAGE LESSON</p> <p style="text-align: center;">AIM</p> <ol style="list-style-type: none"> 1. READING 2. SOLVING PROBLEMS 3. EXPLAINING <p style="text-align: center;">MATHS STARS</p>

MATHS –LANGUAGE: PART 1

1. READ IN HOME LANGUAGE
2. READ IN ENGLISH
- UNDERSTAND??
3. TALK ABOUT IT AND SOLVE THE PROBLEM

MATHS- LANGUAGE : PART 2

1. MARK
- OR
2. EXPLAIN HOW
- OR
3. FIND OUT WHY WRONG

AND

GROUP DISCUSSIONS ACCORDING TO HOME LANGUAGE.

[learners were informed about how the lesson will be conducted]

4. MT: I've been telling you over and over again, What's the aim of this learning mathematics in two languages, in your home language and English.
5. L1: We want to be maths stars (DPD)
6. MT: We want to be maths stars [repeating learners' responses] (DPD)
7. MT: If you want to become a maths star , what is it that you have to do ? You do it over and over again..... Something you practice over and over again (EPD)
8. L2: Home language
9. MT : What is it that you have to do with your home language ? [The class quiet for a while , the teacher a bit impatientShe answers the question herself]

10. Read, read and read over and over again until you understand. Another thing that you have to do ... is to practice, talk about the sum and solve it. That will make you a good person in maths. Please don't sit there and be passive. You need to read and explain. Start with the home language and then read the English side. (RPD),(RCU)
11. MT: How many times must you read? [Learners raising their hands, the mathematics teacher points at one of them.]
12. L: You read over and over again until you understand (RCU)
13. MT: yes.... talk about it until you understand. Don't forget $2L=2U$ [All learners knew what was meant by this, she pointed to the abbreviation and the class interpreted it loudly.] (RCU)
14. The class: two languages is equal to two understanding
15. MT : Now you can start. [The whole class starts reading aloud in different languages. The home language project teachers are moving from desk to desk to assist the different language groups with their reading.]
16. [The Zulu group is reading loudly] “ Inzinsuku ze mvula”(The rainy days) Hi yiphi inyanga enemvula eningi ?(Which month has the most rain?)
17. Sifiso: [points at the January and December]....ingathi hi lezi (it seems it is these two months)
18. Nhlanhla : Si bale u January or uDecember ?(must we count January and December (DCU) (DPF)
19. Sifiso: Zo i two ? (Both) [pointing at both months] (DPF)
20. [The group: The whole group starts counting]....1,2,3.....25 for January and then move on to December to compare it with January.... [Waiting for a moment and not knowing what to write] (DPF)
21. Siphiso : But , asi balanga ianswer ka question 1. (We did not write the answer for question 1)
22. Sifiso: Its' December, it has 25 (DPF)
23. Siphiso: Do we have to write the symbols or the month. Sibala ini , ye?.....[looking at the language teacher]
24. HLPT : what is the question? Uthini umbuzo?

25. HLPT: [The language teacher reads the instructions in Zulu Beka incalender ophendule umbuzo] (*look at the calendar and answer the questions*) [learners turn their pages to the Zulu section and read the instructions and the question again]
26. Siphso: December has the most one, [he starts counting again to verify] (DPF)
27. Nhlanhla: December is 25 (DPF)
28. Siphso : Hi yiphi inyanga? (*Which month has the same amount of rain ?*)
29. They start counting to verify the answer. [they start counting again].....1, 2,3...[They ...hey all ultimately wrote December in their worksheets.] (DPF)
30. [Reading Question 2 in Zulu] Yiphi Inynaga enemvula encane [they turned to the English version] (*Which month has the least rain?*) [They turn to home language version and read.]
31. Siphso : June, July..... agunethi ngo June no July ku ya bhanda (*its June and July it does not rain in Winter*). ... [The other group members were not very happy with the answer because he did not refer to the pictogram which is on the overleaf].(DCU) , (DAR) ,(DPD), (DSC)
32. Nhlanhla : masi zi funde futhi.(*lets read again*) [They reading the question in Zulu and then English.] (CCU), (DPF)
33. Nhlanhla : Hu August ha kuna niks (there is nothing in August) ...,[pointing at the month using the pencil] (DCU), (DAR) (DSC)
34. Sifiso: but bathe imvula encane, a kuna mvula ngo August, hu July . (but they said the month with the least rain) (CCU) , (CAR)
35. Nhlanhla: encane (*the least*)ho “naught” (*its zero*) (DCU) , (DAR), (DSC)
36. Sifiso: Sifiso pointing to compare at the August and the July pictograph. He eeee hu July one mvula encane(No..... but it is July that has the least rain) [They all agreed on that July is the month with the least rain , Sifiso was insisting on July after the argument with Nhlanhla . Now the whole group writes July on their worksheet]. (DAR)
37. [Tsonga speaking group reading Question 4] “How many more days does it rain in February than in March?” [Reading in Tsonga] “Hi Nyenyeyani yi na masiku mangani ku tlula Nyenyenyankulu?”
38. Taki: September and October

39. [The other group members shake their heads to show that they disagree. They read again in both languages.]
40. [The whole group re- reading]: Hi Nyenyeyani yi na masiku mangani ku tlula Nyenyankulu? (*How many more days does it rain in February than in March?*)
41. Taki : 3
42. Nkensani : Why do say 3, (CPF)
43. Taki : a u fumeriYou disagree ne, (CPF)
44. Nkensani : iya , (yes)
45. Taki : See.....the learner points at the last three days in March .[Nkensani shaking her head, to disagree.....]
46. Nkhensani Let's read again [They start reading in Tsonga and then in English. Then start counting the number of rainy days in February and in March.]
1,2,3.....[They ultimately realized that it is 15 for February subtract 13 for March, the difference is 2 , they then write $15 - 13 = 2$] (DPF) , (DCU) (DSC)
47. Nkehansani : 2 , ya hi sona (*it is 2 , yes*) (DPF)
48. [The Xhosa speaking group reading question 4 together with the HLP teacher.]
Imvula ina.... (the teacher pointing her finger on the letters) ngaphezulu ngeee.....ntsu.....(biza legama.....a ... e... i...ou) (*say the vowels a, ... e.... i...., .. o ,u*) ngetsuku ezingaphi .

REFLECTIVE DISCUSSIONS

49. [The teacher disrupts the discussion after 30 minutes of reading and solving.]
50. MT: Read the first question loud, “which month has the most rain”?
51. [The whole class reads the question]Which month has the most rain?
52. MT: What is the answer?
53. L1: December
54. MT: I want to know why, December has the most rain? (CPF) , (CCU)
55. L2: In December, there are more rainy days (DAR)
56. MT: Any other answer?
57. L3: I counted, there are more rainy days in December (DAR) (DPF)

58. MT: I don't want you to count to see if December has the most rains. There are pictures remember. Tell us how you got your answer right or wrong in English please.(CAR)
59. L4: But we know it is right, because there are 25 days in December, but in the other months, they are less than 25 (DAR) (DPF) (DSC)
60. MT: But, we do not have to count (CAR)
61. L5: I saw that it is December, I wrote December
62. MT: I know you wrote December, but I want to know why? I want you to convince me why you are rightbecausebecause....., why is the answer December and not January. (CAR)
63. L6: Because December has five weeks and January has four weeks
64. MT: I want an easier answer. All I have to do is look at the picture, then you will know the answer.... Can't you, It's a graph, you can count later on.9
65. The next one [referring to the next exercise, question 2]
66. MT reading: reading question 2Which month has the least rain?.
67. L: August
68. MT: How can you be sure? (CPF)
69. MT: How do you know you are right? (CPF)
70. L: I did go to the month June, July when I got to August, found that there was nothing in August .(DPF), (DAR), (DCU) (DSC)
71. MT: She is half smart, what can you do to be smarter?, , what is the smarter answer?
72. L: I looked at the graph and saw that there was none in August (DAR) ,(DAR)
73. MT: good , yes it has none , its got the least (RPF), (RCU)
74. MT:[reading the third question]Which months has the same amount of rain?
75. L: May and June
76. MT: who says she is right, how did know it is correct?, it is easy(CCU)
77. L: : It is May, June and October.....
78. . The whole class: Yes.....
79. MT: why do you say it is May , June and July(CPF) , (CCU)
80. L: May has 3 rains, June has 3 and October has 3 (DAR) , (DPF) (SC)
81. MT: what's next
82. [Class reading] :How may more days does it rain in February than in March?

- 83. L: 38
- 84. . L: 2 (DPF)
- 85. L: 2 (DPF)
- 86. L:13
- 87. :28
- 88. L:2 (DPF)
- 89. . The whole class: yes.....
- 90. MT: How do you know its 2? (CPF), (CAR)
- 91. L:I counted and subtracted 13 from 15 (DAR), (DPF)
- 92. MT: Any other explanation.. [Teacher pointing at another learner.]
- 93. L: I looked at February and March,the pattern (using fingers to refer to rows and columns) I saw that March has 2 less days. (DSC), (DCU) (DPF) (DAR)
- 94. [The mathematics teacher attending to the next question]
- 95. .Class [reading]: How many days does it rain in September and October altogether?
- 96. L: 5 days (DPF)
- 97. The whole class: yes
- 98. MT: Next
- 99. Class: Which month has 20 days of rain?
- 100. L: January (DPF)
- 101. MT: How does she know that January has 20 rainy days without having to count the days.... (CPF)
- 102. L: I looked at the picture without counting, looked at when ...goes that way (using fingers to refer to columns and rows)
- 103. MT : Good , [she explains to the class] what is difference if things are going that way and if things are going that ways [pointing to the direction of rows and columns] We call[pointing] going down (RCU)
- 104. [The class quiet ,some students using fingers to indicate that they understand what she is talking about , but they do not have words for it.]
- 105. [The mathematics teacher draws a diagram on the board:]

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106. MT:[She writes the words *rows* and *columns* on the board.] (RCU)
107. MT: Which one said January? , you need to look how at how many columns for January, (she counts) 1.. 2.. 3... 4 columns, and how many rows? (RCU)
108. MT: you see you didn't have to count?(RCU)
109. MT: Next , Question 7
110. Class reading: How many more days does it rain in May than September?
111. [Teacher points to the learner].
112. L: May
113. MT: no , how many more ? (CCU)
114. L: 3
115. MT: how many more? (CCU)
116. L: 3
117. MT: how many more? (CCU)
118. L: 1
119. MT: 1 more than two,Next question (RCU)
120. Class [reading]: Which three months together have the fewest rainy days?
121. L: [Learner answers the question] July and September
122. MT: Which three months and not two? (RCU)
123. L: July, September and October. (DCU), (DPF)
124. MT: next
125. [The class reads loudly.]
126. Class: Are the fewer more or fewer days in May than in October ?
127. 112. MT: What is one row difference? [The class quiet for some time...The teacher intervenes]
128. L: December has 25 and January has(DPF)
129. Teacher intervenes again, No, I want a smarter answer.Remember we got one row of clouds MT: Next the class reads aloud)
130. Class: Which 3 cose.....[the class cannot read the word, the teacher helps them .]consecutive month have the most rain?

131. MT: What do you mean by consecutive? Teacher points at Karabo , she knows were to get the meaning of the word. (EAR),(ECU)
132. L: following one another (DCU)
133. MT: that's smart, very smart,.....follow each other ,..... so what's the answer? (RCU)
134. L: January, November and December
135. MT: let's make them follow one another (teacher pointing at the sequence of the month) (RCU)
136. Class: November, December and January (DCU)
137. MT: They follow each other, lovely!, NEXT....
138. Class reads
139. Class: Which 2 consecutive months have the least rain?
140. MT: the least rainy days.....
141. L: July and September
142. MT: Look at July and September, do they follow each other? (ECU), (ECU)
143. L: No
144. MT: Which 2 consecutive months have the least rain?
145. L: July and August (DCU)
146. MT: Now you start with your dictionaries for your homework.
147. [Learners taking out their personal dictionaries in order to translate the home language words into English.]

TEACHER INTERVIEWS

The mathematics teacher

1. R: On Thursdays your lessons are conducted in English and Home language, why that ?
2. MT: Because now, we'd like to teach the children in English and in their home language.
3. R: Why home language?on the other days, I mean on Mondays , Tuesdays , Wednesday and Fridays you use English when you teach,why Thursday?.
4. MT: It's a project, where we 'like to have see how learners perform in Mathematics when they are learning in two languages because two languages is equal to two understanding..... so they will excel in two languages.
5. R: What is so different about this class or lesson when compared with your regular English classes ?
6. MT:I noticed that the children in this lesson become free because we give them the opportunity to express themselves in their home languages and they also become free to speak in their home languages.
7. R: Your classes are structured in such a way that Zulu, Sotho , Xhosa and other languages are accommodated in your class, how do you do that ?
8. MT: We group our students according to their home languages because we are focusing on language groups. If the learners is a Shangaan , he or she will be grouped with Shagaans. Each learner will learn in his language group.
9. R: Are there any benefits in learning mathematics in home language?
10. MT: Yes , I think there are benefits , by the way this project started three years ago , learners never heard an opportunity to learn in their home language especially in specialization subject like mathematics and Science . I have also noticed that the way we teach them, they will excel in mathematics. .
11. R: how do you teach them?
12. MT: We allow them to use any language that they understand better; we also allow them to explain their solution in those languages.
13. R: I noticed in your lesson that you give them worksheet before the lesson

14. MT: Yes, these worksheet are different because they are written in both English and their home language. But , what we give them is not different from what we leant in the regular English class? Lets say for example on Thursday we going to teach fractions. In my regular English class I am going to teach them fractions. On Thursday, we continue with what I taught on the other days. But this time we allow them to talk more.
15. R: Are there any challenges in working with such a diverse groups of learners?
16. MT: Yes , there are few challenges ... and I am kind of a person who does not fear any challenges, I encounter problems when I am faced with them. The same applies to this project, I had hiccups here and there but I've overcome them .
17. R: What are these challenges?
18. MT: The first challenge was on the setting of the class. That is grouping them according to their home languages. But now we have group leaders they are responsible for the distribution of the worksheet and the setting of the language groups.The second challenge was how to present my lesson; our lessons are divided into parts. The first part is English and home language and the second part is English only.It was also difficult for learners but now they have adjusted to new way of teaching.
19. R: I noticed something , whenever the kids talk to you they use English only, do you insist on that ?
20. MT: You know what, it is because our regular lessons are structures in such way that we speak English only. They only get the opportunity to talk in their home languages during this lesson and in the field or when they talk to each other.

The HLP teacher

1. R: I understand you are teaching home language as a subject in this school, what do you do in the mathematics classroom?
2. HLPT: In the maths classroom, we make sure that the learners receive a worksheet that is written in their home language.
3. R: I also noticed that the you also give them worksheets after the lessons , who is responsible for control or marking of those worksheets?

4. HLPT: You mean the dictionary words; yes, we give them as homework. They have to learn the words that appear in their worksheets and we mark them.
5. R: how does maths come to the picture
6. HLPT : We know maths but we are not gurus.
7. R: I have seen you moving from desk to desk when learners are busy, what do you do?
8. HLPT : What we normally do is that the kids understand what they are doing , we make sure their reading I mathematics is okay. By now, we know who is having a problem with reading. For example, we do not pair our learners with the same learning ability. If they are weak, we make sure the we change their seating, so that they are seated with the right partners. The other thing we do is that we assess their reading, their writing that is related to skills of learning a language
9. R: so you also assess their writing skills
10. HLPT: yes
11. R: Besides assisting them with mathematics, is there anything else you do with them there
12. HLPT: We also give them essays on topics such as “poverty” in their mother tongue.
13. R: oh....
14. HLPT : yes , we also emphasize the importance of mother tongue. For example you find Tsonga , Venda kids hiding away , they identify with Zulus, now they are coming out because we’ve shown the importance of who they are.
15. R: What challenges do you have because you have seven languages in one class?
16. HLPT : You need to be patient , that the first thing , you need to be multilingual that the other thing . You have to be multilingual in order to handle all the seven languages
17. R: are nay benefits or privileges that learners get from your project.
18. HLPT : I think knowing your home language is the most important thing because you think in your mother tongue to transfer to English. It is important for cognitive development. To me being able to know your mother tongue is a privilege because kids use fro thinking. It is easier to understand concepts in your mother tongue then transfer them into English rather than thinking in a language that is not familiar to you.
19. R: what have you noticed, are there any changes that are learning mathematics in their home language and English.

20. HLPT : Their attitude towards their home languages has changed . They have accepted it as part of their lives. They also feel that the other learners are missing out, they feel that every child should learn in their home languages.
21. R: Any other benefits ?
22. HLPT : We also go to the library to help the schools with classification of books “ home language books) . This where we group our learners for story telling.

LEARNER INTERVIEWS

Learner 1

1. R: Which language do you prefer for the interview?
Karabo : Sesotho
2. R:Ke bona mona sekolong le bala mathematics ka Sesotho le English, hobaneng (*In this class you are using Sesotho and English for learning mathematics , why that ?*)
3. R: Ho bala Maths ka Sesotho le English hore etsa di maths stars hobane etsa di maths stars ? (how does learning in both languages make you maths stars)
4. Karabo:*Learning mathematics in Sesotho and English makes us Maths stars .*
5. R: Ho bala ka Sesotho le English ho re etsa di maths stars, ho le thusa jwang hore le be maths star? (*How does learning in both languages make you maths stars*)
6. Karabo: Ha o bala ka Sesotho , o bala ka English o tla ba maths star (*If you learn in Sesotho and in English you become a maths star*)
7. R: why ?
- 8.L2: quietcause ha o learner ka language ya hau le ka sekgowa o tla tseba (.....*because if you learn in both languages you will know.....*)
9. R: jwang?
How ?
(*she points to the worksheet*)
10. L1: Ke qadile ke bala maths ka Sekgowa, ka e fumana e le thata, empa ho na jwale ke etsa ka Sesotho le sekgowa ke e fumane ele easy. (*When I started learning mathematics, we were using English only , I found it difficult , but now that we are using both languages I find it easy*)
11. R : O kae mosebete wa hao (Can I see the work you have done today ?)
[*Takes out the exercises done during the maths period.]*

12. R: Ke batla ho tseba hore o e thotse jwang answer ya question 1 Which month has the most rain ? Wa e utlwisisa sentence eo na? (I want to find out how did find the solution to first question, did you understand the question ?

13. L1: Kei le ka nqena ka sheba hore kgwedi enang le pula e ngata ke efeng ? (Referring to the graph), ka fihla hore di mashome a mabedi , ka thola hore di 25 ,
.....

I referred to the graph to find out which graph has the month has the most rain

14.R: Ke a bona , ke batla ho tseba hore Sesotho se o thotsetse jwang?

OhI see , but how did your home language help you in this question?

15. L1: Ke ile ka bala ka sesothong , pele ke bala ka sekgoweng , Sesotho se nthusitse hore ke tsebe hore the “ most “ ke tse ngata”

I referred to the Sesotho section before reading the English section, the Sesotho section helped me to understand the meaning of the “the most”

16. R:Ke utwile ka lessening ya maths o hlaloesetsa class lentswe lena “ Consecutive” . o le fumane jwang hobane ha le a ngolwa ka Sesothong ? (*During the lesson, I heard explaining to the class the meaning of “consecutive”, the word was not written in Sesotho in your worksheet, how did know the meaning)*

17. Karabo : Ke e shebile dictionaring (I checked the dictionary)

[*She takes out the dictionary to show the definition and the word and she reads loudly to me “ following one another “]*

18. Karabo : Ka fumana hore July , August di a latelana mme ke tsona tse nang le pula e nyane (I realized that July and August follow one another and they have the least rain.)

Learner 2

19. R: O bua language e feng ko hae ?

What’s your home language ?

20.Nthabi : Setswana

21.R: O bua sekgowa neng ? (*When do you speak English?*)

22.Nthabi: Ke se bua mo sekolong feela (*At school only*)

23.R: Which language do you prefer for the interview?

24: Nathabi :Setswana

25R: okay

26.R:Ke bona mona classing ya lona le bala maths ka Setswana le ka English , hobaneng?(*In this class you are using Sesotho and English for learning mathematics, why that?*)

27. Nthabi: Hobane ke batla ho tseba maths ka language yaka hore he ke gola ke tlo ruta bana ba ka hoe na koe ke sa monyane ke ne ke bala maths ka setswana , ke tla kgona ho

ba ruta ka language yaka, Setswana. (*I want to know maths in my language in order to teach my children mathematics in my language?*)

28.R: Language ya hao o ho thusa jwanag hore o tsebe mathematics? (*How does your home language help to learn mathematics?*)

29.Nthabi : E nthusa hore ke tsebe hore e keng le hore e ngolwa jwang? (*It helps to know why and how to write mathematics?*)

30.R: Ke bona mole moo exercises ya rainy days. Question ere “Which month has least rain? Ke kopa o ntlalotse hore Setwana se o thosetse jwang hore o tsebe ho araba question eee? (*In the class you answered your questions very well , how did Setswana help to answer the question “Which month has least rain?”*)

31.L2: E nthusitse , ke ile ka re tse nyane .
It helped to know that the question needed “the least”

32. R: O tsebile jwang hore sentence ena e bua ka tse nyane?
How did know that it meant the least?

33. Nthabi:Nkao o balla yona. “ Ke pula.....enye (Ennye ke
[She started reading the Setswana version of the worksheet] (the least the least)

34. R: jwale he akabe one ose na pampiri ya Setswana o ne o tla utlwisisa sentence ?
(If you never had the Setswan version , would you have answered this question?)

35. Nthabi:Ne eke lontsha dictionary , ke bone meaning keng.(*Yes , I was going to use my dictionary*)

36. R:Ke bona disubjects tse ding mona sekolong o di etsa ka English feela, ha on bothata moo? (*I see you are using English only for other subjects, how do you manage*)

37. Nathbi : Ke bona di le righti (*I am fine with that*)

38. R:Ha o na bothata (*So you don't have a problem*)

39. L2: eeee
yes

40. R: Yanong why o sebedisa Setwana moo matsheng hobane ha o se na bothata le English ? (*Then why are you learning mathematics in both languages if you do not have a problem with learning English?*)

41. Nthabi: Ka hore mabitso a mang moo matsheng a ke a tsebe hantle , Setswana sea nthusa (*There some words in mathematics that I do not know that well, Setswana helps to understand them.*)

42. R: Oh.....ke a leboha

Learner 3

43. R: What's your name
44. L3: Sifiso
45. R: What's your home language?
46. Sifiso: Isizulu
47. R: Ngibona ni funda imathematics ngesiozulu an ngesilungu (*In this class you are using Sesotho and English for learning mathematics, why that?*)
- 48 Sifiso: Yebo
Yes
- 49 R : I mathematics o e thola enjane ?
-
- 50 Sifiso: Imnandi , mangifuna ukuyilena ngizifundisa abanye
It's nice, If I know it I can teach the others
- 51 R: U yayiphasa imathematics? (How is your performance in mathematics?)
- 52 Sifiso: Ngiyayipahasa , eya last week ngiyiphase nayo (*Yes, I do, I also passed my test last week.*)
- 53 R: Yini into engwenza ukuthi ou phase I mathematics? (*What makes you to pass mathematics?*)
- 54 Sifiso: Ngiyifunda nge Sizulu , ngifunde nge English ngize ngi understande bese ngiya explaina ukuthi kuyenzakalani nge English. (I read in Zulu , read in English take mathematics in my home language and English)
- 55 R: okay , Nifunda I mathematics yeno nge English na nge sizulu, kunisiza ngani loko?
(*How does home language help you in learning mathematics?*)
- 56 Sifiso: Khona sizounderstand (*It helps us to understand .*)
- 57 R: Nange English ni ngaunderstander , why ni funda nange Sizulu? (*Even in English you can understand why do use home language for understanding mathematics?*)
- 58 Sifiso: Ukuthi se be nga ma maths Stars (*To become maths stars*)
- 59 R: Yini ezokwenza ukuthi obe hi Maths Star ma usenzisa Isizulu? (*what makes you to become a maths star?*)
- 60 Sifiso: U ku funda , ufunde , ufunde nge Sizulu bese oya ku English, bese oya back bese oya understand kanjalo kanjalo (*To read and read in Isizulu then read in English then back to your home language.*)
- 61 R: U understand ngoba uyafunda , ufunde , ufunde , masinga kupha iEnglish yodwa , o zo understander (Do you understand because you read and read and read in you home language , if we can give an English paper will you understand?)

62 Sifiso:.....iz explianela nge English hayi ngesizulu (Explaining in English only not Zulu?

Quietnot answering.....)

63 R; manje ngoba Monday, Tuesday, Wednesday and Friday ni funda nge English yodwa. U cope kanjani ?

On the other days you are learning mathematics in English only, how do you cope?

64 Sifiso: Kahle (Okay)

R: Ngicazele ?(Can you explain ?)

65 L3: Masifunda ngamashapes, si funda nje , siqala o ku sebenza asi khulumi.
(When we learn about shapes, we just start working (meaning that they do not talk)

66 R: Manje mani sebenza na bangani beno ni sebezisa yiphi I language *(When you talk to your peers in the classroom , what language do you use?)*

67 L3: Si khuluma iEnglish ne zi Zulu (We speak both languages)

68 R: I English nesiZulu (English and Isizulu.)












69 R:Why ni nga khulume I Sizulu sodwa or iEnglish yodwa (Why not English only or Zulu only ?)


70 L3: Abanye abunderstandi I English, masekhuluma isizuklu siyabaqazela ukuthi kwenzakalani nge English . Angithi ba understander isizulu , thina abizi English si zo ba tjela u kuthi kewnazakaalni nge sizulu.. (Other learners dot not understand English, so we explain to them in Zulu.)

TASKS IN DIFFERENT LANGUAGES

Iintsuku ezinemvula!













Jonga ikhalenda. Phendula imibuzo.

Januwari 	Februwari 	Matshi 	Epreli 
Meyi 	Juni 	Julayi 	Agasti
Septemba 	Oktoberha 	Novemba 	Disemba 

1. Yeyiphi inyanga enemvula eninzi?  = Iintsuku ezinemvula!
2. Yeyiphi inyanga enemvula encinci?
3. Zeziphi iinyanga ezinomyinge ofanayo wemvula?
4. Imvula ina ngaphezulu ngeentsuku ezingaphi kuFebruwari kunakuMatshi?
5. Imvula ina iintsuku ezingaphi ngoSeptemba nango-Oktoberha xa zidibene?
6. Yeyiphi inyanga eneentsuku ezingamashumi amabini zemvula?

Maḍuvha a mvula!

Lavhelesani khalendara. Fhindulani mbudziso.












Phando 	Luhuhi 	Ṭhafamuhwe 	Lambamai 
Shundunthule 	Fulwi 	Fulwana 	Ṭhangule 
Khubvumedzi 	Tshimedzi 	Ḳara 	Nyendavhusiku 


 = Maḍuvha a mvula

1. Ndi nga ṅwedzi ufhio hune mvula ya nesa?
2. Ndi nga ṅwedzi ufhio hune mvula ya sa nese?
3. Ndi nga miṅwedzi ifhio ine mvula ya na nga ṅdila i linganaho?
4. Nga ṅwedzi wa Luhuhi i na u fhira nga Ṭhafamuhwe nga maḍuvha mangana?
5. Ndi ṅwedzi ufhio une mvula ya na maḍuvha a 20?

Malatsi a pula!

Lebelela khalentara. Araba dipotso.












Ferikgong 	Tihakole 	Mopitlwe 	Moranang 
Motsheganong 	Seetebosigo 	Phukwi 	Phatwe
Lwetse 	Diphalane 	Ngwanatsele 	Sedimonthole 


 = Malatsi a pula!

1. Ke kgwedi efe e e nang le pula e ntsi?
2. Ke kgwedi efe e e nang le pula e nnye?
3. Ke dikgwedi dife tse di nang le pula e e lekanang?
4. Pula e na malatsi a makae ka Tihakole go feta a e a nang ka Mopitlwe?
5. Ke kgwedi efe e e nang le malatsi a 20 a pula?

Matšatši a pula

Lebelela tšhupamabaka ye o arabe dipotšišo.












Pherekgong 	Dibokwane 	Hlakola 	Moranang 
Mopitlo 	Phupu 	Mosegamanye 	Phato
Lewedi 	Diphalane 	Dibatsela 	Manthole 


 = Matšatši a pula

1. Na ke kgwedi efe ye e nago le pula ye ntši?
2. Na ke kgwedi efe yeo pula e sa nego kudu?
3. Na ke dikgwedi dife tše di lekanago ka pula?
4. Na kgweding ya Dibokwane pula e na matšatši a makae go fetiša ka Hlakola?
5. Re fe palomoka ya matšatši a pula kgweding ya Lewedi le Diphalane di hlakane.
6. Na ke kgwedi efe ye nago le matšatši a 20 a pula?

Matsatsi a pula!

Sheba alemanaka ena. Araba dipotso.

Pherekgong 	Hlakola 	Tlhakubele 	Mmesa 
Motsheanong 	Phupu 	Phupjane 	Phato
Loetse 	Mphalane 	Pudungwana 	Tshitwe 

 = Matsatsi a pula

1. Ke kgwedi efe e nang le pula e ngata?
2. Ke kgwedi efe e nang le pula e nyenyane?
3. Ke kgwedi dife tse nang le pula e lekanang?
4. Pula e nang ka Hlakola e feta e nang ka Tlhakubele ka matsatsi a makae?
5. Ka Loetse le ka Mphalane pula e na matsatsi a makae ha a kopana kaofela?
6. Ke kgwedi efe e nang le matsatsi a 20 a pula?