AN EXPLORATION OF TEACHERS'EXPERIENCES IN TEACHING STANDARD FOUR MATHEMATICS AND SCIENCE CURRICULUM IN SECOND LANGUAGE: A CASE STUDY IN THREE SELECTED LESOTHO PRIMARY SCHOOLS IN RURAL AREAS

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ABSTRACT

This study sought to explore teachers' experiences in teaching Mathematics and Science through second language in Standard 4 at rural primary schools in Lesotho. In addressing this purpose, a qualitative case study method of data production was used. The participants were four Standard 4 Mathematics and Science teachers from three selected schools. Qualitative data were collected through individual semi-structured interviews and lesson observations in the classroom. These were analyzed using a qualitative thematic approach. The study is informed by Vygotsky's social constructivist theory and Shulman's pedagogical content knowledge theory.

The findings revealed that teachers experienced several challenges in teaching Mathematics and Science through second language in a transitional class. The greatest challenge that the participants experienced was the language that is used for instruction in Standard 4. According to the Educational Policy of the Government of Lesotho, English has been approved as the medium of instruction (MOI) from Standard 4 upwards. In Standards 1-3 pupils are taught in their mother tongue (Sesotho); thereafter the MOI changes to English. The participants reported that the shift from Sesotho to English posed a serious problem in the teaching and learning of Mathematics and Science in Standard 4. They further claimed that most pupils in Standard 4 do not proceed to the next class, since these two subjects are core subjects and the MOI makes passing them problematic. Teachers regularly employed code-switching as a strategy to make meaning for their pupils in their classrooms.

It is recommended that the Government of Lesotho should consider changing the medium of instruction to English from Standard 1. It is also recommended that the inspectorate service should be decentralised and that one teacher at primary level should not teach all the subjects but teach according to specialisation. There should also be more regular in-service training of Mathematics and Science teachers.

DECLARATION

I, Mamzandile Alina Thuzini, hereby declare that 'Exploring the experiences of Standard 4 Mathematics and Science teachers in a second-language context: A case study in three selected Lesotho primary schools in rural areas', is my work and that all the sources used have been acknowledged by means of references. In the case of failure to comply completely with the mentioned declaration, I apologise and confirm that it was not my intention to do so. This dissertation was not previously submitted by me for a degree in another university.

…… …….

Signed date

Statement by the supervisor:

This dissertation is submitted with / without my approval.

Prof. Reshma Sookrajh

....

Signed date

ABBREVIATIONS

B.Ed	Bachelor of Educational Degree
FEP	Free Primary Education
MOI	Medium of Instruction
NCDC	National Curriculum Development Centre
PCK	Pedagogical content knowledge
PS	Primary Schools
SSU	School supply unit

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This study is dedicated to my late husband, Seeminayo Joseph Thuzini, Matooane Moremoholo and my mother-in-law, Mavelaphe Thuzini. I know they would appreciate my achievement, may their souls rest in peace.

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INTRODUCTION

1.1 Introduction

In this chapter a brief historical background of education in Lesotho will be provided. This will be followed by outlining the education system in Lesotho. The language policy will be dealt with; this dictates the medium of instruction (MOI) at different levels of education, with the focus on Standard 4 classes. Having addressed the language policy, the problem, focus, purpose and rationale of the study will be discussed. The key questions that the study will attempt to answer will then be posed, and this will be followed by the research design and an overview of the study.

1.2 Education background and context

Lesotho is a mountainous, small and poor country of about 30 355 square kilometres, situated in Southern Africa. Its territory is divided into four regions: Lowlands, Foothills, Sengu River Valley, and Mountains, the latter two being definitely rural while the other two regions are largely urban. The majority of Basotho people live in urban areas because of the accessibility of facilities and infrastructure. There is a shortage of facilities in the rural areas, including in education - schools are located far from pupils' homes, and most of them are not conducive for learning.

Regarding language, Lesotho, like other Southern African countries, has more than one language. The main official languages are Sesotho and English; Sesotho is the first language and English is the second language. However, there are other first languages spoken in Lesotho. According to Lynn (1994), minority groups of people scattered around a few small parts of Lesotho do not consider Sesotho as their first language, but use sePhuthi, isiThembu and isiZulu.

Before Lesotho was under British colonial government, education in Lesotho was informal. It occurred through practical activities and was taught by the elders, local leaders and traditional doctors in the villages (The Education Sector Survey Task Force, 1982). Girls were taught women's duties and boys were taught men's. In the 1830s the French missionaries of the Paris Evangelical Missionary Society brought formal education to Lesotho. Later, other missionaries from the Roman Catholic Church and

the Anglican Church of Lesotho followed, and contributed to formal education in Lesotho (Muzvidziwa & Seotsanyana, 2002). By the time the missionaries came to Lesotho there was much strife and a number of wars taking place in Southern Africa, which forced Lesotho to seek colonial protection from the British. This enabled the British to impose their system of education, that was mainly geared towards the imparting of skills to Basotho, particularly in reading, writing, arithmetic and interpretation of language from English to Sesotho and vice versa. Although these were the main elements that missionaries taught, Christianity and economic gains were their main focus (Muzvidziwa & Seotsanyana, 2002).

In the year 1966 Basotho obtained independence from Britain. The Government of Lesotho continued with the colonial system of education, and later was engaged in the task of working towards making Lesotho's education responsive to individual and national needs (Lehohla, 2006). The education of most Basotho youth was mainly in the hands of various church denominations since they own a large number of schools as opposed to the government. This status quo is still maintained. However, since 2000 on wards the Government has increased the numbers of primary schools and secondary schools being built.

In addition to building more schools, the Government develops and revises the curriculum for all general education. This is done by the National Curriculum unit (NCDC) which is housed within the Ministry of Education and Training, and its mandate among others is to develop curricula relevant to the needs of the country. In primary schools all pupils are expected to complete all the subjects in the syllabi, (Lesotho syllabi) while in secondary schools there is wide range of subjects in the syllabi, and students have a wide choice of subjects. The syllabi and the educational materials are developed by the NCDC in conjunction with subject panels on which teachers are represented. This affirms that the major part of Basotho education is the responsibility of the government.

In addition to this, the Government pays the teachers' salaries for all registered schools, namely church, Government or community-owned schools (Commonwealth Education Fund, 2009). The Government has assisted the schools, and only private

schools (English-medium schools) are building their own facilities. These schools are somehow different from the church and the community schools and exclusively teach all subjects in English from Standard 1 to Standard 7, except Sesotho.

1.3 Lesotho education system

Lesotho has always been following the 7-3-2-4 pattern in the system of general education. This means seven years of primary school, which is divided into lower and higher levels. The lower level is three years (Standards 1, 2 and 3), which is equivalent to the Foundation Phase (Grades 1, 2 and 3) in South Africa, and the higher level four years (Standards 4, 5, 6 and 7), which is equivalent to Grades 4, 5, 6 and 7 in South Africa. This is followed by three years of junior secondary, and two years of senior secondary. Tertiary education takes a minimum of three years for diploma programmes and four years for degree programmes. The pupil-teacher ratio is 50 to 1.

All of the schools charged fees, although the fees were low, not all parents could afford them. The majority of the Basotho people were unable to pay school fees, which disadvantaged many Basotho children and hindered their right to education (Molapo, 2009). However, most Basotho people focus mainly on engaging their children in farming rather than encouraging them to pursue education, especially those in the rural areas.

In the year 2000 the Government introduced Free Primary Education (FPE), starting with Standard 1 and rolling annually standard by standard until the whole primary education was free by 2006. One of the Government's main purposes with FPE was to rescue parents from the burden of fees, which was a deterrent to the education of the children (Ministry of Education, 2000). Normally Basotho pupils started their primary education at the age of six years and completed it at the age of 12 (Ministry of Education and Training, 2005). Children who missed out because of lack of school fees had to join others in different standards. This means that mainstream schools began to include adults. Some pupils who joined in FPE were 10 - 18 years old, being enrolled in Standards 1-4. However, this became a challenge to teachers as the rise in number of pupils increased to a ratio of approximately 80 pupils to 1 teacher.

Primary pupils are given basic literacy and numeracy skills. The Lesotho official curriculum in primary education provides pupils with basic knowledge of Sesotho, English, Mathematics and Science, which are the core subjects, and additional subjects such as Social Studies (Muzvidziwa & Seotsanyana, 2002), Agriculture, Home Economics, Health Education, Arts and Culture, Music, Religion and Life Skills Education. All of these subjects are taught and learned from Standards 1-7, the difference is the teaching approach at different levels. Since teachers were overloaded, volunteer teachers also assist in teaching Standards 1-5; these are unqualified teachers.

1.4 Language educational policy in Lesotho

Lesotho, like other African countries, has introduced policies related to the use of indigenous languages in its education system. It is in this regard that Bamgbose (2000) affirms that all countries under colonial rule use African languages in teaching and learning, particularly in the lower primary school education. The main aim is to ensure that learning takes place in the language that children understand. This means that the use of indigenous language is beneficial for the beginners, due to the fact that the language used at school is similar to the language used at their homes. According to the Ministry of Education and Training (2005), the Lesotho language policy states that pupils from Standards 1-3 should be taught in their mother tongue as the MOI. The same policy states that in Standard 4 and upwards, English should be the MOI.

My study will be focusing on primary education, mainly Standard 4 as a transitional class. The concepts used in Mathematics and Science are acquired through language, so the shift from Sesotho to English poses a serious problem in the teaching and learning of Mathematics and Science in Standard 4 (Vizconde, 2006). Masilo (2008) affirms that pupils in Standard 4 are not yet ready to change language, as they are still developing their own language. This is the main source of the problem for Standard 4 pupils, which this study aimed to explore.

1.5 Problem studied

In Lesotho primary schools English has been approved as the MOI from Standard 4 upwards. This poses a serious challenge to teachers and pupils (Polaki, 2004). In Standard 4 most pupils fail Mathematics and Science; these two subjects are

core subjects and need to be passed well in order for pupils to proceed to the next class. The problem intensifies in rural schools, where few pupils are exposed to the English language (Bialystok, 2001). It is a known fact that the majority of the community in the rural areas is illiterate, and English is rarely used in any setting/conversations. In addition to this, media such as the radio or television seem not to be having any effect on the level of comprehension of pupils in English. Sesotho remains the dominant language in the schools as some teachers also find it difficult to instruct pupils in English, particularly unqualified teachers. Thus English as MOI poses challenges to teachers and pupils, and as a result the latter do not perform well in Mathematics and Science due to non-comprehension of English (Kasule & Mapolelo, 2004).

1.6 Focus of the study

This study focused on the experiences of Standard 4 teachers and concentration was on teachers of Mathematics and Science. These two subjects are those that most pupils fail in Standard 4 and upwards, which is not the case in the lower classes where the MOI is the pupils' mother tongue. In this study teachers will share their knowledge, understanding and skills of teaching Mathematics and Science to Standard 4 pupils. Teachers will be selected from three primary schools in the district of Leribe in Lesotho. The focus will be on those primary schools in the rural part of Leribe (the district has both urban and rural regions). The reason for choosing schools in the rural area is that in these areas English is a foreign language which is only spoken, read and written in school, compared to in the urban areas where it is used and heard more often. Setati (2002) supports this, stating that language issues in rural schools, where there is very limited support for English-medium instruction, is found to be quite complex. This therefore causes challenges to teachers and pupils in the rural areas when teaching and learning Mathematics and Science, because these two subjects have some terms which are not even found in Sesotho.

1.7 Purpose of the study

The purpose of the study was to explore the experiences of Standard 4 teachers in the teaching of Mathematics and Science in second language. The experiences identified will assist the researcher to highlight those factors that impede teaching of these subjects at this level of primary education. It is hoped that this will be able to help

to bring about change in the instruction of these two subjects and improve performance in them.

1.8 Rationale for the study

In Lesotho primary education takes seven years; thereafter, pupils proceed to the secondary education, as long as they have passed all of the core subjects (Mathematics, Science, English and Sesotho) and a few other additional subjects. As a teacher with more than 20 years' experience, I recognise that pupils in lower classes where the language of teaching and learning is Sesotho (mother tongue) perform well in all subjects, including the core subjects, but in the transitional class Mathematics and Science are problematic as most pupils repeatedly fail to pass them. Therefore, they fail to proceed to the next class; as a result there is high pupils'drop-out in Standard 4, which is the class where pupils start to be trained in English (second language) as the MOI.

The literature that I read regarding teaching Mathematics and Science in a second language in other countries reveals that there is a great problem with pupils in acquiring understanding of both subjects when being taught in a second language (Pandian & Revanthi, 2003; Setati & Adler, 2001). That is why I am interested in researching the reason behind this. In doing so, the study aims to determine factors that impede and facilitate the teaching of Science and Mathematics through English in Standard 4. It is believed that this study will bring about insight into the problem that will go a long way towards helping to achieve the effective teaching of Mathematics and Science in Lesotho and, most importantly, in those schools in the rural areas where English is not commonly used by the community.

1.9 Key research questions

In an effort to address the problems that teachers encounter in the teaching of Mathematics and Science, the study will be attempting to answer the following key questions:

What are the experiences of teachers teaching Mathematics and Science in a second language?; and

How do second-language teachers teach Mathematics and Science in English as a medium of instruction?

1.10 Design and structure of the study

The study is positioned within a qualitative interpretive case study of three schools, focusing on Mathematics and Science teachers in Standard 4. This method is useful since it uses a small scale of data production and a search for in-depth information. Interpretivists believe that reality and truth are socially constructed (Robson, 1994). Thus the truth is relative and depends on the context and people's experiences, understanding and beliefs (Lawton, 1975). Therefore, the researcher of a social phenomenon where teachers are participants observed teachers while teaching Mathematics and Science in each of the three schools. The use of semi-structured interviews and document analysis formed part of the research design.

Teachers from each school were interviewed to determine the factors that contributed to their success in the teaching of the Mathematics and Science curriculum as well as those factors that impeded their teaching of both subjects. They were also asked how they teach Mathematics and Science in a transitional class and whether they are confident to teach both subjects using English as an MOI. The researcher sought to find out how teachers tackle the lesson, from the introduction to the end of the lesson, through observation. As part of carrying out of the study, some documents such as preparation books, scheme books, textbooks, assessment tools and pupils' exercise books of Science and Mathematics were analysed. These documents validated findings gathered through interviews and observations.

1.11 Definition of key concepts

In order to ensure a common understanding of terms, a definition of key terms used in this study follows.

Experiences: This refers to anything teachers came across or faced during the teaching of Mathematics and Science. These can be challenges and/or problems they encountered and how they overcame those challenges.

Teaching: "Teaching is the art of getting the pupils to learn the subject matter" (Howe, 1999, p 885). In order to successfully do this, the teacher requires excellent

understanding of both the subject content and the pupils they are teaching. In other words, Howe (1999) is highlighting that teachers need to understand the subject matter and how students learn. On the other hand, Hornby (2000) explains teaching as activities of instructing; activities that impart knowledge or skills. It involves a teacher and learners interacting over a subject in a setting. In this context the term means the act of imparting Mathematics and Science principles and methods to pupils using second language.

According to Morrow (2007), teaching is characterized as practice; he explains that teaching is the practice of organizing systematic learning. Over and above that, Morrow (2007) states that teaching encompasses teaching methods, which he explains as preparation or engaging in teaching in a particular way, including preparation of teaching materials. Teaching is performed under different conditions in different contexts where teachers have different experiences, where it is possible in some cases yet impossible where circumstances and the context are not conducive.

Second language: A language learned by a person after his or her native language (American Heritage Dictionary, 2011). In other words, this refers to any language that one learns or acquires after first-language acquisition. The first language, according to Calvert (1987), cited in Phellipson (1992, p. 39), refers to "the language of the biological mother or father, or a local vernacular language". In this study first language, mother tongue and home language are used interchangeably as they mean the same thing, thus the language spoken in the pupils' home environment and in their wider community.

1.12 Overview of the study

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

Chapter One

This chapter discussed the education background in Lesotho and the context within which the study was carried out, the system of education in Lesotho, and the language education policy. The chapter has also outlined the problem statement, the focus, the purpose, the key research questions and design of the study.

Chapter Two

This chapter outlines the related local and international literature that supports the study. The focus is on teaching Mathematics and Science in a transitional class. Thereafter, the literature regarding the two theories underpinning Mathematics and Science teaching (constructivism and Shulman's pedagogical content knowledge) are also discussed; these two theories provided the theoretical framework of the study.

Chapter Three

This chapter presents the research design and methodology, providing various instruments and methods that facilitated the carrying out of the study. The methodology includes the paradigm, the approach and the research style. It is followed by the field study and data production procedures, such as interviews, observations and document analysis. The chapter further discusses selection of respondents, data analysis method and ethical issues.

Chapter Four

This chapter presents the findings that emerged from the data that were collected. The findings are presented and discussed in themes, and voices from the participants are used. The themes that emerged from the data are language, approaches, and support.

Chapter Five

In this chapter the research findings enable the making of a conclusion and an outline of the insights drawn from the data. The findings reflected the experiences of teachers of Mathematics and Science in Standard 4 using second language. Most of the experiences resonate with the theories that inform the study, as discussed in Chapter Two. For instance, participants experienced that Standard 4 pupils had a problem with English during the teaching and learning of Mathematics and Science. The chapter also provided the recommendations of this study.

1.13 Conclusion

This chapter presented an overview of the study, including the background to the study, statement of the problem, the rationale and the key research questions. It further presented the purpose, which includes the importance of the study, and the logical arrangement of chapters in this thesis.

In the next chapter the review of international, regional and local literature will be discussed.

CHAPTER TWO
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter focuses on reviewing literature related to this study from international and local perspectives, the purpose being to summarise the findings on the subject of teaching of Mathematics and Science using pupils' second language. As stated in the previous chapter, the purpose of this study is to explore experiences of Standard 4 teachers in teaching Mathematics and Science through second language. The chapter addresses the literature on the experiences of Mathematics and Science teachers under the following topics: language used in transitional classes; teaching strategies; teaching and learning resources; and support from the stakeholders involved in education. Thereafter the two theories that informed this study are discussed, namely Shulman's pedagogical content knowledge (PCK) theory of learning and Vyoskosty's constructivism theory of learning.

2.2 Language of instruction

The language used in the transitional classes is a professional challenge for teachers in several ways (Kasule & Mapolelo, 2004). My anecdotal experience as a teacher for some years also attests to this. The transitional classes are where pupils start to be taught in English as the MOI from having been taught in their mother tongue in lower primary. Bamgbose (2000) observes that all countries which were formerly under colonial rule use African languages in teaching and learning, particularly in lower primary school education. Thereafter they start teaching in English from intermediate level. Lesotho as one of the former colonial countries, adopted the same system. Lesotho's educational policy indicates that from Standard 1 to Standard 3, pupils should be taught in their mother tongue and from Standards 4-7 the MOI changes to English. Standard 4 is where most pupils start to experience difficulties, since they start being taught in English. Therefore, this seems to them as the first year and first time to be in school (Murray, 2007). The Free State Department of Education (2004) reported that there was consistent progression in the foundation phase, but when pupils reaches Standard 4 there was a sudden and sharp drop because pupils struggled to cope with the

change to English instruction and are therefore retained in Standard 4. This shows that the language of teaching and learning has an impact on the progression of pupils.

There is no special preparation for teachers and pupils for the transition from the mother tongue to English as MOI (Setoi, 1997; Molapo, 2002). This means that the complete switch from mother tongue to English is instituted before pupils have developed any competence in either. This section therefore discusses the language challenges facing pupils and teachers in Standard 4: English as MOI, mother tongue (first language) as MOI, Mathematics and Science language, code-switching and pronunciation.

2.2.1 English as MOI/using second language to teach Mathematics and Science

The language of instruction or language of teaching and learning has been a challenge to schools in many African countries. Both teachers and pupils have been affected by the type of language that is used in teaching. This is because a different language from the one that a child uses at home is used to teach pupils. Like in many African countries, the language of instruction in Lesotho schools in English. There is no special preparation for teachers and pupils for the transition from the mother tongue (Sesotho) to English as MOI (Setoi, 1997; Molapo, 2002). Many Basotho children encounter English for the first time in school in Standard 4 and rarely use it in their everyday lives (Jusoff, 2009), since all along they have been taught in Sesotho. Therefore, because most of these children come from homes and environments where English is not commonly used, their use of English in schools poses a number of teaching and learning problems (Araromi, 2005). The problem that pupils have with the language leads to poor performance. Monyane (1998, as cited in Mashiyi, 2010) argues that learners perform poorly through the use of second language compared to first language as an MOI. Desai (2003) also observed that Xhosa pupils performed well in isiXhosa, but in other subjects where they had to use English the performance was poor, their spelling incorrect, and they did not answer the questions.

Another challenge that is brought by a second language is that pupils do not speak when they are supposed to use the second language. Osaki (1991) found that pupils with limited proficiency in English would contribute minimally in class

discussions, and if teachers insisted on using English as the MOI they ended up talking to themselves and not getting input from pupils. The pupils with limited proficiency in English are most at risk of school failure (Lemmer & Squelch, 1993). Setati and Adler (2001) observe that schools in rural areas have the most complex challenges with language issues as they have limited support for English-medium instruction. According to Herbst (1988) pupils do not talk in class when English is used, because they experience difficulties when taught in English as many of the sounds are strange to them and some difficult to utter. This poses a challenge to teachers because they might not know whether pupils understand or not, since they do not get responses to the questions. This can discourage teachers from giving activities to learners.

The strategy of teaching can be affected by non-communication of pupils in class, and this can affect the understanding of concepts taught. Jusoff (2009) explains that students' success in understanding their textbooks depends on two factors: the content factor and the language factor. With a problem with language, pupils are unable to understand instructions from the teacher and unable to understand each other during group discussions. They may also have problems in understanding what is written in the text as they read.

The inability of pupils to communicate in English is not the only factor that poses a challenge in teaching Mathematics and Science. Some teachers also find teaching in English a challenge to themselves as teachers. Jusoff (2009) and Ong (2006) summarise the factors that contribute to the problem of learning Science and Mathematics through a second language as: teachers who are not proficient in English; learners' background; poor relationship between teachers and learners; teachers and principal, and teachers among themselves; peer group's feeling towards Mathematics and Science subjects, learners' frequent absenteeism; and the lack of good Science and Mathematics materials.

It is evident that English as a second language poses challenges in teaching and learning. The crucial question is whether schools and teachers should teach pupils in Sesotho in order to solve the problems encountered. Vizconde (2006) argues that Mathematics and Science should be taught in English as all the materials used for the

two subjects are written in English. Other academics have a different opinion to that of Vizconde (2006) for different reasons. The section that follows discusses the use of mother tongue as an MOI when teaching Mathematics and Science.

2.2.2 Mother tongue (first language) as MOI

Part of the literature advocates for the use of Sesotho as the MOI at all levels. Qorro (2009) suggests that teaching and learning should take place in the language that teachers and learners are proficient in, not in a foreign language. This is because the pass rate increases in Science in schools where the MOI is matched to learners' home language compared to schools where there is a mismatch between first language and the language of teaching and learning (Monyane, 1998, cited in Mashiya, 2010). So in order to increase the pass rate in schools, the first language can be used as the MOI. The increased pass rate can also imply successful teaching and learning, which means better understanding of Mathematics and Science concepts by pupils.

Chabana, Sebatana and Lefoka (1989) alluded to this issue by saying that most teachers use translation of mother tongue to English as the MOI and language of teaching and learning, to avoid pupils' misunderstanding of the concepts and terms appearing in both subjects. There is likely to be little learning if pupils and the teacher do not understand each other during communication (Alidou, 2007). This means that the contrary is also true. If teachers avoid pupils' misunderstanding of concepts by using Sesotho as MOI they are actually using Sesotho to enhance better understanding of concepts, and there is more learning because teacher and pupils understand each other. Mgqwashu (2007, p.1) argues that "…Africans learn best in their own languages, the languages they know from their parents, from home. It is in these languages that they can best create and innovate…". Like all Africans, Basotho children can also learn better in their mother tongue, in this case Sesotho. As Sesotho is their first language, learning through Sesotho the Lesotho pupils will get a chance to develop cognitively and to succeed academically (De Klerk, 2002).

The argument of most scholars regarding the misunderstanding of concepts when a second language is used, is that pupils seek to develop proficiency in both the language of learning and teaching (e.g. English) and the learning of Mathematics and

Science (Setati, 1998; Setati & Adler, 2001; Setati, Adler, Reed & Bapoo, 2002). This means that for effective learning to occur, pupils should have understanding of the language and experience (Freira, 1989). They apply what they already know to understand the new concepts. In other words, effective learning occurs when pupils can create meaning by linking new information to what they already know (Good & Brophy, 1997).

Orton (1994, p. 137) observed that "the language used for thinking is always likely to be the first language, thus Mathematics communicated in one language might need to be translated into another to allow thinking, and then would need to be translated back in order to converse with the teacher." Since the thinking happens in the mind of the pupil, the teacher might not notice, and while the learner is struggling to connect these messages the teacher has already passed on to another concept and the child is lost. This contradicts effective and meaningful learning. Relevant, effective and meaningful constructive learning engages learners in creating their own knowledge and understanding by connecting new learning with their prior knowledge and experience (Lambert & McCombs, 1998). The literature also suggests that learners of Mathematics and Science should not only be able to solve problems, but also to explain their answers and show their workings (Loomes & Shafarenko, 2001).

2.2.3 Mathematics and Science language

The language that is used in Mathematics and Science is slightly different from the language used in other subjects and in everyday language. Laplante (1997) argues that the language of Mathematics and Science is different from the languages that pupils use in other subject areas in their classrooms. This presents another kind of challenge to pupils who already are facing a problem with English. The difference between the English language in Mathematics and Science and English language in other subjects and in everyday English is that some terms in Science subjects may mean a different thing to the commonly known meaning. Carlson and Tamm (2000) perceived that everyday words may mean something else in Mathematics and Science subjects; for example, the words "average" and "divide" may be everyday words, but they acquire a more precise meaning in Mathematics and Science. The anecdotal example is that in everyday language some people consider any fraction as half, meaning that any part of

the whole is referred to as half, whereas in mathematical terms half is precisely one part of two equal parts.

In some cases teaching in the mother tongue is difficult or problematic because it lacks some of the common terms used in Mathematics and Science. Selwyn (2007) noted that there were no Sesotho equivalents of some Mathematical terms, such as 'horizontal' and 'vertical'. There are a number of concepts in the two subjects that are not used in their mother tongue (Polaki, 2004). The absence of such terms and others in the mother tongue makes it difficult for learners to build and connect the new concepts to prior knowledge. This problem causes Mathematics and Science to be the most difficult subjects for many Basotho children (Polaki, 2004).

Because of this challenge, most teachers do not like teaching Mathematics and Science as they are uncomfortable with them (Pandian & Revanthi, 2003) and lack understanding of mathematics and scientific concepts which are newly used in transitional class (Polaki, 2004). Since pupils regard Mathematics and Science as the most difficult subjects, they do not take these subjects as their major when pursuing their further studies. The teaching profession is also affected by this challenge, as observed by the Lesotho Ministry of Education (2006) - there is a problem of lack of Science and Mathematics teachers in the country.

2.2.4 Code-switching/using multiple languages in teaching

Code-switching is a classroom practice involving the use of more than one language in order to contextualize communication (Nilep, 2006; Escamilla, 2007). In the case of Lesotho, where there are two official languages (Sesotho and English), code-switching is mostly the use of these two languages. It can also involve the use of languages of the minority groups, such as the Xhosas in the Southern part of Lesotho in districts of Quthing and Qacha's Nek. The other minority group speaks isiZulu or Ndebele and is found in the northern part of Lesotho in Botha-Bothe and Leribe districts.

In such groups code-switching is common since the people are bilingual; with them a regular mixing of languages occurs during communication, for example, when a

person substitutes a word or a phrase from English with a word or phrase from Sesotho/isiXhosa/isiZulu/isiNdebele (Heredia & Brown, 2007). Qorro (2002) argues that in teaching and learning pupils are always code-switching and code-mixing. This act of language mixing is often practiced from primary until secondary school (Thelejane, 1990). The critical influence for children for code-switching is the fact that they are living their lives in a bilingual environment, and therefore code-switching is an important and necessary element of their communication (Escamilla, 2007).

Children are not the only people that use code-switching, teachers are also code-switching and code-mixing. According to Khati (1992) and Sebatana, Chabane and Lefoka (1989), most teachers use their mother tongue more than English in order to facilitate teaching and learning. Teachers usually resort to code-switching in order to make pupils understand Mathematics and Science concepts. Osaki (1991) argues that if teachers insist on using English as an MOI for pupils with limited proficiency in English, they end up talking to themselves and not getting input from pupils. So in order to get input from pupils and make them participate in their learning, teachers opt for code-switching. This issue is well stated by Holmarsdottir (2006, pp. 204-205), who says "code-switching functions include making the curriculum accessible to pupils, facilitating classroom management, eliciting pupils' response and promoting interpersonal communication."

Students' understanding of concepts is regarded as vital by some academics and teachers. Pandian and Revanthi (2003) reported that 81.8% of Malaysian teachers used the mother tongue to explain concepts when pupils faced problems in understanding these concepts in English. Also, according to the Zambia educational policy, "if teachers find that there are concepts which cannot easily be understood by the pupils, teachers may explain them in one of the seven Zambian languages, provided the majority of pupils in that class understand the language" (Lubinda, 2004, p. 97). This illustrates the importance of understanding the Mathematics and Science concepts in teaching and learning, as the Government advocates for code-switching in the Educational policy. In addition, Alidou (2007) states that if pupils and teachers do not understand each other during communication, teaching and learning is likely to be

ineffective. Therefore communication plays a crucial role in the teaching and learning of Mathematics and Science.

Contrary to the benefits of code-switching to enhance understanding of Mathematics and Science concepts, total translation where Mathematics and Science subjects are to be taught in English defeats the purpose of teaching such subjects in English (Bowering, 2003). Pupils are not practising the use of English language and this may result in pupils not being fluent in English. Thelejane (1990) revealed that a mixture of languages is often used until secondary level, and pupils have very little chance to use English. This does not only limit pupils in speaking the language, but even the writing is affected. This is why Bowering (2003, p. 27) recommends that "limited use of first language in the classroom will be of great benefit in helping students meet the challenge presented by English".

2.2.5 Pronunciation

Pronunciation is defined as a way of speaking the word, especially in a way that is accepted or generally understood, or the manner in which someone utters a word or the way a word or a language is customarily spoken (American Heritage Dictionary, 2011). It is important for pupils to pronounce words correctly as pronunciation leads to correct spelling. During classroom interaction some pupils become timid to speak as they are afraid of being laughed at by their classmates. This is also problematic to the teacher because it is difficult for them to understand what the pupils wanted to say. It has been observed that pupils in Standard 4 face challenges in pronouncing English terms, especially pupils from rural areas. These pupils were not exposed to English-medium schools, and their first experience of the English language is in Standard 4.

Herbst (1988) reports that pupils experienced difficulties when taught in English since many of the sounds are strange and some of them are difficult to utter. As they write the words in the way that they sound to them. These sounds are only known to pupils, and teachers have difficulties in assisting pupils because they do not know how to help them. This is why Yelon and Weinstein (1977, pp. 449-450) claim that:

> Because the teacher does not understand what the child says, the teacher may think that the child lacks fluency, cannot think clearly, lacks reasoning ability, and pronounces words incorrectly.

> The child in general, may be considered stupid when in fact; he or she simply needs time to adjust to the demands of a different language and a different culture.

The incorrect pronunciation of English words usually dehumanises pupils in that they are treated differently by teachers and other pupils. They are usually regarded as stupid and incompetent because they pronounce the concepts in their mother tongue (foreign talk), this is indicated by (Wilson, 2000).

2.3 Teaching strategies

Teaching strategies are techniques which teachers employ when presenting subject matter to their pupils. Teaching strategies include the telling method, demonstration, playing method, textbook method where the teacher reads stories or text to pupils, experimentation, problem-solving, class discussion, question and answer method and group work method (Cohen, Manion & Morrison, 2004; Barnett, 1992). Different teaching strategies give different results; some give pupils the opportunity of understanding concepts better than others. For example, a telling method or lecture method would be suitable for teaching in a first language. Shaffer and Percy (2007) argue that Mathematics and Science traditional teaching strategies do not let children bring with them a diverse collection of experiences and ideas from their native cultures. Therefore, teachers teaching in the second language have to use methods which are different from the ones they use when working in the first language (Clegg, 1996). Teachers teaching in the second language should use strategies that involve multiple channels of communication to cater for the diversity of pupils (Cohen et al., 2004). These are the strategies that are designed to help pupils to understand the subject while developing ability in the second language (Clegg, 1996). Since Mathematics and Science are regarded as complex subjects (Polaki, 2004), passive strategies such as the lecture method are not recommended.

In these subjects strategies that result in high-level retention are required (Cohen et al., 2004). This is because effective learning occurs when pupils can create meaning by linking new information to what they already know (Good & Brophy, 1997). Again, Mathematics and Science are different from language learning areas; in Mathematics and Science pupils should be able not only to solve problems, but also to explain their answers or show their workings (Loomes & Shafarenko, 2001). This section discusses

teaching strategies that are commonly used in Mathematics and Science subjects. These allow students to explore and investigate things in order to discover new ideas. The three strategies to be discussed are experimentation or performing of experiments, demonstrations, and group work discussions.

2.3.1 Experiments

An experiment is defined as a test under controlled conditions that is made to demonstrate a known truth, to examine the validity of a hypothesis, or to determine the efficacy of something previously untried (American Heritage Dictionary, 2011). Mathematics and Science are practical subjects in which pupils' understanding is enhanced by doing and observing. An experiment is one of the activities that teachers use to explain abstract concepts to pupils. An experiment is usually conducted in Science subjects, especially in Natural Biological sciences, and it allows learners to experience reality and discover things by themselves. It encourages learners to learn through self-discovery, exploration and observation. This can assist learners to understand because more than one sense is used to learn the concept. According to Fraser, Loubser and Van Rooy (1993, p. 160), this method uses objects during teaching and learners gain insight by means of direct observation and manipulation. It is about the discovery of reality by means of examples and making of generalised statements based on the findings thereof.

2.3.2 Demonstration method

Fraser et al. (1993) defines demonstration as the carrying out of actions by a capable person such as the teacher. During demonstration learners are observing the procedure and noting the results as the teacher is doing the activity. According to Mazur, Adam, Callan and Crouch (2011), the aim of demonstration is to equip learners with certain skills, capabilities or knowledge and understanding, so that learners can master the skills through observation of a series of actions. The demonstrator or the teacher uses examples in the form of models or specimens, and this method is usually associated with Natural Science (Fraser et al., 1993). However, it is applicable to all mathematical and scientific subjects, especially when there is a shortage of apparatus for doing experiments. This teaching method helps pupils who have a challenge in second language to understand Mathematics and Science concepts, since it is one of the

methods where multiple channel of communication are used. Pupils also observe the procedure and apparatus as the demonstrator is calling them by their names, and this helps them to understand the spoken words.

2.3.3 Group discussion

Group discussion can be utilised by the teacher in two different ways. Firstly, the teacher and pupils can discuss a topic in class, where the whole group is the class which is facilitated by the teacher (Freira, 1989). Secondly, the teacher can divide pupils into groups and give them tasks to perform as individual groups. The group size is normally 4-8 members in each group if the class is small or 8-12 members in a group for a large class (Pastirik, 2006). All the groups are usually given the same task, and a group leader and recorder are elected to control and record the groups' findings respectively since the teacher may not be in all the groups at the same time (Pastirik, 2006).

Group work or group discussion is important in Mathematics and Science, because when exploring pupils are encouraged to share their personal experiences (Shaffer & Percy, 2007). Besides, group work helps in the development of social skills like communication, presentation, problem solving, leadership, delegation and organization, and develops interpersonal intelligence (Gardner, 1983). As pupils discuss and share ideas, they also improve their skills of argument usually used in debates, and they learn from each other.

Gillies and Ashman (2003) argue that tasks are completed more easily in a group than individually. Group work enhances understanding of concepts such that pupils are able to solve problems and explain their answers (Loomes & Shafarenko, 2001). Pupils' understanding of Mathematics and Science is even better when they work successfully in groups, and learning becomes more interactive in the presence of the materials where the teacher's role changes to being a facilitator (Vygotsky, 1978; Rhodes & Bellamy, 1999).

Some scholars refer to group work discussion as cooperative learning. According to Cohen et al. (1994) cooperative learning is a pedagogical practice which

promotes learning, higher-level thinking, pro-social behaviour, and greater understanding of children with diverse learning, social and adjustment needs. The attributes of cooperative learning are similar to those of group work as discussed above.

The other concept related to group work learning is constructivist learning (Powell & Kalina, 2009). Constructivism incorporates collaboration and social interaction. In this strategy pupils communicate with each other and with the teacher. Powell and Kalina (2009) view cooperative learning as an integral part of deeper understanding and a part of creating a social constructivist classroom. In constructivist learning, students come to class having a wide range of previous learning and experiences which enable best learning to occur only when information is made meaningful (Moore, 1999). Lambert and McCombs (1998) argue that relevant and meaningful constructive learning engages learners in creating their own knowledge and understanding by connecting new learning with their prior knowledge and experience. According to Vygotsky's theory, pupils construct their own knowledge on the basis of interaction with their environment, and both teachers and pupils apply the knowledge they already have on the use of Mathematics and Science concepts to enhance teaching and learning. The knowledge construction by pupils through the use of prior knowledge and experience assists them to shape meaning and acquire new knowledge (Gillespie, 2002).

2.4 Teaching and learning resources

Teaching and learning resources are substances, textbooks, apparatus, real objects and pictures that a teacher can use to present content of her subject matter in the class. One of the hindrances of smooth teaching and learning of Mathematics and Science is lack of resources (Harley & Wedekind, 2004). Research shows that schools with rich resources produce good results in Mathematics and Science subjects as opposed to those which lack resources. Harley and Wedekind (2004) argue that schools which were most historically advantaged are flourishing, with those most disadvantaged appear to be floundering. Lack of resources was one of the major barriers of smooth curriculum implementation in South Africa (Van Deventer, 2009; Prinsloo, 2007; Ashton, 2008; Wood & Olivier, 2007; Harley & Wedekind, 2004).

A teaching and learning resource is more or less anything which teachers use to meet an educational requirement (Vanides, 2011). Teaching and learning resources are many things that contain the course content which help learners to acquire knowledge, and help teachers to do their work effectively (Farrant, 1977; Coelho, 1998). Literature shows that learners work successfully in groups with materials; learning becomes more interactive in the presence of the material, and the teacher's role changes to being a facilitator in the precence of the teaching and learning resources (Vygotsky, 1978; Rhodes & Bellamy, 1999). This section discusses the types, importance and challenges of different resources used in teaching and learning Mathematics and Science.

Shaffer and Percy (2007) argue that in science teaching and learning understanding is maximised when apparatus and equipment are used. During activities pupils do not only discuss verbally among themselves, but they demonstrate their ideas with the use of resources which could make their point of view clearer. Fathman, Quinn and Kessler (1992) argue that incorporating the use of real objects, pictures and visual and hands-on experiments is helpful in creating a connection between a new word and a concept for second-language speakers.

The other resources that are of importance in teaching and learning Mathematics and Science are textbooks. These are helpful to both teachers and pupils. Ong (2006) observed that some of the problems in learning Science through a second language are not only teachers who are not proficient in English but also the lack of good science textbooks. If good textbooks are not available then pupils only rely on teachers for information, which has its own challenges. In Lesotho the problem of textbooks and other resources became profound after the introduction of FPE, since schools were depending on the Government for provision of teaching and learning resources (Mosisili, 1999).

2.5 Support

Another major factor that affects the teaching of Mathematics and Science is the teacher support. Teachers need support from the Government, the schools (principals and their colleagues) and parents, because education is a result of initiatives that live or die based on the support offered by the larger organizations (Fullan, 2007). The areas for support to improve successful teaching and learning of Mathematics and Science include

financial support, experts support, provision of materials, control of teacher workloads and involvement of local leaders (Marsh, 1997). Fullan (1991) asserts that the government agencies, district, school principal and other external agencies should support teachers by providing adequate materials relevant to the proposed change. McLaughlin (1987) refers to these support areas as local capacities, which can be overpowered by teachers' attitudes and willingness to do the work. On the other hand, Marsh (1997) sees the support areas as structures, policies and support for teachers. He argues that this can have a major effect upon teachers' willingness to teach Mathematics and Science.

Another area of support is monitoring, as observed by Prinsloo (2007), who found that the learning support facilitators failed to visit schools on a regular basis. In addition, children have no command of English because they do not receive help in learning English at home, as parents of the lower-income groups living in rural areas do not speak English (Bialystok, 2001). The observation of Darling-Hammond (1997) is that school change cannot occur by school intervention alone without support and leadership from the policy system. The same sentiments are shared by Fullan (2007), who argues that projects having the active support of the principal were the most likely to fare well. In this case principals' actions are very crucial, and they serve to legitimate whether a change is to be taken seriously and to support teachers both psychologically and with resources.

2.6 Teachers' experiences in teaching Mathematics and Science in second language

A number of research projects on teachers' experiences in teaching Mathematics and Science in second language revealed contradicting results. Some teachers favour the use of the mother tongue instead of English. Araromi (2005), in her study found that some Nigerian teachers claimed that children's use of English in Mathematics and Science classes poses a number of teaching and learning problems because most of the children come from homes and an environment where English is not commonly used. This calls for the use of the mother tongue as MOI because mathematical concepts are acquired through language, and the problem arising from the use of the language has truly affected the learning of these concepts (Vizconde, 2006).

Other teachers advocate for the use of English instead of the first language. They claim that teaching Mathematics and Science in first language defeats the purpose of teaching these subjects in English (Bowering, 2003). This creates problems for pupils in later classes to communicate in English and understand instruction since most of the subjects are taught in English. Vizconde (2006) quoted one the teachers she interviewed as saying "I think we should use English because science is usually published in English." Her study also revealed that the respondents, who were all teachers, were positive about the use of English instead of first language:

> All of the respondents were positively inclined towards the use of English in teaching science and mathematics. They agreed that English is the language of science and mathematics because all materials that they use are written in English. They also stated that scientific and mathematical terms are very difficult to translate in English and that there is an abundance of terms that do not have any equivalent terms in Filipino (Vizconde, 2006, pp. 7-33)

Other research done by Yahaya (2009) on teachers' experiences in Malaysia revealed that more problems mentioned by teachers are related to the prescribed textbook and the multimedia courseware supplied by the Ministry. Government support in teaching Mathematics and Science is crucial for effectiveness in teaching the subjects. Having discussed the literature related to the study, the next discussion focuses on the two theories that informed the study.

2.7 Theoretical framework

Theory is a set of interconnected ideas or views which construct a logical view of events, relationships or behaviour with the aim of explaining or predicting (Cohen, Manion & Morrison, 2007; Neuman, 2006; Henning, Van Rensburg & Smit, 2004). This means that the purpose of a theory is to explain and predict the phenomenon. Therefore, a theoretical framework is important for connecting the researcher to the existing knowledge. The theoretical framework specifies the fundamental variables that provide an orientation of the study for the researcher to stay within (Henning et al., 2004). This research study is informed by the two theories, namely constructivism based on Piaget's and Vygotsky's theories and the pedagogical content knowledge (PCK) theory of learning by Shulman (1986). The section starts by discussing constructivism followed by PCK theory. In each case the discussions incorporate how the theory relates to my study.

2.7.1 Constructivism theory of learning

Powell and Kalina (2009) separate the constructivism theory into two types: cognitive or individual constructivism and social constructivism theory of learning. Cognitive constructivism is based on Piaget's theory, while social constructivism depends on Vygotsky's theory. Constructivism as the cognitive learning theory focuses on mental processes that construct meaning. The theory suggests that ideas are constructed in individuals through a personal process. Its principles are based largely on Piaget's processes of assimilation and accommodation (Van de Walle, 2007). Assimilation refers to the use of an existing plan to give meaning to experiences, while accommodation is the process of changing existing ways of viewing things or ideas that contradict or do not fit into the existing plan.

According to Piaget and Piaget & Semionovich (2006), in the constructivism approach pupils learn by fitting the new information together with what they already know. Piaget's theory of cognitive development proposes that humans cannot be given information which they immediately understand and use; instead, humans must construct their own knowledge (Powell & Kalina, 2009). This theory claims that pupils construct knowledge out of their experience. This promotes active learning where pupils learn by doing (Piaget, 1973). Jonasson (1991) states that constructivism believe that pupils construct their own reality or at least interpret it based upon their perceptions or experiences, so an individual's knowledge is a function of their prior experiences, mental structures, and beliefs that are used to interpret objects and events. Within the teaching of Mathematics and Science, teachers must not only be facilitators, they have to organize what is to be constructed (Orton, 2004). Then they have to ensure that pupils have the ability to construct knowledge in their own minds through the process of discovery and problem solving (Orton, 2004). In such a constructive classroom where pupils learn by doing, the teacher's role changes from being a teacher to a facilitator. In this case the teacher asks questions to initiate a discussion and provide guidelines, and also creates the environment for the pupil to arrive at his or her own conclusion (Piaget, 1973; Armstrong & Hyslop-Margison, 2006). Therefore, the constructivism theory has to do with pupils' construction of knowledge, based on their prior knowledge of Mathematics and Science concepts which they learned in Standards 1-3.

Social constructivism is where ideas are constructed through interaction with the teacher and other students. It is based on the social interactions of a student in the classroom along with a personal critical thinking process. Social constructivist models maintain the need for collaboration among pupils through the zone of proximal development. Constructivism learning theory assumes that pupils construct their own knowledge on the basis of interaction with their environment (Piaget & Semionovich, 2006). Schwartz and Reisberg (1991) contend that reflecting on our experience, we construct our own understanding of the world we live in. This means that in the classroom teachers must build on the foundation of knowledge already possessed by pupils. This theory argues that pupils construct knowledge through interaction with other pupils and the environment. The theory advocates for inquiry approaches of learning, which are normally utilised in science and group work discussions to learn from other pupils.

This theory will inform the researcher about whether the experiences of teachers about teaching Mathematics and Science using second language goes along with this. In other words, when teaching Maths and Science in Standard 4, do teachers experience pupils constructing their own understanding from their prior knowledge? Do teachers experience pupils fitting the new information that they have obtained in Standard 4 with what they have learnt from their environment, such as Standards 1-3 and their homes where the MOI is Sesotho.

2.7.2 Padagogical Content Knowledge (PCK) theory of learning

The PCK theory refers to knowledge about the teaching and learning of subject matter that takes into account the particular learning demands inherent in the subject matter (Shulman, 1986). Friedrichsen and Dana (2005) claim that PCK is influenced by three domains, namely subject matter knowledge, general knowledge and pedagogical knowledge. This complex interaction requires that PCK be studied in context, the context of teachers' classrooms where teachers will be able to solve pupils' problems easily.

Shulman (1986) claims that content knowledge refers to the understanding of the subject matter and pedagogical knowledge as one's understanding of teaching and

learning processes independent of subject matter. In other words, pedagogical knowledge is psychological understanding or professional knowledge that is necessary for teachers (Shulman, 1986). This means that some people can have general knowledge or knowledge of Science but lack in the knowledge of teaching strategies and techniques. Such people might have huge challenges when teaching Mathematics and Science. They might present the information or content that they have in a wrong way or ineffectively, without varying strategies to cater for a variety of pupils. Shulman (1986) claims that PCK exists at the intersection of content and pedagogy, and includes knowing which teaching approaches fit the content and how elements of the content can be arranged for better teaching.

This theory will inform the researcher about the competence of teachers as far as content and pedagogy are concerned in the teaching of Mathematics and Science to the transitional class. The interviews of teachers and lesson observations by the researcher will reveal whether teachers are able to apply appropriate teaching methods to assist pupils to understand Mathematics and Science concepts. If teachers do not have teachers' knowledge, that is content and pedagogy, they might pose addition challenges to pupils who are already possibly faced with the challenge of the English language.

2.8 Conclusion

Chapter Two covered the literature review and theoretical framework. The literature consulted is grouped into language, teaching and learning strategies, teaching and learning resources and support. As far as language is concerned, pupils are faced with the challenge of a second language, which in the case of Lesotho is English, and the technical terms that are used in Mathematics and Science. When pupils are taught in English they do not speak in class or participate in group discussions, and this affects their performance and pass rate. For effective teaching and learning for deeper understanding of Mathematics and Science, pupils should be taught in their mother tongue (Alidou, 2007). Some terms that are used in everyday English may mean something different when used in Mathematics and Science subjects (Carlson & Tamm, 2000). This causes a problem for pupils who are already struggling with English, and as a result they fail to understand Mathematics and Science concepts. To remedy this most

teachers use code-switching since they want their pupils to understand Mathematics and Science concepts and at the same time to learn the English language.

Pupils in Standard 4, which is a transitional class, when learning Mathematics and Science in a second language require a variation in teaching strategies. These will help in reaching children of different abilities, especially when the teacher is using strategies that provide pupils with a high level of retention (Cohen et al., 2004). The effectiveness of teaching and learning Mathematics and Science is also enhanced by the use of proper teaching and learning resources. In order to access teaching and learning resources Mathematics and Science teachers need support from the Government, parents, principals and colleagues. This research is informed by two theories, of constructivism and PCK, which suggest that pupils construct their own knowledge through their prior knowledge and experiences and interactions with teachers, other pupils and the environment.

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology, which includes various instruments and methods that facilitated the carrying out of the study. The chapter discusses the research paradigm, approach and research style followed. Thereafter, selection of the participants is discussed. It also describes how data were collected in order to explore teachers' experiences in teaching pupils Mathematics and Science in Standard 4 in a second language, as well as the data analysis process. Lastly, the chapter discusses the issues of quality of research, the limitations of the study and ethical considerations.

3.2 Research paradigm

A paradigm can be thought of as a lens through which we view the world. Nieuwenhuis (2007, p. 47) defines a paradigm as "a set of beliefs about a phenomena". Opie (2004) defines a paradigm as a basic set of beliefs that guides an action in research. The main purpose of the paradigm is to position the researcher within a theoretical framework. That is, it helps researchers to have a stance to adopt in his or her research (Henning et al., 2004). There are many different lenses for viewing and understanding the world. Cohen et al. (2007) highlight the three paradigms that influence research: the positivists and the interpretive and critical paradigms. According to Henning et al. (2004) and Cohen et al. (2007), data collection methods fall under two broad paradigms, which are qualitative and quantitative approaches. This study was located in an interpretive paradigm and adopted a qualitative approach in order to collect data to answer the research questions.

3.2.1 Interpretive paradigm

An interpretive paradigm, as explained by Cohen et al. (2007), is based on human behaviour, attitudes, beliefs and perceptions. As human beings we always interpret or give meaning to the things that we see in the social world. In addition, Cohen et al. (2007, p. 19) further argue that interpretivist researchers "understand reality through experiences or eyes of different participants and that the social world can be understood only from the standpoint of the individuals who are part of the ongoing

action investigated." As a result, interpretivist researchers believe that the world is changeable because people's behaviours are influenced by power dynamics. Similarly, Bertram, Fotheringham and Harley (2003) explain that interpretivists believe that the world is changeable and people define the meaning of a particular situation in the way they perceive. They further point out that interpretivists argue that the world is the creation of mind and thus it can be interpreted through the mind of people.

The researcher positioned this study within the interpretive paradigm because the purpose of the study was to explore teachers' experiences and their approaches in teaching of Mathematics and Science using pupils' second language in a transitional class. An interpretive framework was useful as it allowed exploration into the participants' natural setting by exploring the environment in which the participants create their reality (Radnor, 2002). Furthermore, interpretivists believe that reality and truth are socially constructed (Cohen et al., 2007). Thus the truth is relative and depends on the context and the people's experiences, understanding and beliefs (Cohen et al., 2007). Therefore, the researcher in a social phenomenon where teachers were participants explored teachers' experiences and their approaches towards the teaching of Mathematics and Science in a transitional class using English as the MOI.

Prasad (2005) explains that reality does not exist in some tangible, identifiable outside world but in human consciousness itself. Therefore, reality is socially constructed through acts of interpretation. He further outlines that knowledge is socially constructed, hence no objective knowledge exists since knowledge is influenced by social location and produced by social interest. This means that only Mathematics and Science teachers provided and interpreted their experiences in the context that they are in and attached meaning to them. Cohen et al. (2007) explain that interpretivists are guided by the assumption that knowledge and reality are socially constructed by active people in the process of research. They further state that knowledge in the interpretivist paradigm is concerned with interpretation, illusion and meaning and all human action is meaningful. Hence Standard 4 teachers were interpreted and understood within the context of social practices (school). The locating in this paradigm is to describe and understand rather than explain and predict human behaviour. As a result, the researcher found the qualitative approach to be suitable for use in this study because qualitative

research can be described as an interpretive and naturalistic approach to the world (Denzin & Lincoln, 2000).

3.2.2 Qualitative approach

This study used a qualitative approach which employed a case study style. Qualitative research is an inquiry approach useful for exploring and understanding a central phenomenon (Cohen et al., 2007). The phenomenon is an idea that the researcher would like to explore, discover, explain, identify or describe (Cohen et al., 2007). In the qualitative approach the researcher seeks for the answers to questions such as "how", "what" and "why" (Gay, Mills & Airasian, 2009). This means that mostly open-ended questions are asked, which let the participants respond freely in their own words. According to Denzin and Lincoln (2003) qualitative researchers stress the socially constructed nature of reality, the closed relationship between the researcher and what she studies, and the situational constraints that shape inquiry. Henning et al. (2004) further state that in qualitative research, researchers want to find out not only what happens but also how it happens and, importantly, why it happens in the way it does. This means that in qualitative studies the researchers seek for in-depth information so as to understand the phenomenon.

Cohen et al. (2007) explain that the qualitative approach acknowledges that the social and physical worlds are different and it seeks to understand human interactions by observing and interacting with people in order to construct the social world around them. In this study the researcher aimed to understand the complex world of Mathematics and Science teachers' experiences from their point of view. The analysis of data was aimed at 'thick' description and to understand the meanings that people attached to activities around them, and how they relate to those meanings with regard to their behaviour.

The qualitative approach stresses a phenomenological model in which multiple realities are rooted in subjects' perceptions; hence reality is subjective (Prasad, 2005). A focus on understanding and meaning is based on verbal narratives and observations rather than numbers. Since the study explored teachers' experiences of teaching Mathematics and Science using second language, the researcher felt that the aim of this

study was consistent with those of the qualitative research approach. According to McMillan (1996), cited in Glatthorn and Joyner (2005), and Cohen et al. (2007), the qualitative approach focuses on meaning and understanding and takes place in naturally occurring situations. The qualitative approach was therefore used to gain an in-depth understanding of the phenomena under investigation, focusing on describing and interpreting events and actions of participants in their natural setting without any interference in the flow of their responses.

In order to gain an in-depth understanding of the phenomena, the researcher employed different procedures such as the case study, sampling and different data collection methods, for example, semi-structured interviews and classroom lesson observations.

3.2.3 Case study

A case study is descriptive research which involves describing the particular events or situations in the present, such as how the events occur (Maree, 2007). This study used a case study style of research as it is often used by researchers in an interpretive paradigm (Cohen et al., 2007). Furthermore, Cohen et al. (2007) indicate that a case study is an in-depth study of one particular case, where the case may involve a person or a group of people and organizations. It also aims to describe what it is like to be in a particular situation. This study explored the experiences of Standard 4 teachers who teach Mathematics and Science in a second language and how they teach in the classroom context. Nieuwenhuis (2007) indicates that case study research aims at gaining greater insight and understanding of the dynamics of a specific situation. Therefore, a case study was done to gain in-depth understanding of Standard 4 teachers' experiences of teaching Mathematics and Science in a second language.

The case study design was chosen to obtain an in-depth understanding in a related context, rather than a broader population (Cohen et al., 2007). Hence the study does not generalise, since the researcher focused on four teachers in three primary schools. Picciano (2004) states that a case study can be chosen to examine in detail a specific activity or persons. Lesego (2009) proposes three types of case studies, which he differentiates in terms of the end product of the research that might be explanatory or

descriptive. For any study a case study can follow a single or multiple cases. This study is therefore a descriptive case study that uses a single community.

3.3 Sampling

Gay et al. (2009) define qualitative sampling as the process of selecting a small number of individuals for a study in such a way that individuals are good key informants who contribute to the researcher's understanding of a given phenomenon. In addition, Lowe (2007) defines sampling as something that involves making decisions about which people, settings, events or behaviours to observe. In this study the researcher used purposive sampling when selecting participants according to their relevance to the research question 'What are Mathematics and Science teachers' experiences of teaching Standard 4 pupils using second language?'

In purposive sampling the researcher selects particular elements from the population that would be representative or informative about the topic of interest. On the basis of the researcher's knowledge of the population, a judgment is made about which subjects should be selected to provide the best information to address the purpose of the researcher (McMillan & Schumacher, 2010). This sampling method was relevant to the study since the researcher selected teachers who are teaching Mathematics and Science in a transitional class (Nieuwenhuis, 2007). This affirms that purposive sampling is used to access 'knowledgeable people'; Standard 4 teachers are the ones who have in-depth knowledge about the teaching of Mathematics and Science, through their teaching experiences in those two subjects in a second language.

This type of sampling does not attempt to be representative and its findings would not be generalizable, but the focus was to acquire in-depth information from knowledgeable people, as the study is concerned with the teaching of Mathematics and Science subjects in Standard 4. In this case the findings could be transfered to any context where the teaching of Mathematics and Science in Standard 4 follows the similar policy as the one followed in lesotho. Therefore, four Standard 4 teachers who were teaching Mathematics and Science were selected from three schools. The number of participants added up to four teachers because in one of the selected schools subject

teaching is carried out whereby one teacher taught Mathematics and another taught Science. In the other two selected schools each of the teachers taught both subjects.

According to Kumar's (2005) argument, a relatively small number of participants can provide the researcher with a sufficiently high degree of probability and a true reflection of the sampled population. Purposive sampling is not only restricted to the selection of participants but also involves the setting, incidents, events and activities to be included in data collection (Nieuwenhuis, 2007; Cohen et al., 2007; Creswell, 2009). Therefore, the study field, the area where the study was conducted, the level of the class studied and the schools are discussed below.

3.3.1 The study field

As mentioned above, the study was conducted in three primary schools in the rural area of Leribe district in Lesotho. The schools' and participants' names used in the study are pseudonyms. In Figure 3.1 the schools are labelled A, B and C to indicate where the three schools were situated. The area of the study, class levels and schools were purposefully selected. Figure 3.1 shows the ten districts of Lesotho, within each of which there are urban and rural areas.

Figure 3.1 Map depicting study context.

Source: www.worldofmaps.net/en/africa/map-lesotho.org

The reasons for selection of items for this study are discussed below.

3.3.2 Area of the study

The study was done in the rural area in Leribe district because this is the researcher's home and she taught in that area for more than 28 years. The researcher had realised that there was a problem with teaching in the rural areas, the main problem she noticed being pupils' poor performance in Mathematics and Science compared to schools in urban areas. This issue was proved by the Standard 7 primary school leaving results for the past few years.

3.3.3 Level of class studied

The researcher's focus was on Standard 4 classes because this is where the transition of language from Sesotho to English starts. The researcher felt that the high Mathematics and Science failure rate for the primary school leaving examinations in schools might be caused by a poor foundation in Standard 4.

3.3.4 School sample

Participating schools were chosen because they are nearer to the researcher's home meaning that it was easy for the researcher to travel there, since there is insufficient transport in the rural areas. Another reason was that the three schools provide a service to the same community. This means that pupils from these schools come from the same community in the rural areas where English is a foreign language only spoken, read and written in schools, unlike in the urban schools with diversified pupils. These schools differ in terms of church denominations, school roll and performance. Other differences were that the first chosen school was rich, the second middle and the last one very poor in terms of buildings and furniture. Therefore the researcher felt that the selected schools would provide the desired data. The selected schools were named Wendy, Rorisang and Mafume Primary Schools. Below are discussions of the three schools and the Standard 4 Mathematics and Science teachers' profiles.

3.4 Schools settings and teachers' profiles

Below is the discription of the schools and the teachers' information

3.4.1 Wendy Primary School

Wendy Primary is a Government school located in the village. It is a full primary school educating a total number of 890 pupils from Standards 1-7 with 16 qualified teachers, 3 males and 13 females. It is one of the biggest schools in that area and the one that produces better results in the PSL examinations. The administration of the school is not the role of the principal alone; there is a deputy principal and Heads of Department in lower primary (Standards 1-3), middle primary (Standards 4-5) and higher primary (Standards 6-7). Teachers in this school do subject teaching, which means that each class has two teachers except Standards 7 and 6 with three teachers per class. The Standard 4 pupils' roll was 98 for the year 2011. These pupils were taught by two teachers, one teaches Mathematics and the other subjects while the other teacher teaches Science and other subjects. Below are these two Standard 4 teachers' profiles with their pseudonyms.

3.4.1.1 Lineo's profile

Lineo is a Science teacher in the Standard 4 class. She is a professional teacher holding a Diploma in Education. It is her second year of teaching Standard 4, since she had being teaching the lower primary for the three years before. It is therefore her fifth year in the teaching profession. Her age is between 20 and 30. She claimed that in her first year of teaching Standard 4 it was very difficult for her to teach in English as she had previously been teaching in Sesotho (her mother tongue). As time progressed she got used to teaching in English, although she still experiences challenges.

3.4.1.2 Thabo's profile

Thabo is a Mosotho man edged 53 years and a Mathematics teacher. He taught in the same standard as Lineo. He did part-time studies with the College of Preceptors which temporarily trained teachers for five years before the Government stopped it. He then obtained his Advanced Certificate in Primary Education which is equivalent to a Diploma in Education. He has 16 years' teaching experiences. He indicated that it was his first year of teaching Standard 4, because he had been teaching Standard 5, 6 and 7

previously. He claimed that in all his years of teaching experience, Standard 4 had been proven to be the most difficult class to teach. He stressed that it is even worse when it comes to the teaching of Mathematics lessons.

3.4.2 Mafume Primary School

Mafume Primary School is one of the oldest and poorest schools in the rural area of Leribe district. The school is situated near the rivers. It is a full primary school educating a total number of 300 pupils from Standard 1-7. It is a church school belonging to the Lesotho Evangelical Church, although it is funded by the Government. Education is free from Standards 1-7. Mafume Primary is one of the disadvantaged schools with a shortage of classrooms and learning and teaching resources. There are seven members of teaching staff, of whom only four are qualified or trained and three are unqualified educators. Three of the four qualified teachers have Primary Teachers' Certificates and one has a Diploma in Education. The enrolment in Standard 4 is 40 pupils, who are taught by one qualified teacher who holds a Primary Teachers' Certificate. She teaches all of the subjects, including Mathematics and Science. Administration was vested in the principal and her deputy. The profile of the Standard 4 teacher is outlined below.

3.4.2.1 Matshepo's profile

Matshepo is a Mosotho woman who trained at the National Teachers Training College, which is now called the Lesotho College of Education, where she obtained her Primary Teacher's Certificate. She is 58 years old and has 26 years of teaching experience. She first taught in the urban areas for 15 years and in her 16th year of teaching moved to the rural area since this is her original home and she felt that she was getting old. She is teaching all of the subjects offered in the school at Standard 4 level with a total number of 40 pupils. She indicated that she taught Standard 4 for many years of her teaching life. However, in the rural school, it was her third year of teaching Standard 4. She further said that teaching in rural schools was more challenging than in the urban schools, especially in subjects like Mathematics and Science taught in the transitional class.

3.4.3 Rorisang Primary School

Rorisang Primary School is a Roman Catholic Church school. Its performance is much better than Mafume Primary School. It is a well-resourced school with a total roll of 500 pupils and 11 teachers. Ten of the teachers are qualified while one is a volunteer and under-qualified. All of the higher primary classes are taught by two teachers. In Standard 4 there are two teachers and 80 pupils subdivided into two classes. Teachers carry out subject teaching as in Wendy Primary School, although the three core subjects of Mathematics, Science and English in Standard 4 are taught by one teacher who holds a B.Ed. degree. The other optional subjects are taught by another teacher. The administration was based on the principal and the deputy principal as in Mafume Primary. Below is the Standard 4 teacher's profile.

3.4.3.1 Mamosa's profile

Mamosa was one of the Standard 4 teachers who taught Mathematics, Science and English in both of the Standard 4 classes. The three subjects that Mamosa taught are regarded as core subjects in the Lesotho primary syllabus. Mamosa is 40 years old. Her qualifications were as follows: Primary Teacher Certificate, B.Ed. degree and B.Ed. Honours. She had six years' teaching experience, and for three of the six had been teaching lower classes. She indicated that she had been teaching the same subjects since she had been teaching Standard 4 pupils, so each and every year she experiences new challenges in the teaching of Mathematics and Science.

3.5 Data collection methods

Methods refer to tools used to gather information, providing and describing an extensive range of methods derived from both first-hand experiences and interviews (Scott & Morrison, 2006). In this study multiple layers of data were generated through semi-structured teachers' interviews and classroom observations. Multiple methods of data collection complement each other and enhance trustworthiness and crystallization of the findings (Nieuwenhuis, 2007). The aim of using different methods of data collection was to answer the research question/s with different methods and to answer the same research question/s from different angles. Creswell (2005) indicates that triangulation is useful where different methods of data collection are used from different sources. This implies that all the data are mapped at different angles to converge and be

analyzed to build a text. When triangulation is employed the researcher is not method-bound (Cohen et al., 2007) and this improves the validity of the study. The following section describes the two methods the researcher used in this study.

3.5.1 Semi-structured interview

Cohen et al. (2007) define interview as a technique used to collect information when one wants to get deep opinions of the participants. An interview is regarded as a professional face-to-face conversation between two or more people, where the researcher collects information from the interviewee/s that may help in answering the research question/s (Cohen et al., 2007). The researcher used face-to-face interviews to interview a Mathematics and/or a Science teacher in each of the three schools. According to McMillan and Schumacher (2010), face-to-face interviews give the interviewer insight into the non-verbal as well as the verbal responses of the participants; it also gives the interviewer the opportunity to motivate the participants. The responses were probed, clarified and elaborated in order to achieve specific accurate responses (McMillan & Schumacher, 2010). In addition, to this Mason and Bramble (1978) argue that interviews allow a researcher to investigate and prompt things that cannot be observed. Therefore the researcher decided to use semi-structured interviews.

Some of the interview questions that the participants answered include the following:

1. *Do you regard teaching of Mathematics and Science as different from teaching other subjects? Give reasons.*

2. *In Standard 4 pupils start to learn subjects using second language. How do you find teaching Mathematics and Science using second language?*

3. *What are the most common problems Standard 4 pupils encounter in Mathematics and Science lessons and how do you deal with them?*

4. *Do you have any techniques that are used to effectively teach Mathematics and Science at Standard 4? Explain.*

5. *What methods do you apply to increase understanding of learners in the teaching of Mathematics and Science?*

6. *Do you get any assistance or support from the staff, Ministry of Education and parents in teaching Mathematics and Science in a transitional class?*

7. *Do you think language plays an important role in the teaching of Mathematics and Science? How? Explain.*

According to Lowe (2007), the purpose of semi-structured interviews is coherent with the qualitative research paradigm because they elicit data that can further the understanding of the social interaction or participants. Moreover, a semi-structured interview is a verbal questionnaire consisting of a series of questions designed to elicit specific answers from the participants (Fraenkel & Wallen, 2008). The information obtained can be constructed or compared (*Ibid*.). The researcher used a semi-structured interview because in this approach she was able to probe so as to find out in-depth information from the interviewees. The questions asked were open-ended so as to stimulate discussion (Fraenkel & Wallen, 2008). This means that the interviewee was free to answer the way in the way that they wished. Furthermore, this approach was used to understand teachers' social opinions, which is the way they feel about certain issues in the teaching and learning process (Van Maneu, 1994). According to Cohen et al. (2007), the semi-structured interview provides a room for negotiation and discussion between the interviewer and interviewee. The interview was conducted in a space where the researcher was with the interviewee only in order to avoid disturbances. In support, Fraenkel and Wallen (2008) indicate that the researcher must establish an atmosphere of trust, cooperation and mutual respect if he or she is to obtain accurate information.

The purpose of this study was to explore the experiences of Standard 4 teachers teaching Mathematics and Science in a second language. The researcher asked each of the participants 10 questions. Grix (2004) and Fraenkel and Wallen (2008) suggest that the semi-structured interview is taken as an in-depth interview where the researcher has formal and informal verbal questions in mind, so that she or he can start with the

informal questions as they are useful in putting the participants at ease, then follow with the formal questions, which cannot exceed 10 in total for manageability. All of the participants were asked the same questions. According to Fraenkel and Wallen (2008), in semi-structured interviews the researcher has to ask the participants questions with an exact wording and sequence. The purpose of asking the same question was that the researcher wanted to understand different experiences from different participants in order to determine factors that contribute to teachers' success in the teaching of the Mathematics and Science curriculum as well as factors that impede their teaching of both subjects. This could be resolved through understanding teachers' experiences of teaching Standard 4 classes both subjects in their second language.

According to Seidman (1998), interviews should not spaced over a long time as this can affect the development of the relationship between the participants and the interviewer. For this reason the researcher spent time on two days to interview all participants per subject in all three schools. On the first day Mathematics and Science teachers were interviewed for an approximately one to one and half hour per teacher, since at the first school that the researcher did interviews at, teachers are doing subject teaching. So the researcher took almost three hours interviewing in all. Then she went on to another school where she spent one hour interviewing the Mathematics and Science teacher. The same time was taken at the last school. In the latter two schools Mathematics and Science are both taught by one teacher. The same interviews were repeated after two days in each of the three schools in order for the interviewees to rectify any mistakes after listening to their first responses. This means that all in all, the interviews were done in eight days. Since the interview was repeated, the researcher used the latest interviews.

Data were collected using handwritten notes and audio-recording. The researcher used the audio-recording so that the information could be kept and listened to when analysing. The interviews were conducted in a language that the participants understood (Sesotho). Table 3.1 shows how the data collection through semi-structured interviews was planned.

Table 3.1 Interview schedule, semi-structured interviews

Name of school	Name of teacher	Interview dates	Subject taught	Time taken (hrs /min)	No.of interviews
Wendy Primary School	Lineo	First 09/05/11 Second 12/05/11	Science	1hr 1 hr 30 min	2
Wendy Primary School	Thabo	First 09/05/11 Second 12/05/11	Mathematics	1hr 1 hr 30min	2
Mafume Primary School	Matshepo	First 10/05/11 Second 13/05/11	Science and Mathematics	1hr 1 hr 30 min	2
Rorisang Primary School	Mamosa	First 10/05/55 Second 13/05/11	Science and Mathematics	1hr 1 hr 30 min	2

Table 3.1 reflects how interviews were conducted as the researcher had two interview sessions. The first interview was carried out on 9 May 2011 at Wendy Primary School for an hour with each participant, the Mathematics and the Science teachers. The same interviews with the same participants were repeated on 12 May 2011, which took a period of 1 hour 30 minutes each. In Mafume and Rorisang Primary Schools the first interviews were on 12 May 2011 for an hour with the teachers of both Mathematics and Science subjects, repeated on 13 May 2011 for 1 hour 30 minutes with the same participants. The extra 30 minutes in the second session was meant for the participants to listen to the voice recording before the second interview started so that they could rectify any mistakes made during the first session. The researcher therefore had eight interviews with four participants. What follows is a description of the classroom observation that was carried out.

3.5.2 Classroom observation

Observations of two lessons per teacher were conducted in the classroom. Timed and detailed notes were made about what the teacher and the pupils were doing concerning teaching and learning. The researcher felt that classroom observation was

relevant in this study because observation is a method which involves the researcher in watching, recording and analysing events of interest (Blaxter, Hughes & Tight, 2006). Kumar (2005) adds and defines observation as a systematic and selective way of watching and listening to an interaction or phenomenon as it takes place. Observation provides the researcher with first-hand information about what is actually done, achieved by recording impressions and happenings in the natural environment (Naicker, 1998). This helped the researcher to describe and understood events as they actually happened at the chalk face. This observation was a structured observation where the researcher had to plan in advance in order to have a clear idea about the issue to be observed (Lowe, 2007). Blaxter et al. *(*2006) state that a highly structured observation helps the researcher to know in advance what she or he is looking for, and will have its observation categories worked out in advance. In this study observation was undertaken to gain a general understanding of the items shown in Table 3.2.

Table: 3.2 Description of observation schedule

Teaching and learning	Resources	Classroom-based assessment
How the teacher introduces the lesson. Goals and objectives clearly stated. The teaching methods used. The concepts are clearly understandable by the pupils. Are the terms or concepts clearly defined? The language used by the teacher for clarity. Do pupils follow English directions in Mathematics and Science subjects? Is there any interaction between the teacher and the pupils? Do the pupils participate in answering the questions orally? Does the teacher wait for the pupils to answer? Does the teacher revert to mother tongue?	Charts, worksheets and or real objects Other teaching and learning materials Planning of the lesson as observed through teaching Use of variety of teaching materials and strategies, improvisation Use of variety of teaching and learning methods, group work, peer learning and/or individual work	Applicability of homework Probing and questioning Formative assessment

This indicates that the researcher had a plan of what was to be observed. The researcher spent four days in each of the selected schools carrying out observations.

The table below shows that classroom observations took four days at each of the selected schools, which made a total number of 12 days. The researcher observed two lessons per subject on the topics given in Table 3.3 above. Each lesson took almost 45 minutes. The dates of observations were scheduled in the table. From the lesson topics the researcher observed the "teaching and learning", which was how the participants carried out the teaching and helped pupils to understand the lessons and how pupils participated. She also looked at the "resources" which the participants used to facilitate teaching and learning, and the way they assessed the pupils. Black and Wiliam (2009) and Volante (2007) claim that classroom assessment is understood as a complex process of collection, analysis and evaluation of evidence about the teaching and learning process and learning outcomes.

The observation schedule is shown in Table 3.3 below.

Table: 3.3 Observation schedule

Name of school	Teachers' names	Date of observation	Subject & lesson topic	Number of lessons	Minutes per lesson
Wendy PS	Lineo	09, 16, 17 & 18 May 2011	Science Five senses	2	45 min
Wendy PS	Thabo	09, 16, 17 & 18 May 2011	Mathematics Right angles	2	45 min
Mafume PS	Matshepo	10, 19, 20 & 23 May 2011	**Mathematics** Number to the nearest 100 **Science** Domestic animals	2 2	45 min 45 min
Rorisang PS	Mamosa	11, 23, 24 & 25 May 2011	Mathematics Equivalent fractions Science Common substances	2 2	45 min 45 min

PS = Primary School.

Wiersma and Jurs (2009) argue that observation is a continuing process whereby the researcher is not limited to sessions of attendance. It is characterised by a prolonged period of intense social interaction between the researcher and the participants (Wilkinson & Birmingham, 2003). The researcher was not involved in a teaching process but remained a passive observer, watching and listening and drawing conclusions from what she observed. Kumar (2005) affirms that in non-participatory observation the researcher does not get involved in the activities. Frequent visits by the researcher allow the teacher and pupils to get used to her presence and not to feel ill at ease that they are being observed.

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

3.6 Data analysis

Qualitative data analysis involves "making sense of the data in terms of the participants' definition of the situation, noting patterns, themes, categories and regularities" (Cohen et al., 2007, p.461). However, qualitative data rely heavily on interpretation, and frequently multiple interpretations arise from qualitative data. The researcher used the thematic content analysis method. Stake (2005) describes this as a way of analysing data by organizing them into categories on the basis of themes or similar features. Similarly, thematic analysis is defined as "the process of tracing the thinking pattern of the interviewees and the pattern of action depicted in observation notes" (Henning et al., 2004). Using this model of data analysis, after transcription the interviews and classroom observations were coded and organised into themes. Gay et al. (2009) point out that the first step in analysing data is to read and write memos about all field notes, transcripts and observer comments to get an initial sense of the data. Nieuwenhuis (2007, p. 101) asserts that "content analysis is a systematic approach to qualitative data analysis that identifies and summarises the message content". He further indicates that content analysis is an inductive and iterative process where we look for similarities and differences in texts that will corroborate or disconfirm the theory. Wiersma and Jurs (2009) argue that qualitative research often produces large quantities

of descriptive information from interviews and observations that need to be reduced or organised.

Again, Cohen et al. (2007, p. 370) state that in analysing data the researcher will listen to the entire audio-recordings several times and read the transcripts a number of times in order to provide a context for the emergence of specific units of meaning and later on themes. Then the researcher transcribed and translated the audio-recordings into language which can be understood by local and international readers, including the researcher's supervisor, as the interviews were recorded in the language in which the participants were free to express themselves (Sesotho).

As part of the research the interviewer also took note of the non-verbal communication that took place during interview sessions (Cohen et al., 2007). This means all of the actions by the participants were noted. In the findings the researcher presented patterns of related themes which relate to the research questions, cross-examined with the literature and the theoretical framework, to limit conclusions that may be influenced by the researcher's perceptions, experiences and beliefs (Krueger, 1998).

3.7 Issues of quality in research

Certain quality issues need to be observed in order to produce an acceptable study. These include trustworthiness, limitations of the study, and ethical issues, which are discussed below.

3.7.1 Trustworthiness

In this study trustworthiness was addressed by using different methods of data collection (Nieuwenhuis, 2007) to enhance trustworthiness. The researcher used two methods of data collection so as to build trustworthiness between the researcher and the participants. Information obtained from the interview sessions was compared with the classroom observations as a means of corroborating the information. Bloomberg and Volpe (2008) maintain that the information provided by different sources should be compared through triangulation to corroborate the researcher's conclusions.

Consequently, Gay et al. (2009) state that research studies are built on trust between the participants and the researcher.

On the other hand, Lincoln and Guba (1985) and Maree (2007) argue that trustworthiness refers to the manner in which the researcher can convince the readers that the findings in the study are of high quality and can thus be trusted. Therefore, the aim of trustworthiness in a qualitative investigation is to support the argument that the inquiry's findings are "worth paying attention to" (Lincoln & Guba, 2000). In this study trustworthiness was ensured by describing in full the process that was undertaken. Lincoln and Guba (1985), Maree (2007) and Nieuwenhuis (2007) point out that trustworthiness in qualitative research is underpinned by credibility, transferability, dependability and conformability.

Credibility was regarded as an important measure in this study. Lincoln and Guba (1985) define credibility as the ability of the researcher to produce findings that are convincing and believable. In this study the interviews were tape-recorded, and this helped the researcher to use verbatim quotes from participants in order to reveal the source of interpretation. The researcher engaged in 'member checking' by allowing the interviewee to listen to the tape in order to verify their responses. In support, Nieuwenhuis (2007) assets that the use of quotes as well as letting the interviewees read the transcripts in order to determine whether the views were correctly recorded enhance the trustworthiness of the study.

According to Bloomberg and Volpe (2008), transferability refers matching the research context and other contexts as judged by the reader. This is the degree to which the researcher determines similarity between the study site and the receiving context. Seminally, Scott and Morrison (2006) view transferability as how well the study has made it possible for the reader to decide whether a similar process will be at work in their own setting and communities, by understanding in depth how it occurs at the researcher's site. Therefore, the researcher clearly interpreted information that she obtained using the three data collection methods. This will enable the reader to make the necessary judgement and other researchers to use the study in their reference literature for their studies.

According to Lincoln and Guba (1985), conformability refers to the degree to which the findings and conclusions are not biased or influenced by the researcher. They further contend that conformability refers to the degree to which the researcher's construction of an interpretation can be traced. The researcher eliminated bias through cross-examining the findings with theories and the literature. Babbie and Mouton (2002) acknowledged that auditing is vital for assuring conformability in research. Auditing can be a process whereby an internal examiner checks the research process and the quality of the research and its findings. Therefore, in the current study the supervisor's role embraced the quality of the research, assuring trustworthiness.

Dependability refers to the degree to which the reader can trust that the findings indeed occurred in the way that the researcher indicates (Durrheim & Wassenaar, 2002, cited in Maree, 2007). The researcher promoted the honesty of the findings through triangulation of data collection forms, namely semi-structured interviews and classroom observation. Moreover, the open-ended questions and teaching and learning of Mathematics and Science lesson observations allowed data that were not restricted by the researcher's personality, position or qualifications. In this way, research was obtained that can be trusted.

3.8 Limitations of the study

This study was conducted in three primary schools, with a small sample of four teachers. Since this is a case study, it is obvious that one could not generalize from findings from only three schools and four teachers to other schools in Lesotho or even the Leribe district where the study was conducted. However, it was not the intention of this study to offer generalized results, because in qualitative studies the researchers' aim is to obtain an in-depth understanding of the phenomenon rather than generalisation of the results. Teachers were repeating the lessons so as to impress the researcher; this means that the teaching and learning observations might not provide appropriate data. The researcher overcame this limitation by telling the participants that she was there to learn and not to judge and that when the lesson is new, she thinks she can learn more. She had several observations for a week per school.

3.9 Ethical issues

The researcher was permitted to conduct the study after applying for ethical clearance from the University of KwaZulu-Natal; this is a legal requirement for those who want to conduct research and pursue studies. However, ethical issues refer to moral principles or rules of behaviour which researchers have to take into consideration before conducting research, particularly research involving humans (Cohen et al., 2007; Kimmel, 2007). Cohen et al. *(*2004) indicate that ethical issues arise from the nature of the research problem, the research context, and data collection methods, nature of the participants and what is to be done with the data.

In order for the study to be conducted in schools, the researcher requested permission from the Ministry of Education in Lesotho (district officer), with written letters explaining the nature and purpose of her study. According to Wiersma and Jurs (2009), when conducting research in an educational setting it is necessary to obtain permission from the site's gatekeeper. Thereafter, the researcher visited the principals of the schools concerned to inform them of the study; again the researcher provided a formal written letter to this effect as to get the permission from the principals. Since the study is aimed at improving the level of performance of pupils in Mathematics and Science, permission was also sought from the Standard 4 teachers who teach the above-mentioned subjects, again with a formal letter. Furthermore, permission was also asked from these participants for use of a tape- recorder during the interviews. The participants were also told how they were expected to participate in the study. Attached to the participants' letters, the informed consent declaration form explained to them the nature of the study, and their right to withdraw at any time without any negative consequences (Kimmel, 2007; Campell, McNamard & Gilroy, 2004). Informed consent was obtained from all participants at the three schools.

3.10 Conclusion

This chapter discussed the research methodology and design used to accomplish the study. The chapter acknowledged the suitability of the paradigm, approach and style used in the study, which was interpretive and located within a qualitative approach and a case study style. The chapter further presented discussion on the selection of participants, data collection methods and analysis strategies. The discussion included

trustworthiness and limitations of the study as well as ethical issues. The next chapter presents the analysis of data derived from the participants' responses that integrates discussion of literature from Chapter Two.

CHAPTER FOUR
ANALYSIS AND DISCUSSION OF DATA

4.1 Introduction

This chapter presents and discusses the findings of the study which explored the experiences of Standard 4 Mathematics and Science teachers using a second language to teach. The participants in the study were four teachers from three selected schools in the rural areas of Leribe district in Lesotho. The research findings were obtained from interviews with teachers and classroom observations.

This chapter begins with presentation of the findings in terms of the profiles of the teachers who took part in the study. Thereafter analysis of teachers' experiences in teaching Mathematics and Science in a second language context is presented. The analysis is divided into three main themes which emerged from data; these are language, teaching approaches and support.

4.2 Biographical information of the teachers

Four teachers were purposively selected from the three schools, as stated in Chapter Three. All of these teachers were teaching Mathematics and/or Science in Standard 4. Of the four teachers, two were selected from one school which was practising subject teaching, where one teacher was teaching Mathematics and the other was teaching Science.

The researcher used pseudonyms for the schools and participants to ensure confidentiality. As shown in the table, three of the participants were female and one was male. These teachers had different teaching qualifications and experience; two had been teaching for less than 10 years, whereas the other two had more than 10 years of teaching experience. As far as their qualifications are concerned, only one participant was a postgraduate with a B.Ed. and B.Ed. Honours degree; the other three were undergraduates with qualifications ranging from a teachers' certificate to a Diploma in Education. Concerning the subjects taught in primary schools, teachers teach all of the subjects, with the exception of some schools where subject teaching is practised, like Wendy Primary School in Table 4.1. The next section addresses the analysis and discussion of themes that emerged from the data.

The teachers who participated in the study and their biographical information are presented in Table 4.1 below.

Table 4.1: Participants' biographical information

School	Teacher	Qualification(s)	Subject	Gender	Experience
Wendy PS	Lineo	Diploma in ducation	Science	Female	5 years
Wendy PS	Thabo	Advanced Certificate Programme	Mathematics	Male	16 years
Mafume PS	Matshepo	Primary Teacher'sCertificate	Mathematics and Science	Female	22 years
Rorisang PS	Mamosa	B.Ed. and B.Ed. Honours degrees	Mathematics and Science	Female	6 years

PS = primary school.

4.3 Data analysis of teachers' experiences

This section presents the data analysis process and discussion. The data discussed here are divided into the three main themes which emerged from the transcription of data. The themes identified were language, teaching approaches and support. The discussion will be infused in the analysis. The first theme to be analysed and discussed is language.

4.3.1 Language

This theme mainly discusses the Mathematics and Science teachers' language experiences. There are three main issues that teachers experienced in teaching pupils through English as the MOI: the first is the use of English as an MOI; the second pertains to pupils' misunderstanding of concepts and terminologies due to the language used in teaching Mathematics and Science; and the final issue relates to pupils' pronunciation of some of the English words in both subjects.

4.3.1.1 English as an MOI

In interviewing teachers it was found that all of the participants acknowledged that they experienced some challenges in teaching Mathematics and Science through

second language as the MOI. Teachers reported that pupils do not understand English as the MOI in a transitional class. Lineo noted as follows:

> *Lineo: Teaching science using second language is problematic because our pupils in the rural schools are not familiar with second language speaking as they speak Sesotho at their homes. This pupils do not understand English; not understanding the language leads to failure in the subjects.*

This was also stated by Thabo, who in addition alluded to the fact that pupils come from rural areas where most of the community members are illiterate, and therefore are unable to communicate in English. The pupils only start communicating in English when they start their schooling:

> *Thabo: Our pupils are not regularly exposed to the use of second language here at the rural schools, so it is difficult to teach Mathematics in English as MOI as the school is their new environment where they start to be retrained in English.*

This shows that these pupils lack English competency. Teachers expressed that the two subjects are therefore more difficult to learn in English. This means that the participants viewed the language as a barrier for pupils to understand the teaching of Mathematics and Science subjects.

This is in line with Araromi (2005), who argues that children's use of English in Mathematics and Science classes poses a number of teaching and learning problems, because most of the children come from homes and an environment where English is not commonly used. This is supported by Jusoff (2009), who indicates that many learners encounter English for the first time in school and rarely use it in their everyday lives.

Another experience of the teachers relating to English was that understanding depends on the level of the learners. This was noted by Matshepo:

Matshepo: I was teaching the same pupils from the lower classes and I did not experience any problem concerning pupils' understanding of Mathematics and Science subjects as the language of teaching and learning was their mother tongue, but in these classes (Standards 4-7) language is problematic as it is pupils' second language...

Matshepo's argument here is that the same pupils whom she taught at the lower grades had no problem with understanding Mathematics and Science concepts when they were taugh in Sesotho. However, the same pupils when taught in English have a problem of understanding the concepts. She concludes that it is because of the language of tuition.

This is also in line with what was seen during the classroom observations. Pupils were fluent when the lessons were diverted to their first language or mother tongue and were participating fully and giving the correct answers. But when the language of instruction was English, they did not respond to teachers' question. The researcher's observations on this issue are presented below:

The teacher was teaching Science, the topic was animals
Teacher: Our lesson today is on domestic and wild animals.
Teacher: Which are the domestic animals?
[Pupils did not respond, they seem not to understand the question.]
Teacher: Domestic animals are the animals that live with people - liphoofolo tse phelang le batho. [The teacher translates the question into Sesotho.]
Pupils: Madam! Madam! Madam! [All of them wanted to give the answer.]
Teacher: Yes Tshili, Dumi, Lebo, Pitso, Mpho …
Tshili: Katse (cat).
Dumi: Pokola (donkey).
Lebo: Khomo (caw).
Pitso: Ntja (dog).
Mpho: Nku (sheep).

[All the answers given by pupils were correct; the teacher writes all the animals on the chalkboard in Sesotho then asks the pupils to give the animals in English. Then the

teacher points at each name and asks pupils to say them in English. Pupils did not respond.]

Monyane (1998, as cited by Mashiya, 2010) also found that learners perform poorly through the use of second language compared to first language as an MOI. In her study Monyane (1998) as cited by Mashiya (2010) reveals that the pass rate increased in Science in schools where the MOI matched the learners' home language, compared to schools in which there was a mismatch between the first language and the language of teaching and learning.

This is similar to Mgqwashu's (2007, p. 1) view that "…Africans learn best in their own languages, the languages they know from their parents, from home. It is in these languages that they can best create and innovate…".

4.3.1.2 Mathematics and Science language

The problem of language does not only relate to understanding of English based on home exposure to it. Participants claimed that "Mathematics and Science have their own language". This was noted by Matshepo in the following way:

> *Matshepo*: *Mathematics and Science have their own language which is different to the English language that we are teaching...*

Concerning the concepts used in Mathematics and Science, it was found that in Mathematics different words that can mean the same symbol are used interchangeably. It was evident from teachers' responses that sometimes the concepts in Mathematics confuse pupils. This was noted by Thabo:

> *Thabo: Sometimes when teaching addition in Mathematics, there is communication breakdown because of pupils' misunderstanding of the concepts ... in Mathematics there are some words which are used interchangeably, such as + sign, which can refer to sum of, plus, add to, and the total of.*

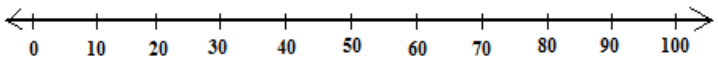
In Science subjects, one participant asserted that sometimes they had problems in explaining the terms used. This was stated by Lineo as follows:

Lineo: The problem pupils encounter are the terminologies that are used in Science; pupils do not understand them and they are sometimes difficult for us to explain ...

The data reveal that Standard 4 pupils struggled with language and understanding of concepts when learning Mathematics and Science subjects in their second language. It also shows that even teachers were not confident enough to explain the terminology. It is more stressful for the pupils to understand a concept especially if, at the same time, the teachers are struggling to make Mathematics and Science concepts comprehensive for second-language pupils. In this case it seems that these teachers do not have an adequate grasp of the subject matter, and thus are unable to explain the terms found in the two subjects.

It was evident from the Mathematics and Science lesson observations that participants did not clearly define the terms or the concepts well, so that pupils could understand what they were expected to do. This resulted in pupils not participating when they were asked oral questions. Even when the teachers tried to translate their questions into Sesotho, few of them participated.

In a lesson observation one of the participants (Matshepo at Mafume Primary School) was teaching numbers in Mathematics under the subtopic rounding off whole numbers to the nearest hundred. Below is an example of an extract from the lesson. Teacher drew a numbered line from 0 to 100, as indicated below.



Teacher: Which number is nearer to 100?

Pupils: 90.

Teacher: Only 90? What about the other numbers? [She wrote the other numbers on the chalkboard 97, 80, 60 …]

Teacher: What about these numbers? Aren't they nearer to 100?

Pule: No madam, 60 is not nearer to 100, it is far.

Teacher: Pule look, all these numbers are nearer to 100.

This observation showed that pupils did not understand the concept of "nearest number" and "round off". Furthermore, it was observed that the participants lacked skills in delivering the two subjects. This was evident from Matshepo's response, as she indicated that she dislikes the teaching of the two subjects because she is not good at delivering them:

Matshepo: ... Mathematics and Science are the subjects that I do not like because I have a problem in delivering them to others, more especially in higher classes where the terms and concepts are in English.

In support, Polaki (2004) states that Standard 4 Mathematics and Science teachers still lack understanding of mathematical and scientific concepts which are newly used in transitional class. In the same way, Shulman's (1986) theory of pedagogical content knowlege (PCK) suggest that teachers must know well what to teach and how to teach the subject. PCK is viewed by Capel and Whiteman (2010) as the distinctive body of knowledge for teaching a particular subject which makes the subject comprehensive to others.

The difficulty teachers experience in explaining Mathematics and Science terminologies and concepts is because there is no special preparation for teachers and pupils for the transition from the mother tongue (Sesotho) to English as MOI (Setoi, 1997; Molapo, 2002). Also, Carlson and Tamm (2000) perceived that everyday words may mean something else in Mathematics and Science subjects; for example, the words "average" and "divide" may be everyday words but they acquire a more precise meaning in Mathematics and Science. The next section is looks at pronunciation.

4.3.1.3 Pronunciation

Another issue that teachers experienced was related to pronunciation. It was found that pupils pronounced the terms and concepts in Mathematics and Science incorrectly. One participant claimed that the incorrect pronunciation was influenced by the way pupils pronounced the terms and concepts and the way they were written from

the lower classes. So it is difficult for pupils in a transitional class to change the way they were pronouncing some of the words. The idea is captured in the following quote:

> *Matshepo: These pupils as they are from the classes where everything was taught in Sesotho [first language], they still pronounced most of the words in Sesotho. For example, they call a triangle "terekele" [meaningless Sesotho word that sounds close to triangle].*

The same issue was also noted by the researcher during Mathematics and Science lessons observations. Pupils' responses were in first language, trying to say or pronounce an English word. For example, in a Science lesson in one of the selected schools, pupils were asked to mention and write the five senses:

> *Teacher: Which are the five senses?*
> *Pule: Sense of semele.*
> *Teacher: Come and write the word on the chalk-board.* [The word smell was pronounced and written incorrectly - *semele.*]
> *Teacher: You are right but spelling and pronouncian are wrong.*

This indicates that the way pupils say or pronounce words has a bearing on the way they write the words. This was also noted by Lineo as follows:

> *Lineo: When doing spelling in writing, most of pupils write the incorrect spelling. They write the words exactly how they pronounced them.*

This is in agreement with the literature, as pointed out by Herbst (1988), that pupils experienced difficulties when taught in English since many of the sounds are strange and some are difficult to utter. Again, Wilson (2000) agues that pupils in Standard 4 pronounce the concepts in their mother tongue, eventually writing them incorrectly. Wilson (2000) refers to this as a "foreign talk".

4.3.2 Teaching approaches

In order to overcome the challenges mentioned above, teachers implemented different approaches that they used to facilitate effective teaching of the Mathematics and Science curriculum through second language. These included teaching and learning strategies such as code-switching, demonstrations, experiments and grouping methods. This section discusses these teaching approaches and techniques that might help other teachers to overcome the challenges Routledge & Kegan Paul discussed.

4.3.2.1 Teaching and learning strategies

In the current study teaching and learning strategies refer to methods that the participants classified as their best to use in the learning and teaching of Mathematics and Science through second language. The main strategy that was used by all participants was code-switching, followed by grouping, demonstration and then experiments.

4.3.2.2 Code-switching

Nilep (2006) and Escamilla (2007) define code-switching as a classroom practice involving the use of more than one language in order to contextualize communication. All the participants indicated that they applied the code-switching strategy. They viewed code-switching as a strategy to compensate for diminished language proficiency in the language being learnt, in order to make communication easy and to help pupils to understand the lesson taught. Thabo noted as follows:

> Thabo: *Sometimes when asking pupils questions in English they do not respond, I use code-switching to make the communication smooth.*

Participants also stated that despite the importance of teaching Science and Mathematics in English, they translated Mathematics and Science concepts and terminology into the pupils' mother tongue by explaining and making clarification in the language that all the pupils understand:

> *Matshepo: I mix Sesotho and English during the teaching process, if I found that pupils do not understand the concepts and the terminologies taught in English I used Sesotho.*

Mamosa: If I found that my pupils do not understand well on what I am teaching, I explain everything in their first language, more especially the concepts and the terminologies.

However, one participant reported that she experienced more difficulty when translating concepts and terms into Sesotho, because the Sesotho language lacks mathematical and scientifically vocabulary:

Lineo: *I do sometimes translate to clarify some of the terms, even though in some terms it becomes difficult to translate them into pupils' first language as I do not have good words to use ... for example, substances such as ' spirit' do not have the Sesotho words.*

One of the reasons why participants indicated that they used code-switching was because their classes were dull as they would be the only ones talking, especially when introducing the new lesson in second language. The participants indicated that there were times when they asked questions in English and pupils did not respond, but when asked the same questions in Sesotho most of them wanted to give the answers:

Lineo: My class becomes teacher-centred because sometimes pupils do not answer the question I pose in English. They just look at me with missarable eyes, but when I repeat the same question in Sesotho they do participate.

Mamosa: When I give them the instructions in English they do not understand or follow. I give the instructions in Sesotho and English then they participate.

This was an evident from the classroom observations too. During the first day of the researcher's observations in all three selected schools in both subjects, teachers were talking alone as they were introducing new lessons. This means that pupils were not paricipating even when asked questions by their teachers.

Below is an example of a lesson taught in Mafume Primary School by Matshepo. Her lesson topic was about dissolving: soluble and insoluble substances. In

the lesson pupils were to identify common substances which were soluble in water and those which were insoluble in water. Pupils had already collected powdered substances from their homes.

> *Teacher: In your group tell me the powdered substances that you have.*
> [There was a long pause.]
> *Teacher:* [Code-switching the same instraction into Sesotho] *Ke re le bolele lintho tse phoofo tse teng lihlopheng tsa lona.*
> [A pause but one pupil said it in Sesotho]
> *Pupil: Maize meal, phoofo.*
> [Then each group mentioned substances in Sesotho; the teacher writes all the Sesotho words on the chalkboard and opposite them writes the English words, for example, maize meal = Phoofo; powdered soap = sesepa se phoofo; potassium permanganate = makhona tsohle; sugar = tsoekere; salt = letsai; sand = lehlabathe.]
> Teacher: *Let us all read these words* [pointing to the words which were written in English; pupils in chorus read the words].
> *Teacher: Good; today's lesson is identification of substances which dissolve in water and those that do not.*
> [Pupils looked, not understanding what the teacher said.]
> *Teacher: Ke re tse kopang hantle le metsi li sa khetholohe*. [It was difficalt for the teacher to give the correct word for dissolve in Sesotho.]

Holmarsdottir (2006) states that the functions of code-switching include making the curriculum accessible to pupils, facilitating classroom management, eliciting pupils' response and promoting interpersonal communication.

In the current study all the participants alluded to use code-switching; it was evident that in all of the schools where the study was conducted, the language used by the teachers for clarity and explanation of terms and concepts was the pupils' first language. This was because the pupils did not follow the English directions in either subjects (Mathematics and Science).

> *Matshepo: If I want my lessons to continue in both Mathematics and Science subjects, I teach in both languages, that is in Sesotho and English. For each and every word or sentence I say in English, I translate it into pupils' first language or mother tongue most of the time.*

This is in line with Pandian and Revanthi (2003), that 81.8% of their respondents in Malaysia teaching Mathematics and Science used the mother tongue (Bahasa Melayu) to explain concepts when students faced problems in understanding these concepts in English. This is supported Chabana, Sebatana and Lefoka (1982), who confirm that most teachers use mother tongue to English as MOI and language of teaching and learning.

As Orton (1994, p. 137) states on the teaching of Mathematics:

> Mathematics communicated in one language might need to be translated into another to allow thinking, and then would need to be translated back in order to converse with the teacher, as he observed that the language used for thinking is always likely to be the first language.

Code-switching and translation, however, could be problematic and could be affecting the effectiveness of teaching and learning. This was observed by Bowering (2003), who argues that total translation where Mathematics and Science subjects are to be taught in English defeats the purpose of teaching such subjects in English. He further claims "limited use of Bahasa Melayu (Malasian first language), in the classroom will be of great benefit in helping students meet the challenge presented by English" (Bowering, 2003 p. 23). Instead of code-switching or translation, some academics argue that teachers should maintain teaching in English. Bowering (2003) suggests that teachers should be exposed to alternative instructional approaches such as the 'Sheltered English Instruction' approach. This approach allows teachers to use simpler English and scaffolding strategies to communicate meaningful input to learners.

In the sections that follow the researcher provides data analysis as it relates to the methods that the participants used in teaching Mathematics and Science.

4.3.2.3 Grouping method

The participants indicated that they always grouped learners when teaching both Mathematics and Science lessons, since this allowed discussions in the group.

> *Thabo: When teaching Mathematics I always find out what pupils already know and then discuss with them different ways of getting the answer, from there I let them to go and work in groups or pairs.*

Matshepo also concured about using group work but stated that sometimes grouping is not effective in the teaching and learning of Mathematics:

> *Matshepo: I use grouping methods when teaching both subjects, although sometimes grouping method does not work as you may find that sometimes there is no communication in a group, only group leaders do the work.*

The participants grouped learners or let them work in pairs in order to assist each other. This was not easy because learners did not talk when the instructions were in English. Activities were given in the second language, in which the terms and terminology were not clear to most of the pupils.

This is in line with what the researcher observed during the lesson observations in both subjects (Mathematics and Science). In Matshepo's class, the researcher noticed that the lesson was not clear from the beginning. The teacher used telling methods in the introduction part of the lesson. She did not interact with pupils in order to find out how much they knew about the topics to be taught. Thereafter, in the development part of the lessons, she asked pupils to work in groups, where the researcher observed that only the group leaders were working. In the other two schools it was different, because the pupils were communicating. An obvious difference was that teachers in Wendy and Rorisang Primary School introduced the lessons by interacting with pupils and linking pupils' knowledge from the known to the unknown, and then let them work in groups.

For example, in Matshepo's class (Mafume Primary School), she did not interact with pupils; she just asked them questions without finding how much they knew about

the concept ‘round off’. She just drew the number line and demonstrated without explaining. She was teaching numbers to the nearest hundred using the number line that she drew on the chalkboard.

Matshepo: Which numbers are nearer to 100? Lipalo tse pela lekholo.

Pupils: 90 and 80.

Teacher: You are right, but they are not the only numbers which are nearer to 100. 90 is nearer to 100 because we just move one step to 100 rather than 40. So when writing 90 to the nearest 100, we write it like this: 90 to the nearest 100 is 100; 40 to the nearest 100 is 0. In your groups go and write the following numbers to the nearest 100:

A) 68 B) 49 C) 70 D) 30

In Thabo’s class at Wendy Primary, the teacher was teaching angles where pupils were to identify right angles. He explained the concept of right angle by giving pupils different examples found in their classroom, and interacted with them by asking them questions. The pupils took time to answer and answered in their mother tongue, before he gave them work. He conducted his lesson as follows:

[The teacher gave pupils objects such as matchboxes, rulers, books, set squares, protractors. He took a ruler and a set square]

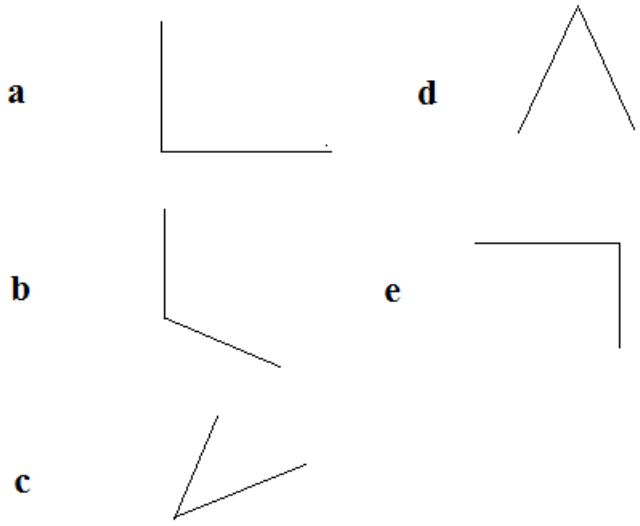
Teacher: Look at the corners of these objects. Which object has a corner that is made of horizontal and vertical lines?

Pupils: Ruler.

Teacher: Which object has corners joined by sloping lines?

Pupils: Set square.

[Then the teacher explains the concept of right angles showing pupils objects that have right angles such as doors, blackboards, and in-boxes. He then divided them into groups and drew different shapes and asked them to identify right angles. The shapes are presented below.]



The decision of participants to use grouping is commendable, as indicated by Gillies and Ashman (2003), who maintain that tasks are completed more easily in a group than individually. Grouping is related to cooperative learning. Cohen et al. (2004) refer to cooperative learning as a pedagogical practice which promotes learning, higher-level thinking, pro-social behaviour, and greater understanding of children with diverse learning, social and adjustment needs. On the other hand, Gardner (2001) states that group learning aids in the development of social skills like communication, presentation, problem solving, leadership, delegation and organisation, and develops interpersonal intelligence. The fact that pupils in the groups were silent is in line with Osaki (1991), who argues that pupils with limited proficiency in English would contribute minimally in class discussions.

4.3.2.4 Demonstration method

One of the methods employed by participants was demonstration. Fraser et al. (1993) refer to demonstration as the carrying out of actions by a capable person. Participants say they use demonstration in both Mathematics and Science subjects. Said Lineo:

> *Lineo: I always use demonstration as in Science I used to demonstrate first before I can give the pupils any activity to do.*

During the lesson observations the researcher observed that teachers showed pupils what they expected them to do and how to do it, so that pupils would discover

concepts and find the answer themselves during their activities. Teachers wrote the tasks on the chalkboard and demonstrated to pupils how to work out the problem. Here is an extract from a lesson on equivalent fractions taught by Mamosa at Rorisang Primary School. Pupils were to convert equivalent fractions, the denominator being not greater than or less than 10.

Teacher: Here is a piece of paper, I can divide it into two equal parts and it will give us half, when I fold it again into two it will make another half, this means half is equivalent to two fourths. That is ½ = 2/4.
Teacher: Come in front Mpho and complete this, ½ = /6.
Mpho: 1/2 = 2/6.

Teacher: It is not correct Mpho, ½ is equivalent to 3/6.
Teacher: Draw the shape on the chalkboard and divide it into 6 equal parts then shade 3, this is how you can find the answer, 3 are shaded and 3 are not, so altogether there are 6 pieces.
Teacher: Then complete this and tell how you get the answers, ½ = 2/4 = 3/6 = /8 = /10 = /12.

It was observed that pupils had difficulties in explaining how they got the answers. They were only giving answers; some were wrong, while others were correct, but they were unable to show the steps and how they got answers. This was also observed by Loomes and Shafarenko (2001), who argue that learners of Mathematics and Science should be able not only to solve problems, but also to explain their answers or show their workings. This could be credited to difficulties with the second language that the pupils were unable to explain their working.

4.3.2.5 Experiments

Teachers further indicated that experiments were one of the methods that they commonly used, especially in Science. This is what Lineo had to say:

Lineo: Science is an experimental subject, pupils learn by seeing the reality and it is about nature.

Furthermore, Mamosa indicated that since she had become a Science teacher, she experienced that pupils learn better by doing and observing the reality. This is what she said:

> *Mamosa: I experienced that pupils learn better by doing. It is better to let pupils perform experiments or improvise, as they will not forget what they have done.*

Mathematics and Science are practical subjects where pupils are expected to learn by doing, observing and concluding. Since Mathematics and Science involve abstract concepts, teachers normally use materials and objects to simplify them to pupils. If the real materials are not avaliable, they improvise or let pupils do so. This is supported by Fraser et al. (1993, p. 160), who affirms that experiments uses objects during teaching and learning. Therefore pupils gain insight by means of direct observation through their experiments.

Also, Mathematics and Science make use of pupils' experiences to make concepts understandable to them. Moore (1999) observes that in constructivist learning, students come to class having a wide range of previous learning and experiences which enable best learning to occur when information is made meaningful.

4.3.2.6 Techniques that might help other teachers to overcome the challenges

On the question of which techniques teachers use for the effective teaching of Mathematics and Science, Mamosa reported that she integrated Mathematics and Science with English in some other topics, so that when teaching Mathematics and Science pupils would be able to link the concepts or the terms with the English words they have already learned:

> *Mamosa: As I am teaching the core subjects, I always make sure that I first look at the topics that are similar in the different learning areas. For example, in Mathematics, Science and English, and then integrate them so that I will use the same vocabulary in teaching Mathematics and Science.*

By integration of subjects, participants want to make it easy for pupils to see the concept as one and associate it with the correct term and spelling. This is in line with Good and Brophy's (1997) suggestion that effective learning occurs when learners can create meaning by linking new information to what they already know.

An other issue is to take pupils away from the pressure of schooling or learning, by creating a relaxing atmosphere of play. This was suggested by Thabo, who stated:

> *Thabo: Mathematics is just a game so pupils must use whatever they can to get the answer, so when teaching I first let them find features and the concept by themselves. Then after that I introduce the concepts to them.*

As pupils find solutions to problems in a game, they discover meanings to the complex concepts. This is supported by Lambert and McCombs (1998), who maintain that relevant and meaningful constructive learning engages learners in creating their own knowledge and understanding, by connecting new learning with their prior knowledge and experience. This is supported by Gillespie (2002) who asserts that idea of knowledge construction by pupils through their use of prior knowledge and experience assists them to shape meaning and acquire new knowledge.

Furthermore, the participants stated that both subjects are natural, and that Mathematics is done in daily life while Science is a seasonal subject and needs to be taught seasonally. Lineo pointed out that it is very important to select the Science topics seasonally:

> *Lineo: When planning, teachers should choose the seasonal topics as Science is nature, so that they can teach the lesson when the materials are available. For example, the teaching of the flowers, it should be done in summer.*

This indicates that teachers should plan for the whole year. In this case, they will plan to teach seasonal topics under favourable conditions. The next section discusses types of assistance experienced by participants in teaching Mathematics and Science.

4.3.3 Support

In teaching transitional classes, participants faced a number of challenges that were different from those experienced in other classes. Therefore, they should receive

assistance in overcoming their problems. Support in teaching Mathematics and Science in transitional classes could be obtained from the Government, school management, fellow teachers and parents.

One of the participants generally alluded to the support that they expect from different stakeholders:

> *Lineo: If the Government, the school and the parents work hand in hand, teaching will be effective. We need support from all the three parties to work well as teachers. You know, education is like a three-legged pot where a pupil is 'cooked', meaning taught. If the legs are strong, giving support to the pot, the teaching will be effective and efficient.*

The analogy illustrated by Lineo is presented below:

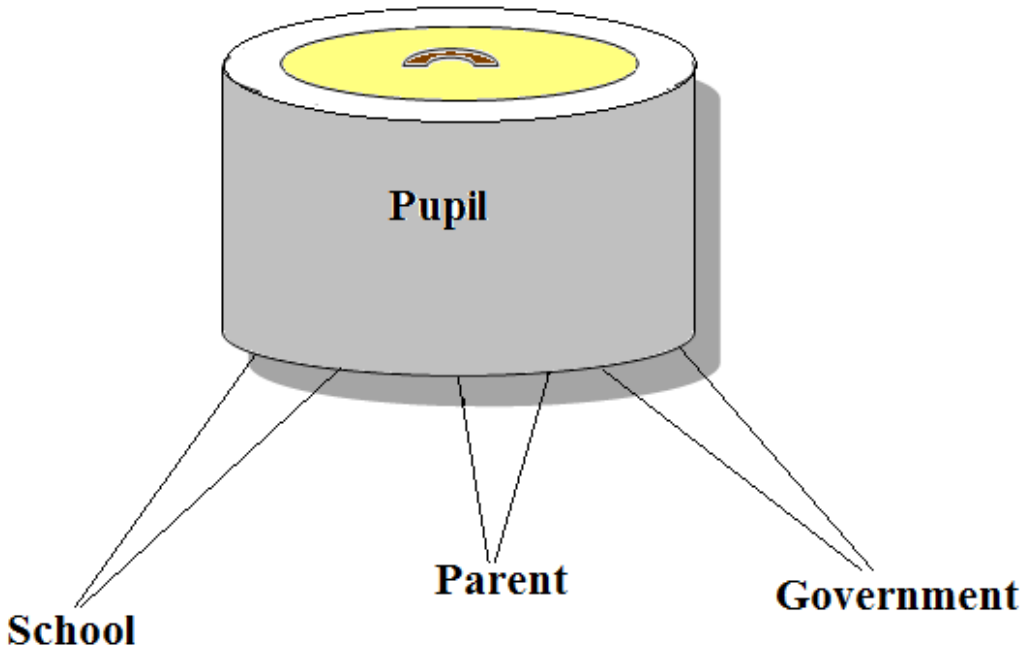


Figure 4.1: Support for effective education, as expounded by Lineo

Parents play an important role in the education of their children through their involvement in their learning. The ability of parents to support schooling of their children facilitates or undermines the teaching and learning of subjects. From the current study it is seen that it is difficult for the parents to be involved since some of them are illiterate. This was also noted by Prinsloo (2007), who argues that there is a lack of parents' involvement in the children's learning process to ensure successful

teaching and learning. Similarly, Lowe (2007) notes that many parents in the rural areas are not able to contribute to their children's school learning because they are illiterate. This means that teachers rely more on support from Government and the school. The next section discusses the support that the participants receive from the school.

4.3.3.1 School support

On the question of what support the participants receive from all involved parties in education, three of the participants indicated that they requested and received support from their colleagues. The first comment is from Thabo:

> *Thabo: Yes I do get assisstance from the staff about the topics which I encounter problems with. From the Ministry ... [shakes his head], I do not think there is any support, because I have never been in any Mathematics and Science workshop.*

The second comment, from Lineo, confirmes that teachers do assist each other in teaching Mathematics and Science:

> *Lineo: Yes we do help each other; if I have a problem I ask for assistance from other teachers. The Ministry of Education does not help us.*

Mamosa concurred that they help each other and there is cooparative teaching. The exception was in Matshepo's school, where she claimed that there was no team work. She further said that in her school, workshops were attended by the principal only. Although the principal gave them feedback, her claim was that as Mathematics and Science teachers they needed the opportunity of attending workshops concerning teaching these two subjects:

> *Matshepo: We did not help each other as teachers; when there is workshops, only the principal goes regardless of what the workshop is about. I think the workshops could help us as we will be retrained for the teaching of Mathematics and Science.*

School management plays an important role in teaching and learning, especially of Mathematics and Science subjects. Teachers will get assistance from the office and from staff members through the guidance and encouragement of the principal. Teachers of Mathematics and Science can also be supported by training and professional development. This is linked to Fraser-Thomas and Beaudoin (2002) perception that lack of professional development as well as lack of administrators and consultants impedes teachers' efforts in delivering the curriculum. In addition, Fullan (1991) argues that administrators' support infuences quality delivery of the curriculum in the classroom. For quality delivery of the curriculum, school administrators need support from the Government. The next section discusses what support the participants receive from the Government.

4.3.3.2 Government support

Although the educational administrators' support is critical for the successful delivery of the school curriculum, the participants reported that they did not get support from the Ministry of Education.

> *Matshepo: We did not get any support from the Ministry of Education. We are far from the education offices and they do not visit us to share with us the problems that we have in the field. Since I am teaching in this school I did not see any distance resource teachers as they are the ones to help us.*

> *Thabo: Yes I do get assisstance from the staff about the topics which I encounter problems with. From the Ministry ... [shakes his head], I do not think there is any support, because I have never been in any Mathematics and Science workshop.*

> *Lineo: Yes we help each other; if I have a problem I ask for assistance from other teachers. The Ministry of Education does not help us.*

Two issues emerged from the data, the first being that schools in the remote rural areas are not supported by the Government. The Government through the Ministry of Education concentrates on urban schools in townships and cities. The second issue is

that some principals do not send their teachers to workshops where they will be supported. For example, Matshepo's principal attended workshops which were meant to support Mathematics and Science teachers, while she was not teaching those subjects. The support of teachers is crucial in teaching and learning; Darling-Hammond (1997) argues that without support for teachers, the implementation of the curriculum is a certain failure. Teachers use different strategies accompanied by teaching resources in order to implement the curriculum mandated by the Government. The next section deals with teaching and learning resources.

4.3.3.3 Teaching and learning resources

Mathematics and Science are practical subjects where activities are performed using objects. Participants mentioned that they do not have enough materials to use in teaching Mathematics and Science. Lineo stated:

> *Lineo: No, we do not have enough materials. I have said that Science is experimental, we don't have a zoo and our pupils do not tour, and the Science laboratary where we can make experiments ... we cannot burn spirits in the classroom.*

A subject like Science is difficult to teach without Science apparatus to perform experiments such as burning of substances like spirits. Some experiments need to be performed in science laboratories, or require use of science kits. Another issue to do with materials is equipment and textbooks, noted by Thabo:

> *Thabo: No, even the textbooks are not enough. I alway use the chalkboard and this wastes time ... the textbooks that pupils use are supplied by the Government, but this year they did not do so ...*

Matshepo added to the issue of equipment by alluding to infrastructure such as classrooms where they can keep pupils' textbooks, since the textbooks are currently kept at the principal's home:

Matshepo: We do not have the room where we can keep the few books that we have, so we allocate them to the pupils … and they damage them. Some of them are kept at the principal's home.

The non-existance of teaching and learning resources can hinder effective teaching and learning processes. This was also found in the studies conducted by Farrant (1977) and Coelho (1998), who indicated that there are many teaching and learning resources which help learners to acquire knowledge and help teachers to do their work effectively.

The lack of teaching and learning resources seems to impose an inconducive environment for teachers in their teaching of Science and Mathematics to novice pupils of English. One of the participants indicated that the lack of teaching and learning resources hinders the activities where learners manipulate and find things by themselves. This is what she said:

Mamosa: In both subjects pupils have to manipulate, do things by themselves, in our school we fail to train them to find things by themselves because of lack of materials.

This makes teachers struggle in making the Science and Mathematics lessons constructive because materials are the cornerstone of a constructive classroom. Pupils work successfully in groups using materials, and learning becomes more interactive and effective, with the teacher's role changing to being a facilitator when teaching and learning resources are utilised (Vygotsky, 1978; Rhodes & Bellamy, 1999).

The Ministry of Education is mandated to give support to schools and teachers for effective and efficient education of pupils. Fullan (1991) asserts that the government agencies, district, school principal and other external agencies should support teachers by providing adequate materials relevant to the proposed change. He further indicates that provision of learning and teaching materials is crucial in building skills and confidence in teachers who deliver the curriculum.

As far as the Government of Lesotho is concerned, the Educational Policy states that all primary schools under FPE depend on the Government for provision of teaching and learning resources (Mosisili, 1999). To get teaching and learning resources such as books, schools have to use the form supplied by the school supply unit (SSU) to state the number of pupils they expect to have in each class the following year. This form must be returned to the SSU at the end of every year. The teachers are also expected to indicate how many books are still in good order and how many new books the school needs for the next year. Therefore, due to the incompetence and ignorance of some of the principals, teachers do not receive resources that are due to them and hence suffer the consequences. This sometimes calls for teachers to improvise and rely on parents' support for buying of common substances such as salt, sugar, cooking oil and baking powder. In the next section parents' support is discussed in detail.

4.3.3.4 Parents' support

Support from parents and guardians is important, especially at primary schools. Parents can support teachers in different ways, ranging from materials and discipline to other areas. Participants experienced support from parents in different ways. Mamosa and Matshepo noted that parents were hiding under the notion that the education provided by Government is free, so they (parents) no longer cared about their pupils' education.

> *Matshepo: parents do not want to buy their pupils books or exercises as they said the Government would supply them with everything. They said this is free primary education.*

> *Mamosa: Parents do not support us, as there are some times that we had to ask them to buy their children the graph books and other additional books that we think can help their children to understand the Mathematics and Science subjects well, but they did not.*

Thabo added the issue of giving the pupils homework; he indicated that only those that have their brothers and sisters at high school did the homework, while the rest did not.

Thabo: I give the pupils Mathematics homework after every lesson topic so that they will get help from their parents at home, but few manage to make it.

Parents need to be educated about the issue of FPE. They need to know which areas are free and in which areas they should contribute for the education of their children. Teachers also need to be aware that most of the parents are illiterate and do not know English, since some of the homework is done in English. Therefore, they should not expect parents to do some of the tasks. This links to what Bialystok (2001) claimed for children with no command of English at all; he indicates that these pupils receive no help in doing homework which is in English, because their parents do not know English.

4.4 Conclusion

This chapter presented the findings from data collected from four participants, three females and one male who were interviewed in their schools. Detailed biographies of the participants were presented, and three schools were involved in the production of data. To reinforce the data collected from interviews, classroom observations were also carried out by the researcher. Most of the observations confirmed what the participants experienced.

The data yielded three main themes. The first theme (language) highlighted that pupils in Standard 4 do not understand the English, and as a result teaching and learning were difficult. The second theme, which is approaches and strategies that teachers used in the teaching of Mathematics and Science, discussed the techniques employed by the participants. They used learner-centred approaches since Mathematics and Science are practical subjects. These approaches include demonstration, experiments and grouping. The main challenge experienced by participants here was that pupils were not able to discuss in English during group work, since they have difficulty in communicating in this, their second language, and this affected the teaching and learning. The last theme that came up from the discussion was support to the participants. The participants noted that they did not get any assistance from the Government; much of their support came from the school in the form of their peers or fellow teachers. They also indicated that

resource materials were lacking and as such they had to improvise when teaching Mathematics and Science.

CHAPTER FIVE
CONCLUDING REMARKS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the Mathematics and Science teachers' experiences using second language at Standard 4 in primary schools. This was a case study of three schools located in the rural Leribe district in Lesotho. The themes discussed in this chapter are derived from the data, and are: challenges experienced when teaching Mathematics and Science in second language; solutions implemented by teachers to minimise and try to overcome problems posed by the language of instruction; and the effects of the practices of teachers in their classrooms. The study reveals that the teaching of Mathematics and Science in English as MOI has a number of challenges for teachers of the transitional class.

5.2 Language of instruction challenges in teaching Mathematics and Science

Standard 4 pupils had a problem with English language when learning Mathematics and Science subjects. According to the participants, there were three main areas where teachers experienced difficulties when teaching Mathematics and Science as far as language is concerned.

The first challenge was having to teach Mathematics and Science in English. It was observed from the results that if the language of teaching and learning was English, pupils were not contributing nor communicating with the teacher and among themselves. However, when the language of instruction was Sesotho, pupils answered questions from teachers and were able to do class activities in groups. This increased the pass rate. This therefore implies that use of the English language was the source of failure and problems encountered by pupils in transitional Standard 4. One of the participants blamed the challenges with the English language that pupils experience on the background of most of the pupils; she claims that teaching Mathematics and Science using English language is problematic because pupils in the rural schools are not familiar with English language speaking since they speak Sesotho at home. Also, as observed by Araromi (2005), children's use of English in Mathematics and Science

classes poses a number of teaching and learning problems, because most of the children come from homes and environments where English is not commonly used.

Besides speaking Sesotho at home and in their environment, such as in the community and playgrounds, English speaking is a new environment for pupils in Standard 4, and is their first encounter with English as the MOI. Pupils are not given a chance to aquaint themselves with this English-speaking environmen; they are expected to adapt to the new environment and at the same time learn new concepts. Using anectodal evidence, people who go for studies in Russia, China, Germany and other non-English-speaking countries are given about a year to learn the new language before they start learning whatever they want to pursue - but for these Standard 4 pupils, it is a different practice. This is why the English language acts as a barrier for pupils to understand the teaching of Mathematics and Science subjects.

According to Vygotsky (1962), language usage in the classroom is the most important process in the social constructivist setting, and language enhances learning and it precedes knowledge or thinking. One of the major reasons why pupils do not understand mathematical and scientific concepts when they are taught in English is that it is difficult for them to make connections of new concepts taught to terms or concepts already known to them. According to Freira (1985), when the pupil achieves an understanding of the object, that is made from pure experience. In this case, pupils do not have the experience of English and cannot relate to unconscious or practical knowledge because they do not know whatever they know is called in English, and as such do not have known concepts to refer to. Also, there is a lot of translation taking place in their minds, since the language used for thinking is always likely to be the first language, Sesotho (Orton, 1994). Sometimes the concept does not have a Sesotho name since the Sesotho language is limited and some Mathematics and Science terms are unique; then it is difficult to built a new concept. If the concept is available in Sesotho, the pupil will still face a challenge, since the pupil thinks in Sesotho; the concept is translated into Sesotho to allow thinking, and then translated back into English in order to converse with the teacher. This translation takes place because effective learning occurs when learners can create meaning by linking new information to what they already know (Good & Brophy, 1997).

The language problem that pupils encounter is aggravated by some teachers who are not conversant with the concepts of Mathematics and Science themselves. The situation at primary schools where teachers are expected to teach all subjects could be a disadvantage. The curriculum at high school is such that some learners graduate from high school without doing Mathematics and Science, just Mathematics Literacy and Natural Sciences. When these high school graduates train as teachers, they are forced to teach those subjects they did not themselves complete or enjoy at high school. This is why Standard 4 Mathematics and Science teachers still lack understanding of Mathematical and Scientific concepts (Polaki, 2004).

5.3 Solutions to language challenges

Trying to minimize the problem of misunderstanding of Mathematics and Science concepts by pupils, participants employed a variety of techniques. Some of them used different teaching methods, all used code-switching, and most also used the mother tongue (Sesotho) for teaching Mathematics and Science.

5.3.1 Teaching strategies and materials

Mathematics and Science are practical subjects, where pupils are expected to learn by doing, observing and discovering. Hence teaching and learning methods for teaching these subjects should be practical orientated. One of the participants alluded to this idea when she said: “I experienced that pupils learn better by doing” (Mamosa). The best teaching methods for these subjects are where pupils complete activities and there are multiple channels of communication (Cohen et al., 2004). Communication is the major issue in education; according to Dewey (1938) communication is the process of sharing experience until it becomes a social possession. As pupils communicate and share ideas with the teacher and other pupils, effective learning is taking place. According to Vygotsky (1962) social interaction and cultural influences have a huge effect on a student and how learning occurs. The group work strategies and experiments performed in Mathematics and Science are an example of cooperative learning, which is an integral part of deeper understanding (Vygotsky, 1962).

Since Mathematics and Science involve abstract concepts, teachers normally accompany the variety of teaching strategies with the use of materials and objects. Both

Mathematics and Science subjects are natural subjects. Mathematics can be taught using a number of objects found naturally and in everyday life situations. Science is a seasonal subject that needs to be planned, since some of the topics are better taught in the relevant seasons when some of the plants are growing and conditions are conducive for some animals. Materials and objects are important in assisting pupils to construct items, and this helps them to develop new concepts.

5.3.2 Support

In order for teachers to overcome the challenge of misunderstanding of pupils due to language, support is needed. Firstly, support is required from the Government in the form of workshops for teachers and materials, teaching aids and good textbooks. Fraser-Thomas and Beaudoin (2002) argue that there should be professional development for teachers in delivering the curriculum, with regular workshops for teachers to equip them with skills on how to handle transitional classes like Standard 4. This would include strategies to implement the curriculum effectively. The Government should also monitor the activities of teachers in schools by visiting and observing teachers in the classroom.

Teachers also require support from parents and guardians in the form of materials and language. Parents can provide some common substances from home for science experiments. Pupils are sometimes asked to bring to class some common substances such as salt, sugar and paraffin and parents should provide these substances willingly for the education of their children. Participants and academics argue that pupils have difficulty in language because they do not speak English in their homes. Lowe (2007) notes that many parents in the rural areas are not able to contribute to their children's school learning because they are illiterate, but parents can encourage their children to speak English with their siblings. Prinsloo (2007) advocates for parents' involvement in their children's learning process to ensure successful teaching and learning.

Therefore, support and assistance of teachers, especially those who are teaching transitional classes, are vital for effective implementation of the curriculum. Darling-Hammond (1997) observes that without the support for teachers the implementation of

the curriculum is a certain failure. Support influences quality delivery of the curriculum in the classroom (Fullan, 1991).

5.4 Effects of some practices of teachers in classrooms

Teachers are in a dilemma as far as language of instruction is concerned. On one hand, teachers are expected to implement the Government policy by using English as an MOI to teach Mathematics and Science. The Educational Policy of the Government of Lesotho states that starting from Standard 4, pupils should be taught all subjects (including Mathematics and Science), except Sesotho, in English. This implies that communication between pupils and teachers and between pupils and other pupils should be in English. Also, all materials such as textbooks, instructional materials and assessment items are supposed to be in the English language.

However, as this study has revealed, there is no effective teaching and learning when English is used as the MOI, and teachers are tempted to use Sesotho to explain Mathematics and Science concepts. The main objective of teachers for using Sesotho as an MOI is to allow pupils to understand the concepts of Mathematics and Science, and this leads to an increase in the pass rates in these subjects (Monyane, 1998 as cited by Mashiyi, 2010). On the other hand, teaching in Sesotho has some effects on pupils. Teaching Mathematics and Science in Sesotho defeats the purpose of teaching these subjects in English (Bowering, 2003). This affects pupils negatively when they meet the challenges presented by English, such as having to answer tests and examination questions that are written in English. It also slows down the progress of pupils' educational development, since they are always depending on teachers to translate for them instead of being independent. The other effect of teaching in Sesotho is that teachers might have a challenge with completing the syllabus on time, because they have to translate concepts back and forth from English to Sesotho and vice versa. A concept planned to be taught in one lesson may take two lessons or more.

5.5 Recommendations

From this study the following recommendations are proposed:

5.5.1 Language

It is recommended that the Lesotho Government should consider changing the language policy as far as the MOI is concerned. According to the policy, pupils are taught in Sesotho from Standard 1 to Standard 3 and the language of teaching and learning changes to English at Standard 4. It is therefore recommended that the medium instruction should be changed to English from Standard 1. This will help pupils when they reach Standard 4 and later classes to understand the Mathematics and Science concepts introduced.

5.5.2 Support

It is also recommended that the Lesotho Government should decentralise support services not only to districts but to villages and rural areas where they are needed most. These services include teaching and learning materials, and infrastructure such as Science laboratories and Mathematics rooms.

5.5.3 Teaching approaches

It is again recommended that subject teaching should be implemented in primary schools. One teacher at primary school is expected to teach all the subjects, even those in which they have no knowledge. The recommendation is that a teacher should teach according to specialisation. Furthermore, in-service training of Mathematics and Science teachers should be done regularly to equip them with appropriate and effective teaching and learning strategies and techniques. Since Mathematics and Science are practical subjects where pupils need to be doing activities, Mathematics and Science teachers should be given skills and be encouraged to use strategies that go along with child-centred approaches.

5.6 Conclusion

The experiences of teachers in transitional classes of teaching Mathematics and Science are summarised in terms of challenges in language of teaching, techniques in minimizing the challenges and effects of some techniques on pupils. The challenges include using the foreign language to teach pupils that are encountering the English

language for the first time, since it is not normally used in their homes. Pupils are forced to learn both the English language and Mathematics and Science concepts simultaneously, and this poses problems to them.

Teachers employ several techniques to help pupils to understand concepts and hence improve the pass rate in Mathematics and Science subjects. These include varying teaching methods and code-switching, while some teachers teach in Sesotho and disregard the Educational Policy that demands that they teach in English at Standard 4 level. Some techniques seem to work temporarily but might have negative effects on pupils in a long run. Teachers might struggle to complete the required content due to translations, and pupils may not learn the English language as quickly as they should. Teachers require adequate support from all stakeholders in order to be able to teach Standard 4 pupils effectively.

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APPENDICES

APPENDIX A: INTERVIEW QUESTIONS

Date:

Time:

Location:

Interviewer

Interviewee / Teacher Profile:

Post Level:

Qualifications:

Years of teaching:

(These questions are open ended so as to stimulate discussion)

Why did you opt for the teaching of Mathematics and Science?

Do you regard teaching of Mathematics and Science as different from teaching other subjects? Give reasons.

In Standard 4 pupils start to learn subjects using second language. How do you find teaching Mathematics and Science using second language?

What lessons or experiences have you learned about the teaching of Mathematics and Science that can help other teachers?

What are the most common problems Standard 4 pupils encounter in Mathematics and Science lessons and how do you deal with them?

Do you have any techniques that are used to effectively teach Mathematics and Science at Standard 4? Explain.

Do you have enough materials for the teaching of Mathematics and Science? Are they helpful or not? Explain.

What methods do you apply to increase understanding of learners in the teaching of Mathematics and Science?

Do you get any assistance or support from the staff, Ministry of Education and parents in teaching Mathematics and Science in a transitional class?

Do you think language plays an important role in the teaching of Mathematics and Science? How? Explain.

Is it appropriate to use English as an MOI in the teaching of Mathematics and Science at Standard 4? Why?

Do you have anything to tell us about the teaching of Mathematics and Science at Standard 4?

APPENDIX B: CLASSROOM OBSERVATION SCHEDULE

THE RESEARCH INSTRUMENT

Exploring the experiences of Standard 4 Mathematics and Science teachers in a second-language context: A case study in three selected Lesotho primary schools in rural areas

Resources: pen and exercise

Preparations**:** each subject will be observed as follows:

Teaching and learning

How the teacher introduces the lesson.

Goals and objectives clearly stated.

The teaching methods used.

The concepts are clearly understandable by the pupils.

Are the terms or concepts clearly defined?

The language used by the teacher for clarity.

Do pupils follow English directions in Mathematics and Science subjects?

Is there any interaction between the teacher and the pupils?

Do the pupils participate in answering the questions orally?

Does the teacher wait for the pupils to answer?

Does the teacher revert to mother tongue?

Resources

Charts, worksheets and/or real objects

Other teaching and learning materials

Planning of the lesson as observed through teaching

Use of variety of teaching materials and strategies, improvisation

Use of variety of teaching and learning methods group work, peer learning and or individual work Classroom-based assessment

Applicability of homework

Probing and questioning

Formative assessment

APPENDIX C: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

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Westville Campus
Private Bag x54001
DURBAN, 4000
Tel No: +27 31 260 3587
Fax No: +27 31 260 4609
mohunp@ukzn.ac.za

22 March 2011

Mrs MA Thuzini (208525413)
School of Educational Studies
Faculty of Education
Edgewood Campus

Dear Mrs Thuzini

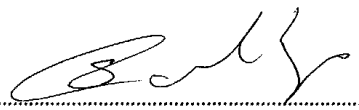
PROTOCOL REFERENCE NUMBER: HSS/0128/011M
PROJECT TITLE: An exploration of teachers' experience in teaching the standard four Mathematics and Science Curriculum in a second language: A case study in three selected Lesotho primary schools in rural areas

In response to your application dated 18 March 2011, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

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

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully



Professor Steven Collings (Chair)
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE

cc. Supervisor: Prof R Sookrajh
cc. Mr N Memela/Ms T Mnisi

APPENDIX D: INFORMED CONSENT LETTER FOR EDUCATION OFFICER

University of KwaZulu-Natal
Edgewood Campus
P/Box X03
Ashwood 3605

06 April 2011

Senior Education officer
Education Office
Leribe
340.

Dear Sir / Madam

RE: AN APPLICATION FOR PERMISSION TO CONDUCT A STUDY

I am a Master of Education student at the University of KwaZulu-Natal at Edgewood Campus. I am conducting a study on teachers' experiences in teaching the Standard 4 Mathematics and Science Curriculum in a second language, in three Lesotho Primary Schools in Leribe. I will be conducting classroom observation and teachers' interviews. This is an academic study from which teachers, principals and the Ministry of Education might benefit.

I am asking for permission to conduct this study in three schools which are under your supervision: Mafume Primary School, Wendy Primary School and Rorisang Primary School. I assure you that all the information will be used for the benefit of the study only.

The study is carried out under the supervision of Professor Sookrahj at the University of KwaZulu-Natal Edgewood Campus. Professor Sookrahj's contact details are: **UKZN Edgewood Campus; P/B X03; Ashwood; 3605; CELL: 0784517764; E-mail**

Thanking you in advance for your cooperation in this regard.

Yours faithfully
Mamzwandile Thuzini

APPENDIX E: INFORMED CONSENT LETTER FOR PRINCIPAL

University of KwaZulu-Natal
Edgewood Campus
P/Box X03
Ashwood 3605

31 April 2011

Dear Principal

Re: Permission to Conduct a Research Project in your School

I am a teacher at Liphofung Primary School and currently have enrolled for a Masters degree in Curriculum studies with the University of KwaZulu-Natal at Edgewood Campus. As part of the programme I request to carry out research in your school.

The study is on the teaching of Mathematics and Science in second language in Standard 4. The aim of the study is to find out why the two subjects are problematic and are the most failing subjects in Standard 4 upwards. This will be obtained from the teachers' experiences and the way they teach the two subjects. It is an academic study from which teachers, principals and the Ministry of Education might benefit.

The study is carried out under the supervision of **Professor Sookrahj Rashme** at the University of KwaZulu-Natal (UKZN) Edgewood Campus. I and the supervisor are the only people that will have access to the information I will gather from your school. I also would like to assure you that there is no way the information in my study would directly reflect to your school or teachers in your school, thus I will not disclose your name or the name of the school. **Professor Sookrahj's** contact details are: **UKZN Edgewood Campus; P/B X03; Ashwood; 3605; Tel: 031-; E-mail sookrahj@ukzn.ac.za**

Notes for the principals

Project title: Exploring the experiences of Standard 4 Mathematics and Science teachers in a second- language context: A case study in three selected Lesotho primary schools in rural areas

1. Respondents in this research are teachers from three selected primary schools that are teaching Mathematics and Science in Standard 4.
2. Those teachers are requested to provide information concerning their success and challenges they face when teaching Mathematics and Science in second language. Each interview session will take about 45 minutes as the intention is to have two teachers, or one for both subjects. Again five days classroom observations for each subject will be taken.
3. Your school is not going to be paid for being selected.
4. There will be the audio-tape and written recordings; the audio-recordings will be done only with the participants' permission.
5. The gathered information will be used solely for this research and when the research is done it will be destroyed.

Thanking you in advance

If you agree to offer me this permission please indicate that you are informed about the study and understand its intention by providing your signature below.
I understand the purpose of the study and hereby give consent to participate.

Name…….
Signature…… Date……

Yours faithfully
Mamzwandile Thuzini

APPENDIX F: INFORMED CONSENT LETTER FOR PARTICIPANT

University of KwaZulu-Natal
Edgewood Campus
P/Box X03
Ashwood 3605

31 April 2011

Dear Participant

I am a Master of Education student at the University of KwaZulu-Natal (UKZN) at Edgewood Campus. I am conducting study on teachers' experiences of teaching Mathematics and Science in Standard 4 using English as a medium of instruction (MOI) in three primary schools in Lesotho in the rural areas. The study seeks for the successes and challenges teachers experience when teaching Mathematics and Science in a transitional class and their approach when teaching both subjects using English as an MOI. This is an academic study from which teachers and the Ministry of Education might benefit.

As a teacher involved with the teaching of Mathematics and Science, your responses will be very useful in determining what factors contribute to your success in the teaching of Mathematics and Science curriculum as well as what factors impede in the teaching of both subjects. The results of this study will help teachers, principals and Ministry of Education officials to identify the problem that causes a high failure rate in those two subjects and what can be done to help the Standard 4 learners as they are in the transitional class.

Your participation in this study is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be established. I want to assure you that I will not disclose your name and the name of your school. All the responses will be confidential to the researcher and the supervisor only. You are free to withdraw from the interview at any time if you so wish. For any further information that you might require, please contact either myself or my supervisor at **UKZN, Professor Sookraj Rashme**, her contact details are: **UKZN Edgewood Campus; P/B X03; Ashwood; 3605; Tel: 031- E-mail sookrahjhre@UKZN.ac.za**

Notes for the participants

Project title: Exploring the experiences of Standard 4 Mathematics and Science teachers in a second- language context: A case study in three selected Lesotho primary schools in rural areas.

1. Respondents in this research are teachers from three selected primary schools teaching Mathematics and Science in Standard 4.
2. Those teachers are requested to provide information concerning their success and challenges they face when teaching Mathematics and Science in second language and how they teach. Each interview session will take about 45 minutes as the intention is to have two teachers, the one teaching Mathematics and the one teaching Science, or the 45 minutes for each subject in each school. Again five days classroom observations will be taken.
3. You are not going to be paid for participating and you do not have to pay anything for participating.
4. There will be the audio-tape and written recordings will be used, the audio recordings will be done only with your permission.
5. The gathered information will be used solely for this research and when the research is done it will be destroyed.
6. Withdrawal from the interview will not result in any form of disadvantage.

Thanking you in advance.

If you agree to offer me this permission please indicate that you are informed about the study and understand its intention by providing your signature below.

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

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT……. DATE…….

Yours sincerely

Mamzwandile Thuzini.