

The use of English and isiXhosa in teaching and learning Physical Sciences in four schools in King Williams Town education district of the Eastern Cape: A case study

By BUSANI SIBANDA

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**UNIVERSITY OF FORT HARE
FACULTY OF EDUCATION**

**Supervisor
MIKE ADENDORFF**

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DECLARATION

I, Busani Sibanda declare that this study, *The use of English and isiXhosa in teaching and learning Physical Sciences in four schools in King Williams Town education district of the Eastern Cape: A case study*, is my own work, and that all sources I have cited or used are indicated and acknowledged by means of complete references.

SIGNATURE

DATE

DEDICATION

To my beloved Wife

BONANI SIBANDA

who has supported me both morally and professionally through
hard work.

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This journey is never completed alone, and so I wish to acknowledge those who have in various ways helped me get here.

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Abstract

The present study investigates the use of English and isiXhosa in teaching and learning Physical Sciences in four King Williams Town schools. Physical Sciences educators and Grade 11 Physical Sciences learners were interviewed to find out about their perceptions with regard to the language(s) used in the learning and teaching of the subject Physical Sciences. The same educators and learners were also observed to find out their actual language practices in class. The findings revealed that English was the preferred medium of instruction in the learning and teaching of Physical Sciences, even though the majority of learners had low proficiency in English.

Both teachers and learners extensively use code-switching to bridge this language gap in order to improve the learning of content. The choice to use isiXhosa to bridge the English second language barrier was influenced by the language profile of the learners. However, even in lessons in which teachers used code-switching, the participation of learners in class discussions was very low because the delivery of the lessons was still teacher-centred.

The National Department of Education assessment policy seems to limit schools toward adopting English as the LoLT even though learners in these schools were isiXhosa first language speakers. The fact that all assessment are done in English leads to school adopting English on LoLT. Schools adopted the English only policy as way of promoting learners' learning and understanding of English, so that the learners are not disadvantaged by the English language factor when writing examinations

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Acronyms

CALP: Cognitive academic language proficiency

ESL: English second language

FET: Further Education and Training (Band)

LiEP: Language in Education Policy

LoLT: Language of Learning and Teaching

TIMSS: Trends in International Mathematics and Science Study

CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction

South Africa has eleven official languages and legally learners receive tuition in their mother tongue until the end of Grade 3. From then on teachers are required to teach through the medium of English or Afrikaans. This means that the majority of learners in the senior secondary school phase study subjects such as Physical Sciences in their second language, which is English. This has a major effect on the performance of learners in Physical Sciences.

This study is an investigation of how educators and learners use English and isiXhosa in the teaching and learning of Physical Sciences in four schools in King Williams Town. This chapter includes the statement of the problem, the research objectives and questions, the limitation of the study, a brief introduction to the methodology used, and the general overview of the dissertation.

1.2 Background

Physical Sciences as a subject is increasingly important in the lives of all South Africans due to its playing a key role in the scientific, technological and engineering development which underpins our country's economic growth and social well-being (DoE, 2007:10). For this reason it is of paramount importance that Physical Sciences should be taught in a language that is accessible to all South African learners.

South Africa is a multilingual country with eleven official languages. However, English dominates as the language of teaching and learning. Although the Language-in-Education Policy (DoE, 1997) recommends school language policies that will promote additive bilingualism and the use of learners' home languages as languages of learning and teaching as far as possible, there has been little implementation of these recommendations by schools.

Learners are initially taught in their home language in the Foundation Phase. From the beginning of the Intermediate Phase, learners are then taught in English or Afrikaans. However, the home language of the learner usually continues to play a crucial role in teaching and learning beyond the Foundation Phase. For example, in non-former Model C schools in the Eastern Cape, it is common for educators to use isiXhosa to explain important concepts and terms in Science and Mathematics to the learners.

A number of studies which have been conducted in many parts of the world (including South Africa) indicate that learners who have to switch from their home language to a different language of learning and teaching in conceptual learning areas such as Mathematics and the Physical Sciences *before they have developed proficiency in the latter language*, often struggle to grasp the major concepts in the subject. According to Abdullahi (1980), one of the impediments to effective science teaching and learning is the use of a foreign or new language as a medium of instruction.

Consequently learners in Physical Sciences classrooms not only have to learn the subject matter, but have to cope with language comprehension too. Setati, Adler, Reed and Bapoo (2002:129) state that the majority of South African teachers, especially in secondary schools, work in classrooms where English is officially the language of learning, but is not the first language of either the teachers themselves or the learners. This means that many teachers are faced with the challenge of teaching Physical Sciences through the medium of their second language, i.e. English, and learners are faced with the double challenge of understanding the subject matter while at the same time they are still learning (and possibly struggling) to be proficient in the language of learning and teaching. Lack of proficiency in the language of learning and teaching is thus a major obstacle to learners' efforts to access the complex subject matter of the Physical Sciences.

In addition, one of the major difficulties experienced by science learners is learning the *language of science* (Wellington and Osborne, 2001:1). Paying attention to language is thus very important to improving the quality of science education, and every lesson should, by implication, be a language lesson (Schaffer, 2007:5; Jaipal, 2001:2;

Wellington and Osborne, 2001:3). To do well, learners should be able to 'extend their knowledge of concepts beyond basic vocabulary and be able to engage in, and manipulate, the appropriate discourse' (Shaffer, 2007:6).

Among the many barriers to the teaching and learning of the Physical Sciences, the use of English as the medium of instruction has been identified as a central contributor to the poor academic performance of learners in the subject.

The South African national pass rate in the Physical Sciences among Grade 12 learners is very low every year, as compared to other subjects. An international assessment, the Trends in International Mathematics and Science Study (TIMSS), indicates that South African children perform exceptionally poorly compared to children in other countries (OECD, 2008). South African students performed poorly in comparison to students of the same age group from other countries (including other African countries), achieving the lowest average score of 326 points out of 800, compared with the international average of 516 (Howie, 1997:27).

In referring to the poor performance of South African learners in the TIMSS Study, Howie (2001:2) states:

...the majority of South African pupils cannot communicate their scientific conclusions in the languages used for the test (i.e. English and Afrikaans, which were the medium of instruction and are the languages currently used for matriculation examinations). In particular, pupils who study mathematics and science in their second language tend to have difficulty articulating their answers to open-ended questions and apparently had trouble comprehending several of the questions.

In referring to the poor performance of South African learners in the Senior Certificate examination, the 'Summary Report on the Evaluation of the Senior Certificate Examination' by Umalusi (Umalusi, 2004:4) states:

In 1998 the Minister of Education appointed a research team to investigate the language issue, on the assumption that learners who write the Senior Certificate examination in a language that is not their mother tongue are seriously

disadvantaged. The team concluded that language was a major factor contributing to poor performance by such learners in the Senior Certificate.

Furthermore, performance in the Trends in Mathematics and Science Study (TIMSS) in 1995 by students from the Eastern Cape Province was the lowest, compared with other provinces in South Africa. Howie (1997) points out that Eastern Cape student scored lower than the South Africa national average, with 307 points as against 326. This general trend has continued; in fact, while the Eastern Cape Department of Education recorded a slight improvement in the 2009 Grade 12 Senior Certificate pass rate, there was a huge drop in the Physical Sciences pass rate.

Language is an important tool for learning, and learning can be facilitated by having an adequate background in the language being used for instruction. On the other hand, Cummins summarises the language barrier as follows: 'the inability of these learners to pass sciences and other learning areas of high conceptual thinking is due to a lack of fluency in the language of instruction' (2000:34).

The former Education Minister, Kadar Asmal, stated that he considered the language of instruction to be a major barrier to learning, not only in the Foundation Phase, but throughout the entire system. He was quoted in *The Daily News* (June 11, 2003) as saying, 'Very soon, I shall announce the establishment of a ministerial committee to investigate the possibility of advancing towards the use of the indigenous languages as the medium of instruction in higher education.'

In the Eastern Cape, more than 86% of learners in rural and township schools are isiXhosa home language speakers, who tend to be disadvantaged by a lack of proficiency in the medium of instruction (English) used in the teaching and learning of Physical Sciences. Their lack of English language proficiency is clearly reflected in their low academic performance, and in the lack of interest shown in the learning of Physical Sciences at the upper exit level of Grade 12 (DoE, 2001).

In 2010, the then-Eastern Cape Provincial MEC for Education, Mahlubandile Qwase, in highlighting the low achievement by learners in Physical Sciences, identified language as a major barrier to the learning of the subject (Pulumani, 2010). Announcing the

results during a media briefing in East London on 7 January 2010, Qwase noted approvingly the increase in the SC pass rate for the province, from 2008's 50.6% to 51.1% in 2009 (OECD, 2010). However, he said that there were serious issues concerning the sciences, and that the 'killer' subject for 2009 was certainly Physical Science, in that 30 121 wrote and obtained a reduced pass rate of 28.6%, which represents a major drop from the 2008 results of 14.8%.

Table 1 below shows the analysis of the Grade 12 results for 2009 announced by MEC Qwase:

Table 1: Eastern Cape Province: Grade 12 pass rate per subject for 2009

Subject	No of candidates	Pass rate
IsiXhosa (home language)	56 089	100%
Afrikaans(home language)	4 652	99.3%
English (home language)	7 484	98.9%
English First Additional Language	-	89.2%
Mathematical Literacy	-	71.3%
Geography	-	68.5%
History	8 622	68.3%
Accounting	20 461	59.1%
Life Sciences	-	58.7%
Agricultural Sciences	-	51.8%
Mathematics	-	37.5%
Physical Sciences	30 121	28.6%

It can be seen that there is serious academic underachievement in Physical Sciences (compared with other learning areas) among Grade 12 learners in the Eastern Cape. What factors might have led to this underachievement? It would be foolish to focus on the language of learning and teaching as if it were the only element contributing to poor performance in the sciences.

Drawing on the work of Adler, Kebeka, Vinjevold, Kahn and Setati over the last decade, Howie and Plomp (2003) identified the following factors:

- Inadequate subject knowledge of teachers;
- Inadequate communication ability of learners and teachers in the language of instruction;

- Lack of instructional materials;
- Difficulties experienced by teachers in managing activities in classrooms;
- Lack of professional leadership;
- Pressure to complete examination-driven syllabi;
- Heavy teaching loads;
- Overcrowded classrooms;
- Poor communication between policymakers and practitioners; and
- Lack of support due to a shortage of professional staff in the ministries of education.

Other factors that have been identified as barriers to academic achievement in Physical Sciences are:

- **Poor quality of teachers** is one of the factors that contribute to poor performance in physical sciences. Ogunniyi (1996:278) points out that ‘no education system is higher than the level of the teacher. Under-qualified teachers in schools lead to a decline in achievement in physical science.’ Teachers who are under-qualified may not be well versed with the content of the subject and thus deliver lessons which are full of content errors, leading to learners not performing well at matric level. ‘Some educators are products of dismal education practices under Bantu Education, which rarely considered science education necessary for 3rd class citizens of SA’ (Mwanga-Zake, 2006:2). ‘Among 104 science educators in a Carnegie project, only 6 were graduates and 98 had studied science at Standard Grade. 20 out of 26 biology educators studied this subject to matric level’ (Mwanga-Zake, 2004:15).
- **School environments** may motivate or demotivate learners. MacDonald and Rogan (as cited in Mwanga-Zake, 1998) argue that some school environments demotivate learning. Schools which have no laboratories (or have poorly equipped laboratories) and whose buildings are dilapidated act as a learning barrier. A well-equipped laboratory would arouse the learner’s interest to investigate and explore, and hence perform better in the subject.

- **Teaching ‘about’ experiment** is another contributing factor to poor performance. The Physical Sciences matriculation examination does not have a practical paper, which means that a learner can pass matric without ever experiencing a practical activity (Muwanga-Zake, 1998). This author points out that ‘learners are fed with truths about practicals. That is, educators model reality for learners and set problems for learners to solve.’ In some schools, science equipment is lying untouched in the laboratories because teachers are not able to use it. The teachers are not even keen to learn how to use the equipment because they are afraid to appear ‘stupid’ if the equipment ‘fails to work’. Learners are just shown what the equipment looks like. This is a clear demonstration that most of the concepts in the subject have a ‘foreign connotation’.

- **Practicals which do not have clear objectives** also contribute to under-achievement in the subject. Most of the practicals in textbooks do not outline the objective of the practical activities; as a result teachers just carry out these practicals with the sole objective of proving laws and theories. However, these experiments have no relevance to the student’s immediate surroundings, and as a result the student’s critical thinking is not developed. White (1996:761) points out there ought to be clear goals of laboratory teaching.

- Another factor which has an effect on academic performance in the Physical Sciences is the **learners’ attitude** towards the subject. According to Howie, other factors that impact on children’s ability to succeed at Mathematics and Science include learners’ personal aspirations and peer attitudes, classroom factors such as teachers’ competence and qualifications, learner access to computers, and factors that operate at school level such as leadership, efficient school administration and time on task.

However, in *this* investigation the researcher zeroed in on the language factor.

The researcher decided to research how teachers use English and isiXhosa in teaching Grade 11 Physical Sciences in schools in the King Williams Town District in the Eastern

Cape Province. According to the Education Foundation (1994:130), in the Eastern Cape '86% of people speak Xhosa and mostly study English as a second language at school,' yet Physical Science is taught mainly through the medium of English and Afrikaans.

Some strategies to address the problem

As a response aimed at addressing the problem, the Department of Education established the Dinaledi schools in all provinces. The primary objective of the Dinaledi School project is to ensure that selected schools are supported to significantly increase the participation and performance of learners, especially African and girl learners, in Mathematics and Physical Science (Department of Basic Education, 2011).

Dinaledi is a programme implemented in 2004 by the Department of Education to develop secondary schools as centres of excellence in the teaching of mathematics and science. In 2006 Dinaledi II was launched, with the purpose of identifying learners who are talented in Mathematics and Science. Four hundred public schools all over South Africa are involved in the programme. The aim is to double the number of African students achieving university entrance passes in Mathematics and Science by 2009. Teachers are also being tested, trained and incentivised to keep them in the system.

Other strategies that were adopted by the Department of Education include: bringing in a cohort of foreign Mathematics and Science teachers as a short-term measure to address the critical shortage; re-hiring qualified Mathematics and Science teachers who left teaching with the severance package system; and putting in place a comprehensive bursary programme to encourage young people into the teaching profession (Zenex Foundation, 2007:12).

The Zenex Foundation has also come on board in contributing to Mathematics, Science and language education. The Zenex Foundation (2006) agreed to commission the development of an English programme for Grades 10 and 11 that is similar in nature to the Dinaledi Mathematics and Science programmes. A programme for English First Additional Language has also been developed by the Institute for the Study of English in Africa (ISEA) at Rhodes University, together with a 36-week work schedule that guides

English teachers through the curriculum. The materials have been uploaded to the Thutong website for the benefit of all schools.

1.3 Statement of the problem

As indicated in the previous section, a high percentage of South African learners are significantly underachieving in Physical Sciences, and the problem seems particularly serious in the Eastern Cape Province (Howie, 1997). There is a common belief that the language of learning and teaching (LOLT) has a significant effect on learning in the Physical Sciences. In addition, a number of studies have pointed to the importance of the LOLT as a factor in determining levels of performance in the sciences (Abdullahi, 1980; Schaffer, 2007; Jaipal, 2001; Wellington and Osborne, 2001). However, the LOLT used in most rural and township schools in the Eastern Cape is English, which is not the mother tongue of the majority of these learners, who are of isiXhosa-speaking background.

The government selected some schools to implement the Dinaledi project so as to ensure that these schools are supported to significantly increase the participation and performance of learners in Mathematics and Physical Science. However, while there has been an increase in the number of learners passing Physical Sciences in Dinaledi schools between 2009 and 2010, according to the Department of Basic Education, the number of students writing Physical Sciences in Dinaledi schools has declined since 2008.

The Department of Education, sometimes in partnership with other organisations, has also implemented other intervention strategies aimed at improving Physical Science results. For instance, science educators from other countries have been invited to facilitate the teaching and learning of the subject in schools. However, according to Howie (2001), it is best for learning and teaching to take place in the language which is best understood by the learner; yet it does not appear that these interventions have focused much on the question of the medium of instruction. Despite various

interventions, both TIMSS and national Senior Certificate (Grade 12) results indicate serious academic underachievement in Physical Sciences.

There is therefore a need to investigate educators' and learners' perceptions of the effect of the use of both English and isiXhosa on the learning and teaching of Physical Science.

1.4 Research Objectives

- 1.4.1 To investigate educators' and learners' perceptions of language use, including code-switching, in the learning and teaching of Physical Sciences.
- 1.4.2 To observe the use of the second language (English) as the language of learning and teaching (LOLT) in Physical Sciences classrooms.
- 1.4.3 To draw, from this study of the use of language in the learning and teaching of Physical Sciences, lessons that may improve practice.

1.5 Significance of the study

It is hoped that the outcomes of this study will eventually come to inform language practices in relation to the language of instruction appropriate for the teaching of Physical Sciences at the FET level. The study is important in the sense that it can help education policy makers to draft intervention policies targeting not only the content of Physical Sciences but also problems associated with the official language of learning and teaching.

1.6 Rationale of the Study

Findings on the low performance of South African high school learners in Physical Sciences compared with other Learning Areas have led the researcher to develop a keen interest in this topic.

The Department of Education has introduced various recovery strategies in Physical Sciences to support and motivate learners. However, these intervention strategies do not seem to be very effective (especially in the Eastern Cape), since performance is still very low when compared with other learning areas.

Because the language of learning and teaching is held to be a crucial factor in learner performance in subjects like the sciences, there is a clear need to investigate in some depth the role that language plays in the teaching and learning of Physical Sciences, as experienced by both educators and learners.

1.7 Scope/Delimitation of the study

This study will focus on FET Band (Grade 10 – 12) Physical Sciences teachers, as well as selected learners who take Physical Sciences as a subject, at two rural secondary schools about 15 km from King William's Town, one Dinaledi school in Dimbaza township (about 15 Km from King Williams Town) and one township school in the King Williams Town peri-urban townships. The assumption is that while most of the learners at these schools come from homes where isiXhosa is spoken as a home language, English is used as the medium of instruction at their respective schools.

1.8 Definition of key terms

1.8.1 Learning

This is the process of acquiring knowledge or skills through study, experience or teaching. It is a process that depends on experience, and leads to long-term changes in behaviour potential (ExSEL, as cited in Olugbara, 2008).

1.8.2 Mother tongue (MT)

Mother tongue is the language(s) that one has learnt first; the language(s) one identifies with or is identified as a native speaker of by others; the language(s) one knows best and the language(s) one uses the most (DoE, 2005).

1.8.3 Home language

Home language refers to the language that is spoken most frequently at home by a learner (DBE, 2010).

1.8.4 Language of Learning and Teaching (LOLT)/ Medium of Instruction

This is the language that is used in teaching/learning. It may or may not be the official language of the territory (Olugbara, 2008).

1.8.5 Code-switching

Code-switching is often used in English second language (ESL) classroom situations and involves going from one language to another in mid-speech when both speakers know the language (Cook, 1991:63; Milroy and Muysken, 1995:7) this requires teachers to be fluent in the learners' first language as well as in English.

1.9 Research Questions

1.9 .1 Main Research Question

How do educators and learners use isiXhosa and English in the teaching and learning of Physical Sciences in the FET phase?

1.9.2 Sub-questions

- a) What are the educators' and learners' perceptions of the use of isiXhosa and English in the teaching and learning of Physical Sciences?
- b) How are languages (in particular LOLT) actually used in the Physical Sciences classroom?
- c) What can be concluded from educators' and learners' perceptions and use of languages in the Physical Sciences classroom?

1.10 Methodology

1.10.1 Research Paradigm

In this study, the researcher adopted the interpretivist research paradigm, which takes seriously the interpretations and self-interpretations of social actors. This was a suitable paradigm because the study needed to draw primarily on educators' and learners' experiences and opinions of their own practices in the Physical Sciences.

1.10.2 Overall Methodology

The overall approach was qualitative. This approach was relevant because the researcher wanted to understand how Physical Sciences educators and learners experience and feel about the use of languages in the learning and teaching of this subject, and why they feel that way.

The researcher used case studies which provided an in-depth understanding of problems associated with teaching and learning Physical Sciences through the medium of a second language. Hofstee (2006) points out that case study are useful when detailed knowledge is required of any particular case, for whatever reason. In this study, detailed knowledge of both the learners' and educators' language practices had to be explored.

The cases in this case study were two rural schools and two township schools in the King William Town District. Within these schools, teachers who teach Physical Sciences from Grade 10 to 12 and learners in their classes formed part of the case study. These teachers and learners were interviewed on their experiences and perceptions of, and feelings about, language practices in the Physical Sciences class.

The researcher also conducted class observations so as to observe how educators and learners actually used languages in the learning and teaching of Physical Sciences so as to confirm (or disconfirm) the perceptions of respondents.

1.10.3 Data Collection Method

Since this research is an interpretivist case study focused on educators' and learners' perceptions of the effects of their own respective teaching and learning practices, the data collection method used was semi-structured interviews and class observations.

1.10.4 Data Analysis Approach

Since interviews were used in this research, the qualitative data from the interviews was coded. Coding is a procedure that disaggregates the data, breaks it down into manageable segments, and identifies or names those segments (Schwandt, 1997).

The qualitative data were analysed by means of content analysis. Content analysis is a method that involves comparing, contrasting and categorising data in order to draw meaning from the data (Gall *et al.*, 2007).

1.11 Overview of the Study

Chapter 1

This chapter provides the introduction, background to the study, nature of the problem, problem statement, and objectives of the study, significance of the study, research questions and a brief introduction to the methodology used.

Chapter 2

Chapter 2 will consist of the literature review. It will discuss the literature on the implications of the use of second language as a medium of instruction for the teaching and learning of Physical Sciences. The chapter will also discuss views on the contentious issue of code-switching, and will also discuss the specialised language of the Physical Sciences. Finally, it will attempt to develop a theoretical framework within which research decisions and data analysis will be undertaken.

Chapter 3

Chapter 3 will discuss the research methodology, research paradigm, data collecting techniques, sampling and ethical considerations.

Chapter 4

This chapter will present the collected data and analysis of the data.

Chapter 5

Chapter 5 will provide a summary of the findings, draw conclusions and provide recommendations. The chapter will also give suggestions for future research.

1.12 Conclusion

Chapter 1 has provided an overview of the study. The next chapter focuses on the literature review and theoretical framework.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The low pass rate in Physical Sciences among Grade 12 South African learners has been blamed on several factors. Many researchers who have researched the possible causes of this serious underachievement in Physical Sciences have pointed out a number of different factors as the barrier to academic underachievement. These factors have been discussed in the Background section. Since this research is focused on language issues as a factor, this literature review will explore debates around:

- (i) the use of a second language (e.g. English) as a medium of instruction in learning and teaching Physical Sciences,
- (ii) the specialised language of Physical Sciences and
- (iii) code-switching.

The language of teaching and learning has been identified by some researchers as one of the factors that contribute to academic underachievement in the Physical Sciences. Literature reveals that Physical Sciences is not generally easy for learners learning the subject through their second language as a medium of instruction, partly because of the specialised science terms (non-technical terms) that usually have a different meaning to the ones they are understood to have in day-to-day activities. Non-technical vocabulary refers to terms that have one or more meanings in everyday language, but which have a precise and sometimes different meaning in a scientific context (Cassels and Johnstone, 1985).

For example, the terms 'power', 'force', and 'energy' are taken to mean the same thing to an isiXhosa mother tongue speaker, but in Physics these words denote different physical qualities. Thus one of the barriers to effective science teaching and learning appears to be the use of a second language as a medium of instruction. Language is an important tool for learning, and learning can be facilitated by having an adequate background in the language being used for instruction.

Lemmer and Squelch (1993:4) argue that language is a critical means of gaining access to important knowledge and skills, it is the key to cognitive development, and it can promote or impede scholastic success. From this it can be seen that language is a means of getting to know the world, besides being just a means of communication. Smith and Ennis (as cited in Garegae, 2008) point out that in schools 'language is both the instrument and the vehicle of teacher-student interaction.'

Researchers in the United States (Rosenthal *et al.*, 1983; Fernandez and Nielsen, 1986; Portes and Schaufliker, 1994; Schmidt, 2001) and in Hong Kong (Cheung *et al.*, 2003) have emphasised differences in medium of instruction and language ability as a primary determinant of the gaps in educational performance. For example, Fernandez and Nielsen (1986) find that Mexican-origin students in the United States who do not speak fluent English are at a serious disadvantage in school.

It can thus be concluded that a learner will learn more effectively in a language he or she understands and commands. In the Eastern Cape (and in South Africa as a whole), the medium of instruction from the Intermediate Phase is either English or Afrikaans, yet for the majority of Eastern Cape educators and learners, their mother tongue is isiXhosa, which means that a majority of learners are probably experiencing some learning difficulties.

2.2 The role of language in science learning and teaching

According to the South African Census (2001), English as a home language is spoken by only 8.2% of the population, yet English has become 'the major language of communication for business, government and education' (Singh, 2009:285). This means that the majority of learners are being instructed in a language that is not their home language by educators who may not be proficient in the medium of instruction.

As a consequence, an overwhelming number of learners are being taught in a language other than their home language (Wildsmith-Cromarty and Gordon, 2009:361; Uys, Van der Walt and Botha, 2005:322), and often by teachers not adequately prepared to teach

through the medium of English (Evans and Cleghorn, 2010:147; Foley, 2002:54; Heugh, 2009:97; Sookrajh and Joshua, 2009:334).

The importance of English in the classroom implies that teachers must have a very good command of the medium of instruction (English) to ensure that effective teaching and learning take place (Mafisa and Van der Walt, 2002:23). However, studies that have been done by other researchers indicate that learners are not the only ones who have low proficiency in English; a majority of teachers as well do not have a good command of English, which is the LoLT in most public schools.

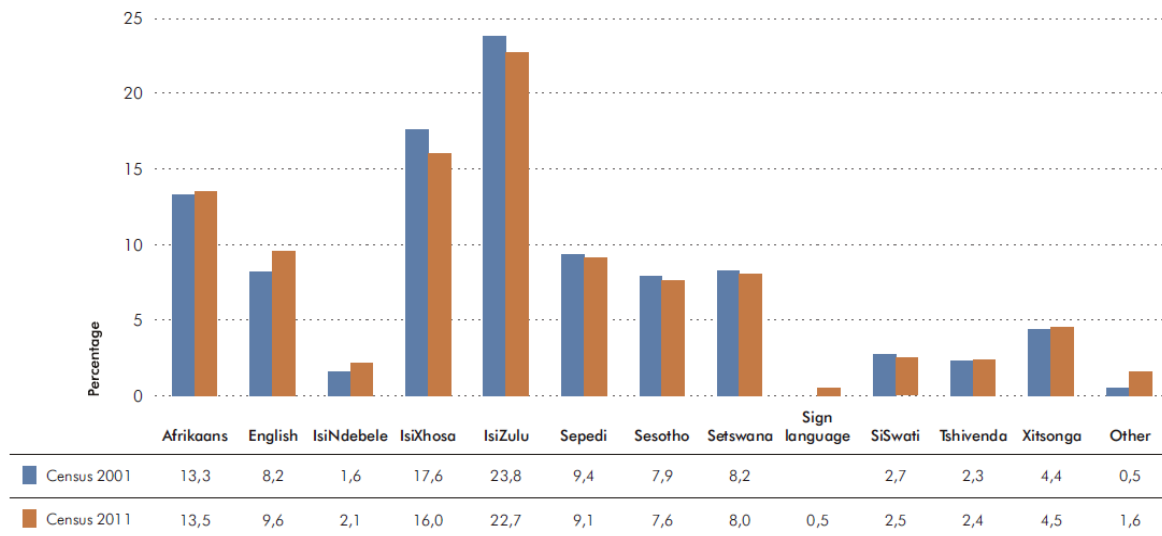
In her study, De Klerk (1995:8) interviewed several teachers on language matters in their schools. Teachers admitted that they could not help their learners as they were not proficient in English themselves and experienced difficulties in understanding reading material prescribed for their learners.

The lack of adequately proficient teachers to teach through the medium of English has been cited as one of the major barriers to effective learning by several researchers, (Pluddemann, 2002:48; Uys *et al.*, 2007:69; Sookrajh and Joshua, 2009:334; Evans and Cleghorn, 2010:141; Hugo and Nieman, 2010:61).

The statistics for South African Census (2011) also showed a similar trend to the statistics for Census 2001 with regard to English as the main medium of instruction in schools, although it is spoken as a home language by only 9.6% of the population.

The bar graph on page 28 shows the population of South Africa by first language spoken at home – Census 2001 and 2011.

Fig. 1: Population of South Africa by first language spoken at home – Census 2001 and 2011



Source: Stats SA 2011

The graph above does not indicate what proportion of learners being taught through the medium of Afrikaans are in fact home language Afrikaans-speakers, nor does it disaggregate for age, but it does give some indication that learners from language groups constituting more than three-quarters of South Africa’s population are taught, at least from the Intermediate Phase on, through a medium of instruction other than their own home language (i.e. English or Afrikaans).

Good communication skills are one of the fundamental skills required in scientific discourse (Erikson, 2002:39). According to Naban (1981:18), the child’s home language lays the foundation of his or her world view and perception. Since physical science is mainly taught through the medium of English in the Eastern Cape, one may argue that it is unlikely that most Eastern Cape learners will be able to communicate their understanding of the subject discourse effectively in English, since most of these learners are not proficient in that language.

For the Eastern Cape learners who are isiXhosa mother tongue speakers, the language used as the language of learning and teaching Physical Sciences is a serious learning

barrier. These learners have both a language challenge and a challenge of learning the Physical Sciences content knowledge. The isiXhosa mother tongue speaker has to grasp the concepts of the Physical Sciences, which are presented in a language he or she does not have a good command of (or worse, does not understand at all). In simple terms, this means that this learner has to understand the subject content, while at the same time has to learn English: a double challenge. Overcoming the language barriers that science presents is even more difficult for ESL students, who must learn science content while they are still learning English (McKeon, as cited in Case, 2002:71). A further problem is that the language in which the physical sciences are couched is not everyday English (Jones, 2000). Rather, the mode of scientific expression in the physical sciences is somewhat different from the English in common use, and many scientific terms have a different significance to that which they have in other contexts – a third level of challenge for the learner whose home language is not English.

The literature indicates that many developed countries which are advanced in science and technology make use of their own languages as media of instruction (Mazrui, 2002, Skutnabb-Kangas, 1999; Soepadmo, 1981). The same literature points to the fact that the majority of developing countries still use foreign languages (e.g. English, French or Portuguese) as languages of instruction, which sometimes alienates learners in the classroom. With regard to development in science, Soepadmo (1981:278) claims that the developed countries have made better progress than developing countries because they use their national languages as media of instruction and scientific communication.

Many research studies relate the use of the learners' mother tongue in teaching to better academic performance at school (Galabawa and Lwaitama, 2005; Langenhoven, 2005; Malekela, 2004; Malekela, 2003; Mwinsheikhe, 2003). All these studies focus on science teaching (including Biology) in Tanzania and South Africa.

Studies in developed countries also indicate some successes where the mother tongue has been used as a medium of instruction. For example, in Germany, millions of people use German, which is their mother tongue, as a language of instruction. Within

Germany, children from families which speak German have been shown to perform better at school than those who speak a different language (Dekker, 1995:60).

Studies carried out in Hong Kong also suggest that students fared better in examinations when they were taught in Cantonese (which was their mother tongue), as compared to when taught in English (Lao and Krashen, 1999). Furthermore, research findings reported by the Hong Kong Department of Education have shown that students in classes using the English language as medium of instruction were more passive, while those in classrooms where the Chinese medium of instruction was used were more active and creative in class discussions.

Research studies conducted in South Africa show that African learners are disadvantaged educationally as they struggle to learn through the medium of a second language (English). According to Heugh (2003), due to insufficient exposure to English and support at home, learners struggle to grasp the content of subjects taught through the English medium, and this affects their academic performance adversely. The results of such practices are revealed in matric results, where schools in which the majority of learners are taught through the medium of their home language (Afrikaans or English) usually obtain better results than (African) rural and township schools, where learners are taught in their second language rather than their home language.

Research thus shows that mother tongue instruction promotes achievement. For example:

- Reddy (2005) observes that after the 1976 uprising, mother tongue instruction for African children was reduced to four years followed by a switch to English for most students, while Afrikaans speaking children continued to enjoy mother tongue education up to university education. The effects of this language policy were revealed in the Mathematics and Science Achievement at South African Schools section of the Trends in Mathematics and Science Study (TIMSS), in which mother tongue speakers of Afrikaans performed the best of all South African students participating in the study (Reddy, 2005).

- Heugh (2002) points out that in South Africa, the educational achievement of African pupils increased during the eight years of mother tongue education, despite poor resourcing in schools. She points out that, while Bantu Education was intended to deprive black learners of meaningful education, the eight years mother tongue instruction contained in the policy, ‘unintentionally’ benefitted the same learners it was meant to deprive of proper education. Her findings are that between 1955 and 1975 there was a high pass rate at the Grade 12 level (during the time in which there were 8 years of mother tongue instruction), and that after the reduction of mother tongue instruction from 1976 onwards, the pass rate fell from 83,7% in 1976 to 44% in 1992. She continues to state that, ‘what the architects of Bantu Education could not know then was that the findings of international studies of bilingual education between 1980 and 2000 would show that in ideal conditions, most pupils need 6 – 8 years of learning a second language before they can use it effectively as medium of instruction’ (Heugh, 2002:24).

Table 2 below allows us to infer the relation between the number of years of first language as the medium of instruction and the academic output at matriculation, as supplied by Heugh (2002:24):

Table 2: Pass rates for African language-speaking matriculants compared with total number of matriculation candidates, 1955 - 1998

Year	Number of African language-speaking matriculants	% pass rate	Overall total number of candidates	% pass rate
1955	595	43.3		
1976 (Soweto)	9 595	83.7		
1979	14 574	73.5	85 276	87

1980	29 973	53.2	109 807	75
1982	70 241	48.4	139 488	69
1992	342 038	44.0	448 491	56
1994	392 434	49.0	495 408	58
1997			559 233	47.4
1998			552 862	49

(Statistics from: SAIRR – Topical Briefing (1984); South African Survey (1996:101; 2000:113)

The third column shows the percentage pass rate of African language speaking matriculants. From the table it can be seen that the pass rate was the highest (83%) in 1976 (during the time in which there were 8 years of mother tongue instruction). After the Soweto uprising, the pass rate begins to decrease.

- Many studies that have been done (Howie, 2001; Macdonald, 1990; NCCRD, 1995, 1998; Strauss, 1999) suggest that learners who learn Physical Sciences in a language other than their own mother tongue usually experience learning difficulties. These research findings highlight the language of learning and teaching (LOLT) as a barrier to learning when it is not the learner’s home language, and when the learner has very little exposure to that language outside the classroom.
- MacDonald carried out a study which focused on the effect of the rapid switch to English. Her findings revealed that the rapid switch to English after only four years of mother tongue instruction resulted in a rapid increase in failure in years after 1976 (McDonald, 1990).

Many learners in rural schools, and in most township schools, are only exposed to English in the formal school context, and not in the immediate environment they live in.

The language infrastructure of English medium urban schools is more supportive, and both teachers and learners in these schools tend to have greater access to proficient speakers of English as well as easier access to English language newspapers, magazines and television (Setati *et al.*, 2002:130).

The problem of language is highlighted in the 2001 report of the Trends in International Mathematics and Science Study (TIMSS), which found that the majority of South African pupils could not communicate their scientific conclusions in the language used for the test. In particular, pupils who studied Mathematics and Sciences through the medium of their second language tended to have difficulty articulating their answers to open-ended questions, and apparently had trouble comprehending several of the questions (Howie, 2001).

Some studies reveal that in some cases, parents are against the idea of having their children taught through the medium of African languages due to some 'stigma' associated with these languages. In South Africa, attitudes towards the use of African languages as media of instruction have been negatively influenced by the language policies under the apartheid government, which in 1953 extended the use of the mother tongue as medium of instruction for African learners from the first four to the first *eight* years of schooling – not for any *pedagogical* purposes, but rather to further their policies of separation and discrimination. Thus the notion of African languages as media of instruction has been tainted by this link to an oppressive and discriminatory political system (Heugh, 1995:43; NEPI, 1992:13).

In a research study conducted by Prophet and Dow (1994) that focused on the impact of the language of instruction on learners' science concept development in Botswana, the results showed that the learners who were taught science through the medium of Setswana, their mother tongue, performed better than those who were taught through the medium of English.

Studies done by other researchers also report that instruction in the mother tongue facilitates more meaningful learning than instruction received in a first or second additional language. A study conducted by Kocakulah, Ustunluoglu and Kocakulah (2005) in Turkey indicated that students who were taught about 'energy' in a foreign language had more misconceptions than those taught through the Turkish medium of instruction.

Another example of a country that makes use of its own language in learning and teaching is Iceland. Holmardottir (2005), points out that Iceland is a small country with modern technology, knowledge of which is acquired through the local language, Icelandic.

In a study conducted by Tobin and McRobbie (as cited in Lee, 2005), Chinese high school learners in Australia were reported to have been limited by their difficulties in using English to learn Chemistry with understanding, despite their efforts. They contended that learning Chemistry could have been made easier by accommodating the non-native English-speaking learners with opportunities to fully employ their native language. While these Chinese learners made all the effort to understand concepts, their low proficiency in the English (that was used as the medium of instruction), limited their understanding.

The discussions above on the role of language in science education have highlighted the importance of mother tongue instruction for good academic achievement. Even countries that have advanced in Science and Technology have made use of their mother tongue as a medium of instruction. In South Africa where the LoLT in many African schools is English, learners have been underachieving in content subjects such as Physical Sciences. This cannot be attributed only to the learners' low proficiency in English, but also to the educators themselves. Many teachers too are not proficient in English, and yet for one to teach effectively in a particular language, he/she must have a good command of that language. Put together the learners' low proficiency in English (together with many other contributory factors) and the teachers' poor command of English, and the outcome is likely to be low academic achievement.

2.3 Challenges with regard to the use of African languages as LOLT

Some scholars argue against the use of African languages in science education. The following are the arguments put forward by Chumbow (1990) and McLaughlin (1978) against the use of an African language as the language of learning and teaching (LOLT):

- Languages such as English are international languages that can be used to relate to the whole world. This may be taken to mean that English is widely spoken, and that where there is a language barrier between two or more people, the barrier is most likely to be bridged through the use of the English language. This can also be taken to mean that learners who are taught through the medium of English during their high school education, may be able to further their education in almost any part of the world because English is a “universal language”.
- African languages do not usually have adequate technical vocabulary in subjects like science. For example, it would be very difficult (if not impossible) to find an African technical vocabulary that could be used to explain or discuss Einstein’s theory of relativity.
- Western technology and scientific knowledge are best acquired through English.
- Technological thought can be most adequately expressed through English.

It is expensive to produce educational material and train teachers to undertake education in African languages. While studies have shown that English is a barrier to the learning and teaching of sciences for learners who are English second language speakers, just ‘switching’ to African language instruction is not a solution. For a language to be used as the LoLT, materials and resources should be readily available in that language. Science learning and teaching materials written in African languages are extremely limited. This situation is unlikely to improve significantly in the foreseeable future, since retaining English as the main LoLT allows for the use of the existing material resources in English

and saves the costs of developing resources in African languages (Titlestad, 1996). It is costly to produce these materials. Besides the availability of such resources, science teachers would need to undergo training and be empowered to teach science through the medium of African languages, and this requires substantial financial resources.

On the other hand, studies that have been done in other countries show that students who speak the language of instruction at home as first language (or mother tongue) may not necessarily perform better than those who come from homes in which the language which is the medium of instruction is their second or third language (L2 or L3). Backer and Pry-Jones (as cited in Howie, 2003) point out that learners in Indonesia, described as a highly diverse country with more than 600 languages and 200 million people, did not appear to have been disadvantaged by writing the TIMMS test in a second language. These studies give rise to a contradiction as to whether language affects or does not affect the learning and teaching of Physical Sciences.

This contradiction is very much of an issue in this study because the second research objective seeks to 'observe the use of second language (English) as language of learning and teaching (LOLT) in Physical Sciences classroom'.

Now, if some studies, in some countries, find that learners are NOT disadvantaged by the use of a second language as a LOLT, the proficiency of South African teachers in the medium of instruction (English) needs to be studied.

This study is, amongst other things, about teachers' lack of proficiency in the language of learning and teaching (English) acting as a barrier to the learning and teaching of Physical Sciences. Could the teachers' lack of proficiency in the LoLT be a contributory factor to the effective learning and teaching of Physical Sciences? Lemmer (1996:330) mentions teachers' limited proficiency in English for effective teaching in South African schools, black schools in particular. Thus for effective teaching of Physical Sciences, it is important that teachers should be empowered with skills to teach in both English and the learners' home language (isiXhosa), since many of those teachers lack proficiency in the second language.

2.4 Language Infrastructure

There are notable contextual differences between the English language infrastructure in rural schools and that in urban schools in provinces like the Eastern Cape. The English language infrastructure of urban schools is more supportive, and both teachers and learners have greater access to speakers of English as well as easier access to magazines, newspapers and television (Setati *et al.*, 2002:130). Learners in urban schools are exposed to environments which provide good opportunities to use English in natural communication situations. Learners in urban schools have access to newspapers which are written in English; they interact with people who can speak English; they are exposed to television programmes which are broadcast in English and they even have access to community libraries.

In rural schools on the other hand, English is not usually spoken in the immediate environment of the learners, thus there are limited opportunities for practising and developing proficiency in the use of English. Learners speak, write and read English only in formal school lessons. Outside school, learners have little or no access to newspapers, television or people who speak English. As Ringbom points out (1987:27), 'There is little or no opportunity for the learner to use the language in natural communication situations.' It can thus be seen that in rural schools, the English language infrastructure is generally less supportive of English as LoLT. In their study, Setati, Adler, Reed and Bapoo (2002) point out the different forms of language infrastructure that have an impact on language practices like code-switching.

2.5 Physical Sciences language

Learning science involves mastering the language of science which is complex, abstract and highly specialised (Jones, 2000:89). It is therefore important that learners not only become proficient in the language of learning and teaching, but that they also master the specialised science terms in the language of learning and teaching. Therefore Physical Sciences, besides being a content subject, also becomes a second language challenge to learners whose home language is not English (the language of learning

and teaching). An English second language (ELS) learner who studies Physical Sciences as a subject, not only has to learn English, but also has to learn the specialised English Science terms; in other words, this learner must learn the language of the Physical Sciences.

Wellington and Osborne also state that one of the major difficulties experienced by learners when learning science is learning the language of science (2001:1). The language of science is unfamiliar to learners and has a difficult subject terminology. Many of the science concepts are abstract and difficult to explain to learners who are not fluent in the language of instruction (English).

Lemke (1990) argues that 'learning science means learning to *talk* science' and the linguistic demands that science instruction presents represent an important barrier to learning for many student (1990:1). Laplante (1997) points out that learning to 'talk science' involves mastering the specific academic language to discuss observations, classifications, hypotheses, natural phenomena, and so on. This on its own becomes another barrier (may be even more difficult to overcome for English second language learners) to the learning and teaching of Physical Sciences.

Anstrom (1997:5) points out that 'native speakers, for whom English is nearly automatic, can focus primarily on the cognitive tasks of an assignment [while] the students with limited ability in English must focus on both cognitive and linguistic tasks.'

Physical Sciences has its own (English-based) language that is used in relation to concepts and phenomena (e.g. in teaching motion we use words such as 'free fall'). Learners have to learn that some words have specialised scientific meanings as well as everyday meanings (e.g. work done, force, power, etc.), leading to some confusion. From the above, it can be seen that many learners in the Eastern Cape face learning difficulties in Physical Sciences because, besides having to master English as an additional subject in order to understand Physical Sciences and other subjects, they are also faced with unfamiliar specialised science terminology. In a way, this reduces the Physical Sciences lesson to an English lesson, without the learner grasping the intended, and crucial, Physical Science lesson concepts.

2.6 Code-switching

Code-switching is often used in bilingual classroom situations, and involves changing from one language to another in mid-speech when both speakers know the same languages (Cook, 1991:63). This means that learners are, in effect, taught bilingually. In this case, both the learner's home language and English are used to facilitate learning of the subject matter (Physical Sciences). For this to be effective, it requires the educator to be fluent in the learner's home language as well as in English.

Rollnick and Rutherford (1996:101) found the use of learners' first language to be a powerful means of getting learners to explore ideas; without code-switching, some learners may develop alternative, inappropriate conceptions that could remain unexposed. Ferreira (2011:105) suggests that teaching and learning in the first language provides the support needed in concept development while learners develop their proficiency in English, the medium of instruction.

Wheeler, like several other researchers (Lee, 2005; Probyn, 2005; Setati *et al.*, 2002; and Skiba, 1997) indicates that code-switching has a positive effect on teaching and learning in school subjects.

Setati *et al.* (2002) recognize that code-switching has a role to play while teaching science or mathematics. According to them, code-switching creates a conducive environment for communication with English second language learners.

In this study, code-switching is distinguished from other related phenomena which are common in bilingual conversations, such as borrowing and code-mixing. According to Adendorff (1993), who studies English/isiZulu code-switching, code-switching for academic reasons, is the building up of learners' understanding of subject matter. With this definition in mind, a teacher can legitimately switch from English to isiXhosa in a Physical Sciences lesson for the purpose of explaining an important concept.

Based on their findings, Setati and Adler (2000:252) recommend that code-switching should be encouraged as a means of enabling learners to talk freely in class, and that

learners should be encouraged to use their home language as a learning resource in learning mathematics and science.

According to Cook (as cited in Skiba, 1997), code-switching is a system whereby teachers alternate between two languages in a bilingual classroom setting, often by starting the lesson in the first (home) language and then moving into the second language and back, especially during the learning and teaching of important concepts. Thus during a Physical Science lesson, the learner's home language is used to facilitate the learning of Physical Sciences and English at the same time. For code-switching to be effective, the educator must be fluent in the learners' first language as well as in English.

As code-switching is about bilingualism, Baker (1996) observed that in bilingual classes the learners have the ability to think more analytically about things, especially when it comes to Science subjects. He also pointed that the use of two languages give students extra advantages because they have a wider and more varied range of experience than monolinguals.

Finally, Setati (2004) states that the Language in Education Policy in South African schools recognizes eleven official languages, and is supportive of code-switching as a resource for learning and teaching.

2.6.1 Functions of code-switching

Code-switching has a variety of functions which vary according to the topic, the people involved in conversation, and the context where the conversation is taking place.

According to Baker (2006), code-switching can be used to:

- emphasise a particular point. In a Physical Sciences lesson, a teacher is expected to switch from the LoLT (English in this case) to the home language of the learner (isiXhosa) when he/she wants to emphasise a particular point. The

teacher has to switch to isiXhosa because it is the language that the learners understand better than they understand English.

- substitute a word in place of an unknown word in the target language. For example, if an English word is encountered that learners do not know the meaning of, even when an explanation is provided, the teacher can substitute an isiXhosa word for the English word, where possible.
- express a concept that has no equivalent in the culture of the other language
- reinforce a request already made in English, so that the learner is able to participate fully in the lesson
- clarify a point. Complex points are understood best if they are expressed in a language that one understands better.
- express identity and communicate friendship
- ease tension and inject humour into a conversation. In some bilingual situations, code-switching occurs when certain famously complex or difficult topics (such as Quantum Physics, Electrochemical reactions, or Einstein's Relativity Theory) are introduced.

Adendorff (1993) studied English/isiZulu code-switching among educators and their learners, investigating the functions of code-switching in three high school classrooms as well as during school assembly. He reports that code-switching from English to isiZulu during an English lesson was used by the teacher concerned for academic reasons, but also in order to maintain 'social relationships in the classroom' (1993:23).

Regarding code-switching for academic reasons, Ferguson (2003) classified the functions of code-switching into three categories, namely:

- code-switching for curriculum access. Here code-switching is used to help learners to understand the subject matter of the lesson; in this case the teacher

uses code-switching to explain abstract terms and to emphasise important points so as to facilitate learning and teaching.

- code-switching for classroom management discourse, for example, to motivate, discipline or praise learners, to deal with late-comers and disruptions, to gain and keep learners' attention, or to encourage classroom participation;
- code-switching for interpersonal relations. According to Ferguson (2003:43), the classroom is not merely a place of learning; it is also a 'social and affective environment in its own right'.

Arthur's (2001) study of code-switching in primary schools in Botswana investigated the function of code-switching in two Grade 6 classrooms. She identified the following two functions of code-switching (2001: 63):

- The first function that code-switching is used for is class and lesson management;
- The second function identified by Arthur (2001) is that of using code-switching to encourage learner participation.

Setati, Adler, Reed and Bapoo (2002) investigated code-switching in Mathematics and Science classes, and state that teachers of these subjects face difficulties in multilingual or non-English mother tongue classrooms because of the double challenge of teaching their subjects in English, whilst their learners are still learning English as a language.

In their study, they identified the two functions of code-switching:

- The first function of code-switching identified by Setati *et al.* (2002) is code-switching as a pedagogic strategy.
- The second function of code-switching identified by Setati *et al.* (2002) is to assist learners in their understanding of concepts and ideas and in their communicating of these understandings.

Setati and Adler's (2000) study was on code-switching in ten rural and urban schools (both primary and secondary schools) in the Northern and Gauteng Provinces. They found that code-switching was used for academic purposes, for example, to explain and clarify subject matter in Mathematics and Science classrooms which officially have English as medium of instruction.

Some of the functions of code-switching can be observed in the classroom environment, and in relevance to teachers' and students' interactions. Olugbra (2008) points out that teachers code-switch from English to the learners' home language for a range of purposes: to explain new concepts, to clarify statements or questions, to emphasise points, to make connections with learners' own contexts and experience, to maintain the learners' attention with question tags, for classroom management and discipline, and for affective purposes.

Code-switching is not only a strategy to be used by teachers. Learners' written work may conceal misconceptions that are more likely to be revealed in group discussions taking place in the learners' first language. Therefore interaction between learners in both English and the learners' home language is also important for exploring ideas and concepts. With the use of code-switching and mixed-language peer communication, teaching and learning in the first language may provide the support needed with concept development, and at the same time, learners may gradually be helped to develop greater proficiency in the medium of instruction.

From these discussions, the functions of code-switching were summarised as follows:

1. Code-switching for academic reasons

- Explaining and clarifying subject matter (Setati and Adler, 2000; Ferguson, 2003)
- Building up learners' understanding of subject matter (Adendorff, 1993; Setati *et al.*, 2002)
- Assisting learners in interpreting subject matter (Adendorff, 1993)

- Confirming that learners have understood what was explained (Rose and Van Dulm, 2007)
- Encouraging learners' participation (Adendorff , 1993; Arthur, 2001; Ferguson, 2003)
- Supporting classroom communication (Setati *et al.*, 2002)
- Supporting exploratory talk (Setati *et al.*, 2002).

In this case, code-switching is used to facilitate the learners' understanding of the new concepts, and to enable the learners to be actively involved in learning processes and classroom activities. Here code-switching serves as a bridge between the first language of the learner and the medium of instruction. This facilitates the transfer of new concepts to the learner in a more understandable way.

2. Code-switching for social reasons

- Maintaining social relationships in the classroom (Adendorff, 1993; Ferguson, 2003; Rose and Van Dulm, 2007)
- Humour (Adendorff, 1993; Rose and Van Dulm, 2007)
- Reasons of solidarity (Adendorff, 1993; Ncoko *et al.*, 2000)
- Showing defiance (Ncoko *et al.*, 2000)
- Increasing social distance (Ncoko *et al.*, 2000).

Code-switching for social reasons is important in the expression of emotions. It builds strong relationships with the teacher and his/her learners in the sense that the teacher can reach out to the learners in a language they understand better.

3. Code-switching for classroom management purposes

- Classroom discipline, e.g. reprimanding learners (Rose and Van Dulm, 2007)

- Dealing with late comers and disruptions (Ferguson, 2003)
- Gaining and keeping learners' attention (Ferguson, 2003).

When discipline breaks down, no meaningful learning and teaching can take place. Hence it is of paramount importance for the teacher to emphasize discipline in a language that is best understood by all learners so that they are all well informed.

2.6.2 Disadvantages of code-switching

Olugbara (2008) states that teachers have a negative attitude towards code-switching and feel that it promotes reliance on the bilingual learner's first language rather than the target language, which is the LOLT and also the language for assessment.

English is the only language used in the examinations for most English Second Language FET learners. There is no code-switching during examinations, and this makes it difficult for the learners to communicate their answers in the target language which is English (Van der Walt and Mabule, 2008). As a result most teachers tend to stick to English when teaching, even though it might be clear that their learners do not understand; learners, they feel, have to get used to the language of assessment.

Teachers are faced with the challenge of teaching learners of limited proficiency in English and they cannot benefit much from code-switching (Moodley, 2007).

Physical Sciences examinations are set and written in English. While learners of limited proficiency in English may understand the concepts through the use of code switching, these learners would fail to articulate their ideas in English during examinations, thus not benefiting much from code-switching.

2.7 The Language in Education Policy (LiEP)

Language policy issues are important in the learning and teaching of Mathematics and Science (as well as in all other subjects). In the Foundation Phase (Grades R-3) in

South Africa, teaching is done through the medium of the home language. However, in Grades 4-12, Mathematics and Science are usually taught through a medium of instruction that is different from the home language of the majority of learners.

Before the emergence of democracy in 1994, African indigenous languages were largely erased from the linguistic map in South Africa by the apartheid government. The country was officially considered bilingual, but only with regard to English and Afrikaans as the sole recognized official languages. The Nationalist government introduced a 50/50 language policy for African students in 1976. This policy prescribed that all African children at secondary school should learn 50% of their subjects in Afrikaans, the other 50% in English, and that the mother tongue should be used only for non-academic subjects (Setati, 2002).

South Africa became a democratic nation in 1994, and this brought about the recognition that South Africa is a multilingual country rather than the bilingual country that it was assumed to be during the apartheid era (Kamwangamalu, 2000). The democratic government initiated multiple policies across all social services by considering the sociolinguistic situation in the country, which had been neglected by the apartheid government. Moreover, the Constitution adopted in 1996 attempted to promote language equality through the recognition of eleven official languages, and for the first time nine African languages received official status in addition to English and Afrikaans (Setati, 2002; Probyn, 2001).

According to McLaughlin (1978:9), the learners' needs should get preference during the teaching process. McLaughlin points out that learners who are not fluent in the language of instruction are commonly identified as learners with learning disabilities.

In 1997, the erstwhile Minister of Education formally announced the New Language in Education Policy (Department of Education, 1997). This policy aimed at promoting multilingualism in South Africa's education system, whereby all eleven languages would enjoy equal status, thus allowing schools to determine their own language policies in consultation with parents and the school communities (Ncoko, *et al.*, 2000).

The New Language in Education Policy states that:

Subject to any law dealing with language-in-education and the constitutional rights of learners, in determining the language policy of the school, the governing body must stipulate how the school will promote multilingualism through using more than one language of learning and teaching, and/or by offering additional languages as fully-fledged subjects, and/or applying special immersion of language maintenance programmes (Department of Education, 1997:8).

The LiEP (DoE, 1997:4) aims to achieve the following:

- To promote full participation in society and the economy through equitable and meaningful access to education
- To pursue the language policy most supportive of general conceptual growth amongst learners, and hence to establish additive multilingualism as an approach to language in education
- To promote and develop all official languages
- To support the teaching and learning of all other languages required by learners or used by communities in South Africa.

Another element of this language policy is the principle of additive bilingualism, which involves the maintenance of the mother language and access to an additional language. The objective of additive bilingual education is to use the mother tongue as a medium of instruction (with the official language being taught and learnt as a subject in its own right) or to use the mother tongue and an official language as dual media of instruction with the aim of achieving a high level of proficiency in both mother tongue and an official language (Heugh, 2000).

However, the implementation of the language in education policy has not been a walk in the park.

- Some research studies indicate that an insignificant number of schools have developed their school language policies in line with the LiEP (Brown, 1998; Burkett, 1999; (Kgobe & Mbele, 2001).
- In spite of the presence of the LiEP, a majority of parents and learners are still choosing English as a medium of instruction. These misconceptions of Black parents with regard to the use of African languages as language of learning and teaching, have worked (and still continue to work) against the design and implementation of schools language policies in line with the LiEP.

Most parents and schools do not opt for African mother tongue as language of instruction because they associate the African language policy with inferior education. African language mother tongue education was seen as a tool of apartheid, limiting the opportunities of black learners and denying indigenous African language speakers a politically powerful *lingua franca* (Hunt, 2007:83).

The National Education Policy Investigation (NEPI) report revealed that:

Parents' memories of Bantu Education, combined with their perception of English as a gateway to better education, are making the majority of Black parents favour English as a language of learning and teaching from the beginning of school, even if their children do not know the language before they go to school (NEPI, 1992:13).

Gamede (1996) investigated the attitude of high school learners towards the use of African languages as the language of learning and teaching. The results indicated that in former 'Model C' schools, rural and township schools, learners regarded the African languages as useless.

Studies were also conducted in Cape Town to investigate how English impacted on isiXhosa- speaking students. Findings of the research study show that African (isiXhosa speaking) learners still preferred English as the language of learning and teaching.

South African learners who were interviewed by Setati (2005), and Langa and Setati (2006, as cited in Ndamba, 2008:178) also preferred the use of English in the learning of mathematics in the secondary school. These researchers attributed learner choice of the language of instruction to the socio-political situation, opportunities to access technology and science, and a wider means of communication. From these findings, it can be suggested that parents do not want their children to be confined within their communities, but to be able to access the 'outside world' as well. For this reason they prefer their children to be taught in English, which they regard as a universal language. Parents also want their children to acquire technology and science, which can be most readily accessed in English, hence they advocate that their children be taught in English.

Findings from a research study by Probyn, Murray, Botha, Botya, Brooks and Westphal (2002) in four Eastern Cape education districts indicate that parents also choose English as language of learning and teaching because they associate it with status, in addition to regarding it as a language of technological and scientific access. These parents agree that their children should learn isiXhosa as a language, but not use it as the LOLT. In the same study, these researchers (2002:30) give a number of reasons provided by other researchers as to why schools have failed to implement the LiEP (Probyn *et al.*, 2002:30):

- Schools do not have knowledge of the policy,
- Lack of experience and expertise in developing their own policies,
- Schools do not know what support the DoE will provide (Taylor & Vinjevold, 1999),
- Education Department district officials who might advise schools, also lack knowledge of the LiEP (NCCRD, 2000).

Parents and learners are not the only ones shunning the African languages; many schools have also chosen to continue using English as the medium of instruction. In spite of the government's policy of additive bilingualism, schools have generally continued to choose English as their language of learning and teaching (Banda, 2000).

Research studies by Brown (1998); Burkett (1999); Kgobe and Mbele (2001), reveal that an insignificant number of schools have developed their language policies in line with the LiEP. A number of research studies give possible reasons as to why LiEP has not been implemented by schools.

Probyn *et al.* (2002) suggest that one key reason why these schools have not developed their school language policies according to the LiEP is a lack of experience in designing policies. Learners have been slowly and informally introduced to English from as early as Grade 1 in some schools where there is a strong demand for English by the parents and in the school policy, and from Grade 2 onwards in the schools where this demand is not that strong (Plüddemann, Mati and Mahlalela, 1998).

From Grade 4 upwards, learners are expected to move from the mother tongue LOLT to English medium at a time when they are not yet functionally literate, even in their mother tongue. At this stage, learners will not have achieved the necessary English competence to cope with English medium teaching and learning.

The old tendency for schools to teach in English from Grade 3 upwards has been recognised, accepted and encouraged by most parents in African schools, and is assumed to be an accepted language policy in spite of the new LiEP. Pressure is mounting on teachers in the African schools to use English as early as Grade 1, because of parents moving their children from the African schools to the formerly 'white' and 'coloured' schools that use English as their sole LOLT (Mati, X and Mahlalela, 1998). The result of this is that learners may become incompetent in both their home language and the medium of instruction.

According to Cummins (1981:38), learners attain a very low level of proficiency in one or both of their languages; their interaction through these languages, both in terms of input and output, is likely to be impoverished.

From the above account, it can be seen that the implementation of the LiEP has come with its own challenges, not only from the schools, but from parents who want their children to be instructed through the medium of English, a language they associate with 'prestige, technology and job opportunities' (Klerk, 2006:6).

However, it is pleasing to observe that education policy makers have realised the importance of mother tongue instruction, as revealed by the change that has been brought in since 2011 with the Curriculum and Assessment Policy Statement (CAPS). In CAPS, there have been changes in the mother tongue instructional time allocation, where the LoLT is the learner's second language.

While the LoLT still remains English, there has been an increase in the instructional time in which the home language of the learners is used. Only when the learner reaches the final FET Phase does the instructional time in English (or any other first additional language) become equal to the instructional time in which the learner's home language is used as the medium of instruction.

This is a huge shift from what happened in the past, where learners were instructed through the medium of the home language in the Foundation Phase, followed by a sudden change to second language instruction when the learner got to the Intermediate Phase. In the Intermediate Phase, the learner discovered that he/she did not only have to learn English as a subject, but also had to use it as the LoLT in all other subjects except in Xhosa classes.

The instructional time (in hours) for the different phases as given by the DBE is summarised in Table 3 below:

Table 3: Instructional hours per Phase and Grade

Phase	Subject	Grade		
		Grade R	Grade 1 – 2	Grade 3
Foundation Phase	Home Language	10	7 minimum 8 maximum	7 minimum 8 maximum
	First Additional Language	-	2 minimum 3 maximum	3 minimum 4 maximum
Intermediate Phase		Gr. 4 -6		
	Home Language	6		
	First Additional Language	5		
Senior Phase		Gr. 7 – 9		
	Home Language	5		
	First Additional Language	4		
FET Phase		Gr. 10 – 12		
	Home Language	4, 5		
	First Additional Language	4, 5		

(Physical Sciences CAPS Document 2011)

From the above table, it can be seen that English first additional language will now be taught from Grade 1; no longer Grade 2 as has been the case in most schools. It can also be seen that instruction is still in the home language of the learner, with English as an additional language. This is in accordance with the LiEP, which advocates for mother tongue instruction during the Foundation Phase.

The adjustment in the language policy is further officially confirmed by the Minister of Basic Education, Angie Motshekga (2010). On 6 July 2010, she presented a statement on the progress of the review of the National Curriculum Statement:

...Additional recommendations that Council approved include the following:

Firstly, the Council approved the recommendation that from 2011, the language chosen by the learner as a Language of Learning and Teaching shall be taught as a subject, or as a First Additional Language, from Grade One (1) and not from Grade 2, as is currently the case.

What this means, for instance, is that the teaching of English will occur alongside mother tongue instruction for those learners who choose English as a language of learning and teaching. English will not replace the mother tongue or home language in the early grades, as some commentators have interpreted the recommendation... (DBE, 2010:3).

Language and Cognitive development: The African context

Research has been undertaken by the Association for the Development of Education in Africa (ADEA) in some African countries to demonstrate that languages and cognitive development play a crucial role in the progress of children during schooling. The following studies all have shown positive connections between language and cognitive development (Wababa, 2009:38-39):

- The six-year Yoruba project carried out in Nigeria in the 1970s;
- The experimental school project that took place in Mali in 1985;
- The Threshold project conducted in South Africa in 1990;
- The 1999–2001 PanSALB and PRAESA project;
- The LOITASA project carried out in South Africa and Tanzania.

Wolff (in the ADEA report: 1996:134–135) articulates the results of the research as follows:

- (i) Cognitive benefits can be derived when the child's home language is used as the language of instruction in early education (ADEA, 1996:10). The gains to be accrued by children from being instructed in their mother tongue fall into the following categories: cultural; affective; cognitive; socio-psychological; and pedagogic (Nigerian six-year primary project, 1970).
- (ii) Where the home language differs from the language of instruction used in the classroom, pedagogical and cognitive problems can be attributed to the choice of the language of instruction (ADAE, 1996:10).
- (iii) In direct comparison, children receiving mother-tongue education generally perform better than do their counterparts receiving instruction in a foreign language (Nigerian six-year primary project, 1970). Such a finding also holds true for the core subjects, such as mathematics and science.
- (iv) Mother-tongue education, in terms of which a foreign language is studied only as a subject, will not render children older than 6 years in age less proficient in, for instance, English, than those who had English as their medium of instruction throughout their primary education (Nigerian six-year primary project, 1970. The learners were found to understand mathematical and scientific concepts better when taught them first in the mother tongue and later in English).
- (v) Repeating classes occurs far less in mother-tongue schools than it does in foreign language schools. In the Mali project, 48% reached Grade 6 in mother-tongue schools without having to repeat any classes, compared with only 7% in French-medium schools.

These findings confirm how important mother tongue is in developing a deeper conceptual linguistic proficiency that can be transferred to the L2, as well as confirming that instruction in the home language is crucial for cognitive development and conceptual understanding (Cummins, 1986).

2.8 Theoretical Framework

The theoretical and conceptual framework which informs and frames this study emerged from studies of bilingualism (and its two forms, namely the additive and the subtractive forms) and from related models of second language teaching.

2.8.1 Subtractive Bilingualism

Subtractive bilingualism refers to the limited form of bilingualism often associated with negative outcomes (Lambert, 1975). The term is applied to a context in which speakers of usually low-status languages are expected to become proficient in a second language (for them) such as English. Lambert states that it is applied to a context in which speakers of usually lower-status languages (such as isiXhosa in the post-Foundation Phase) are expected to become proficient in an second language, which is usually a dominant language of higher status (such as English in the post-Foundation Phase).

Subtractive bilingualism arises out of a situation where the second language is acquired without accommodating the linguistic skills that have already been developed in the first language (Mwamwenda, 1996). In this model, the learners' first language skills are *replaced* by the second language skills, thereby placing linguistic and associated cultural systems *in conflict* instead of complementing one another (Robinson, 1996). Baker (2001) points out that the academic competence of the learner depends on achieving cognitive academic language proficiency (CALP) in the first language. It can therefore be argued that, in a subtractive bilingual approach, the learner is switched to the language of learning and teaching when CALP is still underdeveloped. This model

(subtractive bilingualism) is thus likely to disadvantage English second language learners in the learning and teaching of Physical Sciences and other subjects.

According to the theory of subtractive bilingualism, if a child discontinues, or partially discontinues, the use of a first language before a second language is securely developed, then this discontinuity negatively impacts the child's ability to acquire language. If on the other hand, you retain the use of your first language while you are learning a second, then your cognitive abilities progress at an age-appropriate pace while the new language is acquired. There is little back-sliding in your ability to express complex thoughts during this learning process. The majority of the learners in this study came from communities where the home language was isiXhosa. These learners had been exposed to isiXhosa since birth. When they got to school, the LoLT was isiXhosa during the first three years. However, when they entered the Intermediate Phase, there was a sudden shift from isiXhosa to English as the LoLT. At this stage, their home language (isiXhosa) was not fully developed as a LoLT, but they find that they now had to cope with a new language (English) at the expense of their home language. Since these learners had not yet acquired a high degree of proficiency and linguistic skills in isiXhosa, they then struggled not only with attaining proficiency in English, but also in learning and understanding concepts in content subjects such as the Physical Sciences.

2.8.2 Additive Bilingualism

Additive bilingualism refers to the bilingualism associated with a well-developed proficiency in two languages, as well as with positive cognitive outcomes (Lambert, 1975). The term is applied to a context in which speakers of any language are introduced to a second language in addition to the continued educational use of the home language of the learner as the LoLT. In this approach, both the home language and the additional languages are supported and developed.

In South Africa, the national Language in Education Policy is in support of additive bilingualism when it states:

Whichever route is followed; the underlying principle is to maintain home language(s) while providing access to an effective acquisition of additional languages(s). Hence the Department's position that an additive approach to bilingualism is to be seen in as the normal orientation in our language-in-education policy (DoE, 1997).

Heugh (2005) advocates an additive bilingual programme wherein the mother tongue serves as the primary medium of instruction for at least the first eight years of schooling, and thereafter an additional language is introduced as medium of instruction, preferably in a dual medium programme.

In the additive model, Lambert (1977) says that bilingualism arises out of a situation whereby society attributes positive values to both the individual's first language and his or her second language.

Borich and Tombori (1997) observe that the development of additive bilingualism does not have any negative effect on the children's academic, linguistic or intellectual development. This additive strategy is linked to the concept of code-switching, which is the norm in classroom practice in South Africa.

Van der Walt and Mabule (2001:257-268) observe that the use of code-switching in the classroom situation is not well documented, though anecdotal evidence suggests that such use is common practice. The teaching of science in most township and rural schools is dominated by a high degree of code-switching and code-mixing in teaching strategies and practices.

2.9 Conclusion

This chapter has explored the part which language plays in the teaching and learning of Physical Sciences in South African schools. The challenges and difficulties experienced by learners who learn Physical Sciences in a language other than their own mother tongue, or home language, were also discussed. On the other hand, studies from other

countries which show the opposite were also cited (studies showing that students who speak the language of instruction at home as a first language may not necessarily perform better than those who come from homes in which the language which is the medium of instruction is their second or third language). The specialised language of Physical Sciences was also discussed. This does not consist of just everyday English; it also consists of specialised language and specialised terms. The use and functions of code-switching as an effective teaching and learning strategy in the second language Physical Sciences classroom were also discussed in detail, as was the Language in Education Policy.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology, research paradigm, data collecting techniques, sampling and ethical considerations pertaining to this study. The instruments (semi-interviews and observations) used in the collection of data and the method of analysing the data are also discussed.

3.2 Research paradigm

Bogdan and Biklen (as cited in Mackenzie and Knipe, 2006), define the term 'research paradigm' as 'a loose collection of logically related assumptions, concepts or propositions that orient thinking and research'. The methods of data collection depend on the paradigm and the research questions. As Mackenzie and Knipe (2006) point out, it is the paradigm and research questions which should determine which research data collection and data analysis methods (qualitative, quantitative or mixed methods) will be appropriate for the study.

In this study, the researcher adopted the interpretivist research paradigm, which takes seriously the interpretations and self-interpretations of social actors. In this form of research, 'the researcher relies upon the participants' views of the situation being studied, and recognises the impact on the research of their own background and experiences' (Creswell, 2003:8). Interpretivists are interested in the meaning that people give to phenomena and require a detailed and thorough analysis of social situations and also require firsthand knowledge (Willis, 2007).

3.3 Overall methodology

The overall research approach was qualitative. According to Van Maanen, qualitative research seeks to describe, decode, translate, and otherwise come to terms with the

meaning, rather than the frequency, of certain more or less naturally occurring phenomena in the social world (Van Maanen, as cited in Imenda and Muyangwa, 2006:55). The qualitative approach aims to understand the meaning of human action. Peshkin (1993 in Leedy and Ormrod, 2005:134-135) explains that qualitative research serves one or more of the following purposes:

- Description – it reveals the nature of certain situations, settings, processes, relationships systems or people.
- Interpretation – it enables a researcher to gain new insights about a particular phenomenon; develop new concepts or theoretical perspectives about the phenomenon; discover the problems that exist within the phenomenon.
- Verification – it allows a researcher to test the validity of certain assumptions, claims, theories, or generalizations within real world contexts.
- Evaluation – it provides a means through which a researcher can judge the effectiveness of particular policies, practices, or innovations.

Of these, description and interpretation were probably the main purposes served by a qualitative approach in this study.

- (i) The data obtained from the interviewees and the observations both contributed to a richer picture of the problems and challenges encountered by both teachers and learners in the learning and teaching of Physical Sciences through the medium of English as a second language.
- (ii) After collecting the data, the researcher sat back, analysed and interpreted the result, in the light of theory based on a review of the literature. The interpretation of these findings, obtained in response to the research questions, enabled the researcher to gain new insights about language practices in the learning and teaching of Physical Sciences.
- (iii) To a lesser extent, the researcher was also able to evaluate, though this was not the explicit intention of the study, the practices of learning and teaching of the Physical Sciences through the medium of English as a second language and code-switching.

This approach was relevant because the researcher wanted to understand how the use of a second language as LOLT affects learners' ability to comprehend and learn Physical Sciences, how educators and learners experience and feel about the use of languages in the learning and teaching of this subject, and why they experience it this way and feel the way they do.

The researcher conducted case studies, which were likely to provide an in-depth understanding of the problems associated with learning and teaching Physical Sciences through the medium of a second language. Hofstee (2006) points out that case studies are useful when detailed knowledge is required of any particular case, for whatever reason. In this study, detailed knowledge of both learners' and educators' language practices and experience in the learning and teaching of Physical Sciences was required.

The cases in this case study were two rural schools and two township schools in the King William Town District. One of the schools (out of the four chosen schools) was a Dinaledi school. Within these schools, teachers who teach Physical Sciences at FET band, and learners (in Grade 11) who are taking the subject, formed part of the case. These teachers and learners were interviewed on their experiences and perceptions of, and feelings about, language practices in the Physical Sciences class.

3.4 Data collection methods

The methods of data collection depend on the paradigm and the research objectives or questions. As Mackenzie and Knipe (2006) point out, it is the paradigm and research questions which should determine which research data collection and data analysis methods (qualitative, quantitative or mixed methods) will be appropriate for the study. Since this research is an interpretivist case study focused on educators' and learners' perceptions of the effects of their own respective teaching and learning practices, the data collection methods used were:

- Semi-structured interviews with Physical Sciences learners and teachers, and

- Class observation of Physical Sciences lessons.

One-on-one interviews were conducted with the eight participating teachers (two educators from each school) and sixteen participating learners (consisting of four learners from each school).

Both educators and learners were interviewed to get their views and feelings with regard to language use in the teaching and learning of Physical Sciences. The researcher used semi-structured interviews because the respondents had to give their detailed views, opinions and perceptions with regard to their perceptions on language use (including code-switching) in the learning and teaching of Physical Sciences.

The researcher also conducted some class observations, so as to observe how educators and learners actually used languages in the learning and teaching of Physical Sciences. This helped to confirm (or disconfirm) the perceptions of respondents.

Marshall and Rossman (1995:79) define observation as ‘the systematic description of events, behaviours and artifacts in the social setting chosen for the study.’ Fifteen-minute segments of Physical Science lessons were video-recorded, with the main focus on the educators and learners who formed part of the sample.

According to Sherman and Webb (1991), in qualitative research there are two types of observation, namely simple observation, where the researcher remains an outsider, and participant observation, where the researcher is simultaneously a member of the group under study. In this study the researcher adopted the observation method to collect data from the sample under study.

3.4.1 Interviews

The most widely used approach in the production of qualitative data is interviews with participants. Potter (1996:96) has defined interviewing as a “technique of gathering data from humans by asking them questions and getting them to react verbally.”

The purpose of the interviews in this study was to gain a full and detailed account from the Physical Sciences teachers and Grade 11 learners who were studying Physical Sciences.

Powney and Watts (1987) explain an interview as follows:

An interview is essentially a conversation initiated by the interviewer for the specific purpose of obtaining relevant information, and focused by him or her on the content of specific research objectives or systematic description, predictions or explanations (Powney and Watts, 1987:6).

McMillan and Schumacher (1989:36) describe an interview as an oral questionnaire where an interviewee gives the information needed orally and face-to-face. Gay and Airasian (2000) mention that interviews permit researchers to obtain important data that cannot be obtained from observation, and that they can explore and probe participants' responses to gather more in-depth data about their experiences and feelings. They can also examine attitudes, interests, feelings, concerns and values more easily than in using pure observation.

In this study the researcher made use of one-on-one, semi-structured interviews with learners and educators. These were characterised by in-depth questions and probing, which allowed the interviewees to recount their detailed experiences, opinions and perceptions of language used (including code-switching) in the learning and teaching of Physical Sciences. The individual interviews provided the researcher with an opportunity to check the reliability of the participants' responses by asking follow-up questions.

All the interviewees were asked more or less the same questions, but these questions were open-ended so as to allow the interviewer the flexibility to probe for details or discuss issues (Kerlinger, 1970). A general interview guide was used. This was intended to ensure that the same general areas of information were collected from each interviewee, and to provide more focus.

The interviewer audio taped the interviews. The use of a voice recorder ensured that more data was captured. It also allowed for a record to be made of the tone of the respondents when responding to questions asked by the interviewer. The recordings were then transcribed, transforming the data obtained from their original oral form into written form. The purpose of the conversion into a written account was to allow the detailed and to-and-fro reading required in the analysis of the qualitative data.

The disadvantage of using a tape recorder was that it could have led to the respondents keeping information to themselves that might have proved important to the research, due to the fear that they might be asked to say what could land them in trouble.

The advantages of semi-structured interviews are that:

- i) they are more appropriate for complex and sensitive situations; the interviewer can prepare and explain to the respondent (Seliger and Shohamy, 1989)
- ii) they are useful for collecting in-depth information; the researcher is able to probe when responses are superficial (*ibid.*)
- iii) questions can be explained where the respondent does not understand terms used, or the intent of the question (*ibid.*).

All of these advantages of semi-structured interviews applied in one way or the other to this study. On many occasions the interviewer had to explain the intention of the question to an interviewee because he or she did not understand the question. To some of the learners who were interviewed, the researcher had to explain the question to them in isiXhosa because they did not understand it in English. This also enabled the respondents to be relaxed and respond freely. The interviewer could also follow up a respondent's answers to obtain more information and clarify vague statements.

Some of the disadvantages of semi-structured interviews are that:

- i) they are relatively time-consuming and expensive, especially where respondents are scattered over a large geographical area (Bless, 1995)

- ii) the quantity of data obtained depends on the quality of the interaction; interaction in each interview is unique, so responses may vary significantly (*ibid.*).

The first of these disadvantages in particular applied to this study, at least to a certain extent. The respondents were scattered over a large geographical area, which meant that the researcher had to do a lot of travelling. This was expensive, as hired transport was required to get to the schools. At times the researcher had to go to the same school more than once because the interviews had not been completed to his satisfaction, and this meant more expenses on transport and at the same time, required more time.

3.4.2 Classroom observation

Observation is the technique of gathering data through direct contact with an object—usually another human being. The researcher watches the behaviour and documents the properties of the object (Potter, 1996:98).

Marshall and Rossman (1995:79) define observation as ‘the systematic description of events, behaviors and artifacts in the social setting chosen for the study’. Observation is used quite often in qualitative research.

This strategy is used as a principal data gathering strategy in qualitative research because researchers are interested in the ways in which people usually make sense of or attach meaning to the world around them (De Vos, 2001:277).

The researcher conducted classroom observation so as to observe how the selected educators and learners actually used languages in the learning and teaching of Physical Sciences. This helped to confirm or disconfirm the perceptions of respondents gathered in interviews.

According to Sherman and Webb (1991), in qualitative research there are two types of observation, namely simple observation where the researcher remains an outsider, and

participant observation, where the researcher is simultaneously a participating member of the group under study.

In this study the researcher adopted the simple observation method to collect data from the sample under study. Participant observation might have jeopardized the authenticity of the interactions and responses the researcher was looking for in focusing on the effects of using one or more languages in the class. For this reason, the researcher had planned to make use of video-recording during classroom observations. Fifteen-minute segments of Physical Science lessons were to have been video-recorded, with the main focus on the educators and learners who formed part of the sample. However, in the end this proved impractical.

The observation schedule was based on the following categories and lesson elements:

- Recapping of the previous lesson
- Introduction of new concepts
- Explanation of new terms
- Language used for general communication in the classroom
- The use of English and isiXhosa terms in the learning and teaching of Physical Sciences
- The language used by teachers when giving instructions, asking questions, and explaining scientific concepts
- Participation by learners
- Group discussions
- Provision of feedback
- Conclusion of the lesson.

Babbie (2005) identifies the following advantages of observation:

- Observation can be done anywhere. If possible the researcher is also able to take notes on his/her observation as the events unfold. It forces the observer to familiarise herself/himself with the subject.

- Observations allow previously unnoticed or ignored aspects to be seen. It is said that actions speak louder than words, and therefore observing participants' actions were valuable.
- Observations are unobtrusive, and when obtrusive, the effect wears off in a reasonable time.

The other advantage of observation is that it allows simultaneous recording of both behaviour and circumstances, and permits the recording of events which would have been left out in the interview.

On the other hand, observation is not without its problems. The researcher conducted some classroom observations and found out that the presence of the observer may alter the behaviour of the participants. This means that if the participants are under observation, their normal behaviour can be affected and this change in behaviour has a negative effect on the reliability of data being collected. This is known as the "observer effect". Gall *et al.* (1996) define observer effect as an action by the observer that has a negative effect on the validity or reliability of the data being collected. According to Wilson (1987), it is necessary for researchers to produce positive arguments for the status of their data so that any conclusions based on such data do not turn out to be unfounded.

Observing and recording events at the same time could be problematic. Written notes are often insufficient to capture the richness of what one observes (Leedy and Ormrod, 2005). With this in mind, the researcher decided to engage the services of an assistant researcher, so that at the end of each classroom observation, what was observed by the two could be reconciled.

Classifying observation for the purpose of comparisons could be difficult, owing to the lack of standard sequence of behaviour as each event may be unique. Also the observer's own perceptions, beliefs and biases could influence the way he or she observes and interprets the event. This disadvantage was minimised through the use of an observation guide, as well as by having two observers in one classroom. The

researcher and the research assistant had decided beforehand which behaviour to observe and to record.

Inattention, fatigue and the limitations of the sense organs may oblige the observer to miss some of the events that he or she could have regarded as being unimportant, had s/he noticed them. To solve the problems that memory may pose, the researcher and the research assistant could have video-recorded all the observations as the lesson progressed in each classroom, and compared observations afterwards. However, this plan was discarded as it caused the participants to very uncomfortable, which would have created a problem on its own.

3.5 Sampling

Kumar (as cited in Reid, 2001) explains that a sample is a sub-group of the population you are interested in. In this study, the sample was comprised of educators who teach Physical Sciences from Grade 10 to 12 in each of the four schools, and four Grade 11 learners (per school) who study Physical Sciences at these selected schools. The schools were selected purposively – two rural schools and two township schools which offer Physical Sciences as a subject. In a case study such as this, selection is purposive in order to obtain data from relevant individuals or to maximise broad representivity rather than in order to generalise to a population.

The four schools that were selected for participation in the study are located in the urban and rural areas of King Williams Town Education District, the assumption being that the communities in these areas are isiXhosa-speaking.

3.6 Data analysis approach

Babbie (2001) points out that when analysing qualitative data, the researcher seeks to discover patterns and possible causal links between variables. In this study, semi-structured interviews and classroom observations were used for collecting data in this

study. For the data from the interviews, the qualitative data from the interviews were coded. Schwandt (1997) points out that coding is a procedure that disaggregates the data, enabling it to be broken down into manageable segments and then re-grouped under categories, themes and patterns as the latter emerge.

Semi-structured interviews were subjected to open coding to discover the participants' view on the use of isiXhosa and English in the learning and teaching of Physical Sciences. Babbie (2001:366) states that in open coding, data are broken down into discrete parts and compared for similarities and differences.

The interpretation of data that was obtained from classroom observations was based on the following aspects:

- (i) how language was used
- (ii) how concepts and scientific terminology were explained in both English and isiXhosa in order to promote the cognitive development and conceptual understanding of the learners.
- (iii) teacher-learner interaction and learner-learner interaction.

Particular attention was paid to:

- How the lesson was introduced
- The explanation of concepts and terms
- How questions were asked
- How feedback was provided
- How the lesson was recapped
- How the lesson was concluded.

For classroom observations, an observation schedule was designed to assist with capturing data related to the teachers' and learners' language practices during the learning and teaching of Physical Sciences. The data collected from classroom observations was transcribed. The transcripts of the classroom observations were subjected to coding in order to discover patterns of language use, practices and the apparent reasons behind the observed patterns of language use.

According to Hancock (2002), the qualitative researcher has no system for pre-coding data, and so a method was adopted of identifying and labelling (coding) items of data which appeared in the text of a transcript so that all the items of data in one interview could be compared with data collected from other interviewees. The same approach was applied in analysing the notes from the classroom observations. This method required a process called content analysis. *Content analysis* is a procedure for the categorisation of verbal or behavioural data, for purposes of classification, summarisation and tabulation (Hancock, 2002:17). Content analysis involves coding and classifying data.

To analyse the data, the basic procedure described below by Hancock (2002:17) was followed:

- A copy of the transcript was read through. When something that contained apparently interesting or relevant information was seen, it was written under the code column.
- After having a list of items excerpted from the transcript, a list of data items was read through and each item was categorised in a way that described what it was about. Some of the categories were used several times because several items of data referred to the same topic.
- Looking at the list of categories identified from the transcript, some of the categories were linked in some way. Those were listed as major categories/themes.
- The categories of data were compared and contrasted. As “the big picture” started to develop, some items of data were perceived differently and seen as “fitting” better into an alternative category.
- The stages above were repeated for the next transcript. As work was done through the second and subsequent transcripts, new categories of information were identified, but some items of data seemed to belong to previously identified categories. Eventually, new categories ceased to emerge, and all the items of

relevant and interesting information were found to have been accommodated in the existing categories.

- All the extracts from the transcribed interviews that were put into one category because they appeared to bear some relationship to each other, were collected together. Each of the extracts was examined in turn to check whether they belonged together, or whether there were any extracts that at that time looked as though they did not fit and really belonged in a different category.
- When all the relevant transcript data were sorted into categories, data contained in each category were looked at again. As data were reviewed within the developing system of categorisation, some items of data were moved from one category to another. Some of the information was in the right categories, the “right place”, in that they fitted together, but the terms used to name or describe the categories were found to be inaccurate or inappropriate.
- Once all the categories were sorted out and the researcher was sure that all the items of data were in the right category, ranges of categories were looked at to see whether two or more categories seemed to fit together. If so, major themes were formed in the research.
- Original copies of the transcripts were revisited. Text that had never been highlighted at all because it did not appear relevant at the time was now looked at. At this time themes, major categories and minor categories were clearly sorted. Some of the previously excluded data were found to be relevant and were included in the results.

3.7 Reliability and validity

The inclusion of classroom observation was important, as it introduced a measure of methodological triangulation, providing a validity check on the perceptions voiced by the interviewees.

According to Ary and Jacobs (1990:256), “The validity question is concerned with the extent to which an instrument measures what one thinks it is measuring and the reliability of a measuring instrument is the degree of consistency with which it measures whatever it is measuring.”

This study was located within the interpretive paradigm. In order to enhance the credibility of this study and its findings, a pilot study was carried out with two teachers from two different schools (one teacher from each school) in the King Williams Town Education District, who were not part of the main study. The purpose of the pilot study was to test the practicability of the data collection plan that was initially proposed for the study.

Bell (1993) confirmed that a pilot study is an exercise to detect all problems that may crop up during a study. Such setbacks could be dealt with before the commencement of the actual investigation. Piloting was also essential to determining whether the research instruments that were designed for the study functioned properly before they were used in the actual study (Johnson and Christensen, 2008).

During the pilot study, it was found that the participants (both teachers and learners) became tense when they were video-recorded. From this observation, the researcher was able to come up with a backup strategy in case something similar was experienced during the actual study. The researcher decided to engage an assistant researcher to help during classroom observations.

A further measure aimed at enhancing the trustworthiness of the study was the use of member-checking to determine the accuracy of the findings through taking specific descriptions back to participants and determining whether those participants felt that they were accurate.

3.8 Ethical considerations

Prior permission to undertake this research was granted by the Education and Research Committee of the University of Fort Hare. Permission to conduct research in the selected schools was also requested from the Department of Education through the office of the King Williams Town District education circuit. When approval was received, the researcher approached the school management and the teachers of the participating schools. A letter was sent to the principals of the selected schools seeking permission to use the schools for research. The researcher also visited the schools and explained the purpose of the study to all the selected participants.

Permission was also sought from the parents of learners who were to form part of the research study. The researcher explained the purpose and nature of the research, and that, while the learners had been selected to participate in the study, they had a choice to accept or reject participation. The researcher also explained that the learners had the right to withdraw at any time without prejudice, and that the interests of no participant would be harmed in any way owing to his or her participation.

The researcher also assured the participants that data collected by the researcher would be anonymous in the dissertation and that in any articles which may follow the study, the names of schools and interviewees would not be revealed or made public. In other words, participants were assured of anonymity, as well as the confidentiality of information obtained from them. Indeed, participants were not asked to state their names during the interviews. The researcher rather formulated codes with which he identified the schools and teachers throughout.

The researcher also gave back the interview schedule and transcribed responses to the respondents to check that they were a true reflection of what the latter had said, and whether they still adhered to their (initial) responses.

3.9 Conclusion

This chapter explained out the research design and methodology used in this research. A qualitative approach was used, situated within an interpretive case study. This approach was chosen because of the purpose of the research and the nature of the data that needed to be collected. Data were collected through interviews and classroom observation. Each of these methods has been described in detail. In the following chapter, the findings are presented.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The current study investigated the language practices of both educators and learners in Physical Sciences classrooms. The research was intended to investigate how current language use practices affect the academic performance of isiXhosa-speaking learners in the Physical Sciences learning area.

The previous chapter dealt with the methodology and research techniques that were employed in this study. This chapter presents analyses and interprets the results of the research findings obtained from the research participants. The data presented were collected through lesson observations and face-to-face, semi-structured interviews with eight teachers from four schools (two teachers from each school) and sixteen learners from the same schools. For ethical reasons, pseudonyms have been used for the eight teachers as well as for the sixteen learners.

Table 4 below shows how these participants are referred to in this study:

Table 4: Pseudonyms for the teachers and learners

School	Teacher	learner
School A	Teacher A1	Learner A1
		Learner A2
	Teacher A2	Learner A3
		Learner A4
School B	Teacher B	Learner B1
		Learner B2
	Teacher B2	Learner B3
		Learner B4

School	Teacher	Learner
School C	Teacher C1	Learner C1
		Learner C2
	Teacher C2	Learner C3
		Learner C4
School D	Teacher D1	Learner D1
		Learner D2
	Teacher D2	Learner D3
		Learner D4

The following research questions guided the data presentation:

Main research question:

How do educators and learners use isiXhosa and English in the teaching and learning of Physical Sciences in the FET phase?

Sub-questions:

- a) What are the educators' and learners' perceptions of the use of isiXhosa and English in the teaching and learning of Physical Sciences?
- b) How are languages (in particular LoLT) actually used in the Physical Sciences classroom?
- c) What can be concluded from educators' and learners' perceptions and use of languages in the Physical Sciences classroom?

This chapter is structured as follows:

- i) Synopsis of the schools where the study was conducted
- ii) Biographical data of participants
- iii) Presentation and analysis of data gathered through interviews
- iv) Presentation and analysis of data gathered from observations
- v) Limitations of the study

vi) Conclusion.

4.2 Synopsis of the schools

Four schools were involved in this study. All four schools are in the King Williams Town District. Two of the schools (Schools A and D) are situated in rural areas and the other two are urban schools. All of them are high schools, with classes ranging from Grade 8 to Grade 12. More than 80% of the learners in all these schools are isiXhosa mother tongue speakers.

Table 5 below shows the matric (Grade 12) pass rate of three of these schools since 2009 (all subjects aggregated). School C will have its first group sitting for matric examinations in 2013.

Table 5: Matric pass rate (2009 – 2011) for the participating schools

School	2009	2010	2011
A	N/A	11,15%	17,0%
B	19,6%	8,5%	46,9%
C	N/A	N/A	N/A
D	35%	46,4%	26%

4.3 Biographical data of the participants

4.3.1 Teachers

Table 6: Biographical data of the participants (Teachers)

Teacher	Teaching experience	Teaching experience in the subject	Qualifications	Gender	Subject majored in	Home Language	LOLT	Language used in class
TA1	15	5	B.Sc	Female	Maths	isiXhosa	English	Eng. & IsiXhosa
TA2	4	4	B.Sc	Male	Phys. Sciences	isiXhosa	English	Eng. & IsiXhosa
TB1	15	8	S.T.D B.Ed	Male	Phys. Sciences	isiXhosa	English	Eng. & IsiXhosa
TB2	5	5	B.Ed Hons.	Male	Maths	isiXhosa	English	Eng. & IsiXhosa
TC1	8	5	B.Sc	Female	Phys. Sciences	Afrikaans	English	English
TC2	5	5	B.Sc	Male	Phys. Sciences	chiShona	English	English
TD1	19	15	S.T.D B.Ed	Female	Phys. Sciences	isiXhosa	English	Eng.& IsiXhosa
TD2	12	8	B.Sc	Female	Phys. Sciences	isiXhosa	English	English

The language of teaching and learning at all of the schools is English. The teachers in Schools A, B and D share the same home language with the learners (isiXhosa).

4.3.2 Learners

Table 7: Biographical data of the participants (Learners)

Learner	Gender	Age	Home language
LA1	F	16	isiXhosa
LA2	M	17	isiXhosa
LA3	M	16	isiXhosa
LA4	F	16	isiXhosa
LB1	F	16	isiXhosa
LB2	F	16	isiXhosa
LB3	M	17	isiXhosa
LB4	F	17	isiXhosa
LC1	M	17	isiXhosa
LC2	M	16	isiXhosa
LC3	F	16	isiXhosa
LC4	M	17	isiXhosa
LD1	F	16	isiXhosa
LD2	F	16	isiXhosa
LD3	F	16	isiXhosa
LD4	M	17	isiXhosa

4.4 Data collection and data analysis

A qualitative method was employed for analysing the data. Leedy (1997:160) states that one of the most important aspects of such data analysis is that the researcher organises, arranges, and orders the data, searching for recurring themes or patterns that represent the participants' perspectives. For interviews, the individual responses

were coded and re-arranged into different categories. A similar method was employed to analyse data obtained through classroom observations. Codes/categories were developed from data that were obtained through the classroom observation.

4.4.1 The interviews conducted with the teachers

One-on-one interviews were conducted with the eight participating teachers, consisting of four teachers from each school. The questions were open-ended and allowed the interviewer the flexibility to probe for details, and both the interviewer and the interviewee the freedom to discuss issues (Kerlinger, 1970).

The Physical Sciences teachers from the FET Phase at the four schools were asked the following questions, in more or less the same sequence:

- Is there a language policy at your school? If yes, what does it emphasise and how effective is it?
- Which language do you mostly use to teach in your Physical Sciences lessons? Why do you use this language?
- What problems, if any, do you encounter in teaching Physical Sciences through English?
- What do you think may be the possible causes of the problems you mentioned above?
- What steps do you take to solve (or minimise) these problems? How well do they work?
- What do you understand by code-switching?
- Do you find that you use more than one language, and switch back and forth from one to the other when teaching?
- Which language do you think best helps your learners understand Physical Science concepts? Why?
- If you use code-switching, how do you *feel* about this practice?
- I asked you a few minutes ago what steps you take to solve problems that you encounter in teaching Physical Sciences through English. Now that you have had

a bit longer to remember, are there any other techniques you might like to mention?

- Are there any further points you would like to make about the question of language in the teaching of Physical Sciences?

Responses received to the question: Is there a language policy at your school? If yes, what does it emphasize and how effective is it?

The eight teachers were asked to state if there was a language policy in their schools, what it entailed and how effective it was.

All eight teachers that were interviewed stated that a language policy existed at their schools. The responses from these teachers also indicated that English was the medium of instruction at all of these schools. For example, teacher TA1 from School A said, *'It stipulates that all teachers, in all subjects except for isiXhosa, should strictly adhere to English as their medium of communication in class.'*

These teachers (from all the four schools) also said that the use of English as a medium of instruction was emphasised by the Senior Management Team (SMT), and that the instruction was that they were expected to teach all subjects in English. The only subjects that were to be taught in any other languages were the additional languages.

The teachers were also asked to elaborate on how effective the language policy was in their schools. Teachers C1 and C2 just stated that the language policy was *'quite effective'*, or *'working quite well'*, without elaborating. The responses of four of the teachers seemed to suggest that the policy was not effective, and they cited low proficiency in the English language as the reason why the policy was not effective. For example, teacher TA1 from School A, said, *'(The policy) is not very effective because both teachers and learners are struggling with English,'* while teacher TA2 from the same school said, *'It is not working because learners do not understand English'* and teacher TB2 from School B said, *'Everyone has a problem with English, but we don't have a choice.'*

The next question was meant to find out the language that the teachers mostly used to teach Physical Sciences lessons, and why they used that language:

Responses received to the question: Which language do you mostly use to teach in your Physical Sciences lessons? Why do you use this language?

The responses that were obtained here were interesting. Four out of the eight respondents said that they used both English and isiXhosa. Two of these respondents were from School A, and the other two were from School B. The four respondents from Schools C and D said that they used English.

When the respondents were asked to give reasons for their language choices, the following reasons were given by the four teachers who said that they used English and isiXhosa:

- TA1: *I have to use both languages because English is the language used in assessments, and I use isiXhosa to make my learners understand.*
- TA2: *Learners do not understand English. So you have to mix languages so that they at least get something.*
- TB: *The text books, syllabus and examination are set up in English, so learners have to get used to English. IsiXhosa makes them understand.*
- TB2: *I use English, which is the language used in assessment, but I also use isiXhosa because learners do not understand English.*

The following points emanated from the responses of these teachers:

- English is used in the everyday teaching of Physical Sciences, as per school language policy
- Because of the challenges of understanding faced by the learners, these teachers also use isiXhosa to act as a bridge to English in order to facilitate the learning and teaching of the subject.

The responses obtained from two of the four teachers who said that they used English only, seemed to indicate that they were very aware of their schools' language policies

which stipulated English as the medium of instruction. The other reasons for using English only all emphasised the need to familiarise the learners with this language – in which textbooks were written (2 teachers), and in which assessments would be conducted (3 teachers). As teacher TD2 said: *'English is the language used in textbooks and for examination purposes, so I have to teach in English so that my pupils become used to this language. I also use English to make my pupils to understand the subject.'*

While the teachers acknowledged that their learners were struggling with the English language, they said that they felt it was the right thing to be teaching in English, as by so doing they were making their learners to be familiar with the language used in assessments and for setting examinations.

However, it is important here to point out that class observations revealed that, in practice, even these teachers who preferred the use of English to the exclusion of isiXhosa, in one way or another allowed the use of English as a medium *together with isiXhosa* in the teaching and learning of Physical Sciences. This apparent contradiction suggests that teachers are quite aware of the content of the LiEP, which advocates teaching in both the medium of instruction and the home language of the learners. All the teachers, regardless of whether or not they had stated that English was the language they used the most in their teaching, were asked to mention problems (if any) that they encountered in teaching through the medium of English.

Responses received to the question: What problems do you encounter in teaching Physical Sciences though English?

The responses that were obtained from this question seem to highlight the low proficiency of learners (and also of some teachers) in the English language as being one of the barriers to the learners' understanding of Physical Sciences concepts.

Teachers said that they faced a challenge in teaching Physical Sciences through the medium of English because their learners were not proficient in English. These are some of the responses highlighting this English second language challenge:

- *The majority of my learners struggle to understand some basic concepts of the subject, maybe because of the English language.*
- *Learners just don't understand the subject matter, and English is making it even worse as my learners are struggling with English.*
- *Some concepts are abstract and not easy to teach in English to learners, of which a larger percentage of them are of low English proficiency.*
- *Learners just don't understand the subject matter, and English is making it even worse.*
- *Learners just can't cope with the English used in the teaching of the subject.*
- *At times you feel like learners are not even hearing what you are trying to convey to them because most of them have a serious handicap in the English language.*

Here, it can be seen that these teachers are focusing much of the blame for the problems encountered in the teaching of Physical Sciences on the English incompetence of their learners. Even teachers from School C, who said that they did not use any other language besides English when teaching, acknowledged that their learners were struggling to grasp concepts because of the English second language barrier.

While it is true that most of the learners in these schools were struggling with language, it is also true that some teachers too were struggling to teach Physical Sciences in English, even though some were not open about this challenge. However, it was interesting to note that other teachers were frank enough to confess that their learners were not the only ones who had problems with understanding English, admitting that they themselves were not proficient in English and that they were actually struggling to teach in English.

This was what some of the teachers had to say when asked about the problems they encountered in teaching Physical Sciences through English:

- *I am not very proficient in English myself, and I also struggle to teach in English.*
- *... I have a problem with English too, I have a challenge to teach with it and I just can't teach in English only.*
- *At times I also don't understand the abstract concepts and worse still, to teach these concepts in English.*

What emanates from all these responses can be summarised as follows:

- Learners from these schools are of low proficiency in English.
- Some teachers are also of low proficiency in English.
- English is seen here as a barrier to learning and teaching of the subject.

When the teachers were further asked to provide the possible causes of the learners' low proficiency in English, several mentioned that the learners were exposed to the English language at a very late stage. All the participating teachers pointed out that their learners were from a rural background, and that they were not exposed to English at an early age, thus their proficiency in the language was low. To make matters worse, English had been taught to these learners as a second language when they were going into the intermediate phase; and immediately this language (English) had become their language of instruction when they had not yet fully developed proficiency in the language.

The participating teachers were then asked to provide how they approached this challenge in order to minimise the language problem:

Responses received to the question: What steps do you take to solve (or minimise) this language problem? How well do they work?

The participating teachers said that they tried to solve the (English) language problem by using isiXhosa as a supporting language in the teaching and learning Physical Sciences. For example, one of the teachers said:

"Since I must stick to English, if they struggle to understand a certain aspect, I usually break this rule and I explain again, using isiXhosa, or I rather ask one of

them to interpret the concept in his/her own words. Usually after the same concept has been repeated by different learners, they do grasp it.”

Another teacher responded this way, *“I try to use English as much as possible, but if they continue to struggle, I use a few Xhosa terms.”*

Even the teachers from School C, who were not proficient in isiXhosa, realised the importance of isiXhosa instruction, and even though they could not speak the language, they asked other learners to explain to their peers in isiXhosa. For example, a teacher from School C said, *“After I have explained a concept or term, I usually ask one of the learners to repeat to the whole class using English.”*

The teachers endorsed English as the medium of instruction (MOI), but at the same time they agreed that the home language of the learners (isiXhosa) should be used alongside English because their learners understood isiXhosa better than they did English.

When the teachers were asked to explain whether they thought that the strategy they used worked, they said that it did work, but did not explain further.

The next question was meant to check whether the teachers knew and understood what was meant by code-switching:

Responses received to the question: What do you understand by code-switching?

The responses that were received to this question indicated that, while the teachers had heard about code-switching, some of them clearly did not understand what code-switching means. They seemed to think that it is the use of a vernacular language without proper planning or knowing what objectives one hopes to achieve by code-switching. Vague responses were obtained such as:

- *Using vernacular instead of using English to explain to pupils.*
- *Using vernacular instead of English to explain terms.*
- *Teaching in isiXhosa. Explain in isiXhosa.*

After finding out what the teachers knew about code-switching, they were then asked whether they code-switched when they were teaching Physical sciences.

Responses received to the question: Do find that you use more than one language, and switch back and forth from one to the other when teaching?

The teachers that were interviewed might not have been able to explain the term 'code-switch', but all except the teachers from School C said that they used code-switching in their lesson presentation. Teacher A1, for example, said, *'I have no choice but to switch to isiXhosa because my learners do not understand English.'*

The other teachers shared similar frustrations: *'My learners don't understand a single thing. They can't even follow instructions if said in English, but when I use isiXhosa, it becomes easier for them.'* Another teacher said, *'If you want to talk alone, then talk to these learners in English. That is why I mix languages; it's not by choice, but the learners' situation forces me.'*

But the concern about examinations still exerted a strong influence: several of the teachers who said that they code-switched, explained that while they did switch, they had to be cautious that they did not overdo it because their learners would have to write examinations in English. For example, when Teacher C1 was asked whether she used code-switching, she said that she did, but *'...if you use code-switching too much, learners won't be able to write answers in English, and they will write it the way you taught them, or leave gaps.'*

On the other hand, some teachers revealed a different perspective on the examinations. For example, one teacher said, *'The exam papers should be in the home languages, or there should be a version in the home language, even if English is used, because Afrikaans has this advantage, so why are isiXhosa or South Africa vernacular languages not used?'*

These teachers (while they are forced by the low English language proficiency of their learners to use isiXhosa when presenting lessons) are nevertheless of the belief that

English should be used in the classroom because learners will be learning to operate in this language.

The teachers were then asked to identify the language which they thought would best help learners to understand the Physical Sciences concepts.

Responses received to the question: Which language do you think best helps your learners understand Physical Science concepts? Why?

Five of the teachers were of the opinion that learners learn better when they are taught in their home language. They said that the learners do not understand English, but when taught in isiXhosa, they do at least grasp a few things. One teacher said they learned better if taught in isiXhosa, and gave the reason for this simply as *“they don’t understand English.”* Another teacher said, *“IsiXhosa makes them understand, because they get involved in the discussions. They can then link it to the English language. Otherwise in English they don’t learn at all; it’s just as good as you are talking to yourself.”*

However, one of the teachers from School D sounded a note of caution. She said that both languages were equally important, citing ‘momentum’ as a term that can be better explained in English, but not in isiXhosa: *“... Both languages, because Physical Sciences has scientific languages. So even if you are code-switching, you can’t change the terms as ‘momentum’ is ‘momentum’ in any language.*

Among the responses to this question of the language best suited to enhancing the learners’ understanding, the concern about examinations again came up: one of the teachers from School C suggested that the language that best helped learners understand Physical Science concepts was English, because English was used for exam papers and other assessment.

The follow-up question to the questions above was meant to check whether teachers code-switched, and if they did, how they felt about it.

Responses received to the question: If you use code-switching, how do you feel about this practice? (Here the responses are displayed in full :)

Table 8: Responses to the question on how teachers feel about code-switching

Teacher concerned	School involved	Question: If you use code-switching, how do you feel about this practice?
TA1	A	<i>It is a good thing because learners get involved and learning takes place.</i>
TA2	A	<i>Code-switching is good because it give learners opportunities to freely express themselves.</i>
TB1	B	<i>I feel that code-switching is the way to go because it promotes the participation of learners.</i>
TB2	B	<i>Code-switching is the best because it makes learners feel accommodated and makes them to get involved in the learning activities.</i>
TC1	C	<i>I don't code-switch because I don't speak the learners' mother tongue, but I do feel that code-switching will promote effective teaching and learning as it will enable pupils to get involved in their learning.</i>
TC2	C	<i>I never switch. I personally would not feel comfortable because I cannot express myself in my pupils' vernacular. Even if I knew how to, it will still make me feel like I have not done justice to the subject and to my pupils as well.</i>
TD1	D	<i>It's good because learners understand the work and it's their language, so they are comfortable and can even ask questions.</i>
TD2	D	<i>Code-switching is good because it makes learners to understand and to participate freely.</i>

Almost all the teachers who said that they used code-switching, argued that it was a good thing to code-switch because it made the learners to open up and participate. They also said that it helped to clarify concepts and to emphasize key concepts. Some

even said that it encourages and motivates learners to learn, and that it improves communication in general.

Only the two teachers from School C said that they did not use code-switching when teaching because they could not speak isiXhosa. However, only one of these teachers expressed a negative opinion about code-switching, saying that she felt that she would be doing her learners a disservice by code-switching.

Teachers were then asked to mention any other techniques they employed to improve the learning and teaching of Physical Sciences.

Responses received to the question: Now that you have had a bit longer to remember what steps you take to solve problems that you encounter in teaching Physical Sciences through English, are there any other techniques you might like to mention?

Some of the teachers said that the best way to overcome the problem of teaching Physical Sciences through English was to set learners problems to solve in small groups. For example one teacher (TA2) said, *“You group the learners into small groups and then give them some problems to solve in these groups. The assumption is that in these groups they will be able to discuss in isiXhosa and help each to understand.”*

Teacher TB1 said, *“The major problem is the English which they don’t understand, so you allow them to discuss and teach each other in small groups. They will understand because they will be discussing in English.”*

Placing the learners in small groups was meant to promote group discussion, which tended to take place in the home language of the learners. By organising learners in groups, teachers were also promoting, among other things, peer interpretation from the LoLT into isiXhosa. They said that when learners were placed in small groups, those learners who were fluent in both isiXhosa and English (the LoLT) would first start by explaining the learning task to their group members using isiXhosa. This would help the group members to understand what was required of them and thus promote more active discussion, which also took place in isiXhosa.

4.4.2 The interviews conducted with the learners

One-on-one interviews were conducted with the sixteen participating learners, consisting of four learners from each school. All the participating learners at the four schools were asked the following questions, in more or less the same sequence:

- What is the official language of learning and teaching at your school? How competent are you in this language?
- Which language do you use for communication?
- Which language/s does your Physical Sciences teacher in fact use in teaching this subject?
- What do you like about learning through the medium of this language?
- What *don't* you like about learning through the medium of this language?
- Which language/s do you and your classmates use to discuss Physical Sciences in the classroom? When you answer the teacher's questions? When you do homework or classroom assignments in Physical Sciences? If you use different languages in these different situations, why do you do so?
- What particular problems do you find in learning Physical Sciences through the medium of English?
- Which language best helps you to understand when your teacher explains scientific terms?
- In which language do you prefer to be taught Physical Sciences? Why?

The participating learners were asked about their competency in the language of learning and teaching. The responses that were given by learners from the four participating schools indicate that the language of learning and teaching (LoLT) in each school was English. The responses that were received also show that most of the learners were not competent in English, the language of learning and teaching. The four learners from School C all indicated that they were competent in English, which was a contradiction of what their teachers had said, when they were interviewed, about the English proficiency of their learners. Their responses reveal that, while the LoLT in these four schools was English, in practice teachers extensively utilised the home

language of the learners as well during the delivery of lessons because the learners did not understand English.

Responses received to the question: What do you like about learning through the medium of English?

Learners were asked to explain what they liked about learning through English.

Interesting responses were received to this question. It was surprising to note that, while the majority of learners said that they did not understand English much, they all said that they liked being taught in English. The reasons they gave for their preferred choice of English as the medium of instruction, corresponded to those that were highlighted in the literature. Some of the reasons they cited for preferring English were:

- It is a universal language (LA1 & LC1)
- It is the language used in examinations and tasks (LA2)
- It is the language used in universities (LC3).

On the other hand learners were also given opportunity to highlight what they did *not* like about learning through the medium of English. The participating learners pointed out that while they preferred to be taught in English, they experienced challenges in trying to learn through the English medium. They said that English made it difficult for them to learn and understand Physical Science concepts.

Below are some of the responses that were obtained from the learners:

(LA1): *“Since we cannot speak English properly, it makes it difficult for us to take some instructions, and meaning is easily lost.”*

(LA2): *“At times I feel as though I cannot understand questions asked in English, and therefore I struggle to answer the questions, meaning that I easily lose marks.”*

(LB3): *“Some pupils they struggle with English, so when they express themselves, other learners laugh at them, which makes them shy to answer questions in class.”*

(LB1): *“English has big bombastic words which make the subject difficult.”*

Responses received to this question reveal that the majority of learners struggled to learn through the medium of English, even though they all said that they preferred to be taught in English. It is interesting to note that the responses of the learners interviewed correspond with those of the teachers. Teachers had also highlighted that English was a barrier to the learners, and that if they (the teachers) were to use only English when delivering lessons, no learning would take place.

On the question of which languages the learners used during class discussion, when answering the teacher's questions, or when doing homework and assignments, all the interviewed learners from Schools A, B and D said that their discussions in class took place in both English and isiXhosa. They said that they did this because most of them were struggling with English, and so they used isiXhosa as well so that they could participate freely. They said that they understood isiXhosa, and so they mostly used it during discussions as it helped them to understand the science concepts, but they also had to use English because tests and examinations were set in English, so they had to learn and get used to English. For example, learner D1 had this to say with regard to the language practices of his learners during class discussions: "*We discuss in isiXhosa as it is our language, to make us understand. We then ask somebody who is fluent in English, to tell us what it means in English, because we are going to write the examination in English. No isiXhosa in exam, so we have to use both – isiXhosa for understanding, and English is to make us pass the examination*".

Learners from School C said that they used English simply because their teachers did not understand isiXhosa, but that given a chance, they would prefer to use both English and isiXhosa. However, during classroom observations, these learners too were observed discussing mainly in isiXhosa. They only used English when they were reporting back on their findings.

All learners who participated in the study said that they answered questions using English. The reasons they gave were that in some cases it was an instruction from their teachers, and that it was preparing them for the examinations which are written in English. Again, this did not exactly correlate with what was observed. With the

exception of learners who were taught by TC1 in School C, all the other learners who participated in the study were able to give answers to questions in class using either English or isiXhosa, or both English and isiXhosa.

To probe further, the participating learners were asked the particular problems they encountered in learning through the medium of English. The responses to this question seem to suggest that most of the learners were struggling with English, which means that English was undoubtedly a barrier to their learning of Physical Sciences.

The responses to this question are listed below:

Table 9: Responses to the question on problems encountered in learning through the medium of English

LA1	A	<i>English is a very complicated language sometimes.</i>
LA2	A	<i>A t times I do not understand some things and so that makes learning Physical Science challenging.</i>
LA3	A	<i>Some terms are difficult to understand.</i>
LA4	A	<i>There are words that need to be discussed, that is, bombastic words.</i>
LB1	B	<i>I don't understand some words.</i>
LB2	B	<i>The terms are sort of hard to understand.</i>
LB3	B	<i>Some terms that are used in Physical Sciences makes the subject difficult. Even if the teacher tries to explain those deep scientific terms, we tend to forget as time goes on.</i>
LB4	B	<i>English makes everything complicated.</i>
LC1	C	<i>Spellings and pronouncements of some words.</i>
LC2	C	<i>There are some complicated words.</i>
LC3	C	<i>Well, as I said, there are words used to express the topic and it might be hard to define them.</i>
LC4	C	<i>Bombastic words.</i>

LD1	D	<i>No problems.</i>
LD2	D	<i>None.</i>
LD3	D	<i>I don't understand English.</i>
LD4	D	<i>Most of the English words are difficult to understand and to even remember them.</i>

When the learners were asked to explain which language (English or isiXhosa) helped them to understand the scientific concepts, the majority of them mentioned both English and isiXhosa as playing a crucial role. In fact it was only the four learners from School C who mentioned only English.

According to the responses given by the learners (Table 9 above), it can be concluded that isiXhosa plays an important part in the teaching and learning of Physical Sciences. Learners viewed the use of isiXhosa together with English in the learning and teaching of Physical Sciences as being beneficial. They said that, while Physical Sciences was 'an English subject', the use of isiXhosa to explain some terms and abstract concepts was helping them to understand the content of the subject. The responses that were obtained from learners from School C were expected, since these learners were exposed to the teaching and learning of Physical Sciences in English only.

In the previous question, learners had said that they learned better if both English and isiXhosa were used together during the learning and teaching of Physical Sciences. Surprisingly, when they were asked which language they would prefer to be taught in, all but one said that they preferred to be taught in English.

Learners seemed to be contradicting themselves because, on one hand, they said that English was making them fail the subject, since they did not understand English much, but they also said that they preferred to be taught through the medium of English.

The reasons they gave for their choice of language of learning and teaching seemed to agree with what was found in the literature review regarding why schools had not implemented the effective school language policies: the widespread view of English as

the language of power, employment, the gateway to success, etc. For example, some of the learners gave the following reasons as to why they preferred to learn in English:

- *... because it is spoken in every country in the world, so if I learn Physical Science through English, it makes me get jobs in overseas.*
- *English, for the future and for work.*
- *Taught in English because English is the language of the world.*
- *English because I want to know it and get job.*
- *English so that I can go to University and find work after that.*

The learner interviews revealed that while the learners were not proficient in the LoLT (English), they still preferred to be taught through English because they thought of it as a language that would increase their chances of going to university, thus increasing their chances of getting good jobs. It was clear from the learner interviews that the learners endorsed English as the LoLT.

4.4.3 Classroom observation

All classroom observations of Grade 11 Physical Sciences classes at the selected schools were undertaken during the second half of the 3rd term of 2012. The observations were structured to shed light on how both educators and learners use isiXhosa and English in the teaching and learning of Physical Sciences in the FET phase. Two classroom observations were carried out in each of the selected schools.

The observation schedule was designed to guide the observation of language practices during the learning and teaching of Physical Sciences, in order to establish which of the two languages (isiXhosa or English) was in fact the most frequently used. The issues observed formed part of either 'teacher – learner talk' or 'learner – learner talk' (see observation schedule, Annexure 1).

The schedule was organised around structured themes relating to the language distribution used during teaching and learning. Particular attention was paid to how both

the isiXhosa and English languages were used in introductions, explanations and recapping.

Initially, fifteen-minute segments of Physical Science lessons were supposed to be video-recorded, with the main focus on the educators and learners who formed each part of the sample. However, the recordings were not very helpful because learners and teachers became tense in classes that were being video-recorded. The video recording failure occurred at the first two schools in which classroom observation was done. In the end, the whole video recording was discarded. Classroom observations were carried out with the help of an assistant researcher. The researcher had no choice but to reschedule classroom observation at these two schools.

School A: Classroom observation

The language profile of the teachers and learners involved in the study

The teachers of both classes observed were home-language isiXhosa and second-language English speakers. The proficiency of these teachers was, therefore, at different levels in the two languages. Both teachers were proficient in isiXhosa. The official medium of teaching and learning for the content subjects (in this case Physical Sciences) was English. However, in practice the situation that was observed was totally different.

All learners who were doing Physical Sciences were found to be isiXhosa mother tongue speakers. These learners came from isiXhosa-speaking communities and they had not been exposed to English at an early age, which meant that they were not proficient in English, the medium of teaching and learning. The learners were found to speak the same language (isiXhosa) as their teachers, so it meant that there was no teacher–learner language barrier in respect of the first language (isiXhosa).

General conversation in the classroom

Before teacher A1's Physical Sciences lesson started, it was observed that learners conversed only in isiXhosa. Even during the lesson, learners spoke more isiXhosa than English. The teacher gave instructions, and insisted on discipline, in the home language of the learners (isiXhosa). This appeared to make it possible for the learners to understand. Accordingly, starting with the home language of the learners was seen to provide a sense of security that validated the learners' lived experiences, allowing them to express themselves.

Whenever the teachers switched to English, there was dead silence in the classrooms. Most of the time, when these learners were being addressed in English, they tended to look down, and appeared as if they were lost. However, the same learners became lively when spoken to in isiXhosa.

Judging by their gestures, behaviour and attitudes, it was clear that most of the learners were not comfortable when addressed by their teachers in English: they appeared to appreciate being addressed in isiXhosa, rather than in English.

The lesson topic: Ohm's Law

- **The introduction of the lesson**

- (i) **Teacher A1 (TA1)**

The introduction of the lesson was done in English. The teacher started by asking a question which was meant to recap what was done in the previous lesson. There was no response from the learners. The teacher repeated the question several times, hoping to get a response from the learners. When the class continued to remain silent, the teacher switched to isiXhosa: 'Yintoni umbane?' Immediately, a reasonable number of hands went up. The response was given in something like a chorus manner. The teacher then got into the topic of the day, without affirming whether the response given was correct or not.

During the lesson, all writing on the board and in the learners' note books was done in English; however, verbal interaction between the teachers and the learners took place mostly in isiXhosa; in fact, the learners spoke only in isiXhosa, though a few English words were used by the teacher.

(ii) Teacher A2 (TA2)

The introduction of the lesson was done in a mixture of English and isiXhosa. The teacher started by asking a question in English which was meant to recap what was done in the previous lesson, and before the learners could even attempt to answer the question, he translated the question from English into isiXhosa. The question was close-ended and required a one-word answer without elaboration. Learners responded in a chorus of 'yes's', but a few 'no's' were also heard. Just like teacher TA1, this teacher did not bother to elaborate on the learners' response. Immediately after the class had 'chorused' their response, the teacher got into the topic of the day.

- **The explanation of terms**

(i) Teacher A1 (TA1)

The teacher would start by explaining the terms and concepts to the learners in English, but would afterwards switch to isiXhosa. Throughout the lesson the teacher would just alternate between using English terms and isiXhosa terms, but without fully explaining what the terms really meant in the respective language. At the end of the session it was not clear whether the teacher wanted the learners to understand the concepts, or just to make them get involved in discussions which did not contribute much to their learning of the major concepts of the topic. It was observed that the teacher did most of the talking, while learners were passive throughout the lesson. From time to time the teacher would ask the learners close-ended questions, pause for a moment, and then answer the question himself. It was interesting to observe that even when the

teacher would have switched to isiXhosa, the delivery of the lesson still remained teacher-centred, while the learners still remained passive.

(ii) Teacher A2 (TA2)

The teacher delivered his lesson mainly in isiXhosa. He would start by explaining the relevant terms and concepts in isiXhosa, dropping a few English words here and there. There was not much elaboration from the teacher whenever he used English. The teacher would, for example, refer the learners to read the definition of Ohms Law from their textbook, at the end of which the teacher would immediately switch to isiXhosa and continue delivering the lesson: no elaboration or discussion of Ohms Law was engaged in. Despite the fact that the lesson was presented mainly in isiXhosa, a language which the teacher shared with his learners, there was minimal teacher-learner interaction, because the lesson was teacher-centred. The teacher did not create or provide any opportunities for classroom discussion.

There was some agreement between the teacher's actions and his responses in the interview on how he employed the two languages during lesson delivery. He mostly employed the learners' home language (isiXhosa), and used minimal English (the language of learning and teaching at his school) to deliver the lesson.

- **The asking of questions**

(i) Teacher A1 (TA1)

Questions were asked both in English and in isiXhosa. The teacher would start by asking the question in English and then translate it to isiXhosa if there was no response from the learners. At times the teacher would ask the question in isiXhosa only. A question asked first in isiXhosa was not translated into English.

When questions were asked in English, learners would keep quiet. This was usually taken as an indication that they did not understand the question. When the teacher rephrased the question in English, a few hands would go up. However, the responses that they would give revealed gaps in the concepts that were supposed to be grasped. Learners would respond in isiXhosa, giving one-word answers; in fact most of the questions that were asked by the teacher required the learners to give 'yes' or 'no' responses. Most of the time, instead of the learners responding to the questions they had been asked, they would ask their teacher to 'explain again', saying that they did not understand. To this the teacher responded at times by saying that they should get used to the way questions were asked in English because Physical Sciences was a subject that was supposed to be learnt and taught in English, and that they were going to write their exams in English.

While it was clear that learners were struggling with English, the teacher still endorsed English for teaching and learning, believing that this would make them become proficient in the language, which would in turn improve their achievement in Physical Sciences. The teacher seemed to be contradicting herself as far as the use of English in assessment was concerned. She would ask questions in both English and isiXhosa, allowing learners to respond in isiXhosa on one hand, but on the other hand, she would discourage the use of isiXhosa by suggesting that the learners should get used to English because this was the language used in exams.

(ii) Teacher A2 (TA2)

Questions were asked mostly in isiXhosa. The questions were close-ended and did not challenge the learners to engage in dialogue or argue their points. Learners responded in isiXhosa even when the teacher asked the question in English. When learners were given a chance to ask questions, they always did so in isiXhosa. The teacher would respond to their question either in English only, isiXhosa only or use both English and isiXhosa.

- **The provision of feedback**

- (i) **Teacher A1 (TA1)**

The teacher allowed her learners to use isiXhosa when discussing in their groups, but was 'strict' when it came to feedback. Feedback could only be given in English as this was the language of assessment. She would say that isiXhosa is used only to facilitate their understanding of Physical Sciences content, but assessment is carried out in English only, and feedback is part of assessment. Here again, the teacher demonstrated inconsistency. The teacher allowed learners to use isiXhosa when answering questions, but said they should stick to English when giving feedback. This reveals a gap between the teacher's beliefs and practice.

- (ii) **Teacher A2 (TA2)**

After group discussions, the teacher allowed his learners to use isiXhosa to give feedback to the class. The teacher would then try to summarise and elaborate briefly on the feedback from each group. He would do this using English, and at times he would use both English and isiXhosa.

- **Recapping**

- (i) **Teacher A1 (TA1)**

The recapping of the lesson was done in English. The teacher adopted the English-only approach during the recapping of the lesson, even though she was aware of the challenges experienced by her L2 learners. It was obvious that learners were not following these interactions; their heads were bowed down, and some seemed to pretend they were asleep. There was dead silence, an indication that not much (if any at all) learning had taken place. The expression of the learners clearly showed that no meaningful learning had taken place.

(ii) Teacher A2 (TA2)

IsiXhosa was used by the teacher to recap the lesson. He was very brief and did not give any opportunities to the learners to ask any question related to the content that they had just been taught.

- **Conclusion**

(i) Teacher A1 (TA1)

The teacher concluded the lesson by giving the learner some homework to do in small groups. She explained, using isiXhosa, what they were expected to do in the homework. She wanted to make sure that they received clear instructions, so that they would do exactly what she wanted them to do.

(ii) Teacher A2 (TA2)

The same language practice was exhibited by this teacher when he was concluding his lesson delivery. He gave his learners some work which they were supposed to do in small groups. The home work was written in English, but he explained everything in isiXhosa.

School B: Classroom observation

The language profile of the teachers and learners involved in the study

The two teachers in this school who participated in the study were home-language isiXhosa and second-language English speakers, which meant that their proficiency was at different levels in the two languages. Through informal conversation with these teachers, it was observed that one of them was struggling to express himself in English. Both teachers were proficient in isiXhosa. The language profile of the teachers at this school was essentially the same as that of School B.

All learners who were doing Physical Sciences were found to be isiXhosa mother tongue speakers. These learners came from isiXhosa-speaking communities and did not appear to be proficient in English, the medium of teaching and learning, probably because they conversed only in isiXhosa as they were growing up.

Since both the learners and their teachers were isiXhosa home language speakers, this meant that there was no teacher-learner communication breakdown between the teacher and learners (or among the learners themselves).

General conversation in the classroom

Both before the lesson started and during the lesson, it was observed that the learners conversed only in isiXhosa. The teachers gave instructions and insisted on discipline in the home language of the learners (isiXhosa). The teacher greeted and shared jokes with the learners in isiXhosa. Even when the teacher was about to start the lesson, learners were instructed to keep quiet in isiXhosa.

Judging by their gestures, behaviour and attitudes, it was clear that most of the learners enjoyed being addressed by their teacher in isiXhosa. During such times, the teacher did not utter a single word in English.

The lesson topic: Ohm's Law

- **The introduction of the lesson**

- (i) Teacher B1 (TB1)**

The introduction of the lesson was done in English. The teacher asked a question in English. The behaviour of the learners immediately changed from that of a jovial and lively group, to a somber and tense mood. Sensing this, the teacher immediately switched to isiXhosa, 'Hayibo!, bethuna, siyenzile lento' (we did this topic). The teacher then translated the introductory question into isixhosa. The learners immediately responded in a chorus (without even raising their

hands), to which the teacher responded by saying 'That's correct', even though it was evident that the learners had not 'sung' the same thing. The teacher then got into the topic of the day.

(ii) Teacher B2 (TB2)

The introduction of the lesson was done mainly in isiXhosa, with a minimal use of English. The teacher started by asking learners close-ended questions based on the previous lessons. These questions were asked in English, but were translated into isiXhosa by the teacher because he knew the challenges experienced by his learners as far as English was concerned. Participation of learners was almost non-existent, even though the teacher had given them the leeway to respond to the question in isiXhosa if they pleased. The teacher himself answered most of the questions he had asked.

- **The explanation of terms**

(i) Teacher B1 (TB1)

During the lesson all writing on the board and in the learners' notebooks took place in English, but verbal interaction between the teachers and the learners took place mostly in isiXhosa. In most cases, the teacher would just 'Xhosalise' the English terms. The teacher would not bother to look for a Xhosa word/term to substitute for the English word/term in isiXhosa terms, but would just say the English word in isiXhosa. For example, instead of using the Xhosa word 'umbane' for electricity, the teacher just pronounced the word in a Xhosa accent by saying 'ielektrisiti'. The presentation of the lesson was teacher-dominated, and through the lesson, the learners were just passive consumers of knowledge. Even though the teacher was using isiXhosa to deliver the lesson, he did not engage his learners in dialogue and discussions.

(i) Teacher B2 (TB2)

Although this teacher endorsed English as the language of learning and teaching, he used more isiXhosa than English in his lesson presentation to promote understanding and participation. Definitions were read straight from the learners' textbooks, after which the teacher would try to explain to the learners using isiXhosa. However, his learners still did not participate at all because the teacher did not create opportunities for dialogue and discussion; even learner-to-learner participation did not exist.

- **The asking of questions**

(i) Teacher B1 (TB1)

Questions were asked in English because the teacher was using questions from past exam papers. At times the teacher would start by asking a question in English, and if there was no response from the learners (most of the time there was no response from the learners), would translate the question to isiXhosa. When questions were asked in English, learners would keep quiet. This was again, in most cases a clear indication that they did not understand the question. Even when the teacher rephrased the question in English, no hands would be raised by the learners in an attempt to answer the question. It was clear that the learners were not able to link the 'Xhosalised lesson' with the questions that were being asked, an indication that little or no meaningful learning had taken place. The learners would be seen whispering among themselves. This would seem to frustrate the teacher, who would ask a learner, 'Yinto ingxaki yenu? Ileson siyithethe sayigqiba. Akukho into intsha ibuziweyo. Kutheni lingakwazi ukuphendula eziquestions?' (What is your problem? We are done with the lesson. Nothing new has been asked here, so why are you failing to answer these questions?)

(ii) Teacher B2 (TB2)

The teacher asked questions in English, but these questions were explained in isiXhosa and the learners were told that they could use either English or isiXhosa, or both, to answer the questions. In any case, most of the questions only required one-word answers. The questions asked were mainly ones that required reproductive answers (mostly featuring verbs such as 'list', 'name' and 'state') which did not challenge learners to think critically (as 'why' or 'how' questions would have been more likely to do).

The provision of feedback

(i) Teacher B1 (TB1)

While learners were allowed to give feedback in isiXhosa, the teacher encouraged them to try to use and get accustomed to using English, which is the medium of assessment. Some learners appeared not to be keen to give feedback. It was not clear whether this was due to a reluctance to use English, which the teacher clearly hoped for, or to the learners genuinely not knowing what to say.

(ii) Teacher B2 (TB2)

The teacher had previously given his learners work to do in groups. He asked the representatives from the respective groups to come forward, one after another, and give feedback on their groups' findings. All the group representatives did their presentations in isiXhosa. It was the teacher who would elaborate on each presentation, using both English and isiXhosa.

- **Recapping**

- (i) **Teacher B1 (TB1)**

For some reason or reasons best known to the teacher, the recapping of the lesson was done in English only, even though it was clear that learners were not following the English-only deliberations. This could have been due to the fact that the teacher had assessments (which are in English) in mind. It seemed like the teacher was torn between using a language that would facilitate learning and the language that is used in assessments.

- (ii) **Teacher B2 (TB2)**

The recapping of the important terms, laws and concepts of the topic was done in English. However, the teacher later on used isiXhosa to facilitate learner understanding.

- **Conclusion**

- (i) **Teacher B1 (TB1)**

In concluding the lesson, the teacher gave the learners a collection of questions from different past exam papers to do in small groups. He told them that their major problem was English. They needed to improve their English competence. Surprisingly, the teacher delivered the whole lesson in a language that could be described as something between English and isiXhosa; maybe he did so for the benefit of his learners who were struggling with English. He instructed his learners (in isiXhosa) to answer the questions in groups and in English only. He told them that he wanted them to use English so that they could get accustomed to it because it is the language used for examination purposes. Once again there was a hint of contradiction in the teacher's practice.

(ii) Teacher B2 (TB2)

The main points/highlights of the lesson were summarised in English. However, this summary was also explained in isiXhosa

School C: Classroom observation

The language profile of the teachers and learners involved in the study

The teachers of the classes observed in this school were not home language isiXhosa-speakers. In fact, they could not speak the language, although they could understand a few words in isiXhosa spoken by the learners. However, these teachers were highly proficient in English, the medium of teaching and learning for the content subjects (in this case Physical Sciences).

All the learners who were doing Physical Sciences were found to be isiXhosa mother tongue speakers. These learners came from isiXhosa-speaking communities and they had not been exposed to much English at an early age, which meant that they were not proficient in English, the medium of teaching and learning. The learners were found not to be speaking the same language (isiXhosa) as their teachers, so it meant that there was a teacher-learner language barrier in respect of the first language (isiXhosa).

General conversation in the classroom

Before the lesson started and during the lesson, it was observed that learners conversed among themselves in isiXhosa. When the lesson did commence, the learners tried to converse in English but it could be seen that they were struggling to maintain the conversation in English. The teachers gave instructions and insisted on discipline in English. The teachers greeted and shared jokes with the learners in English, throwing in one or two words of Xhosa at the same time.

Judging by their gestures, behaviour and attitudes, it was clear that most of the learners enjoyed being addressed by their teacher in English, even though they tended to respond to their teacher in a mixture of English and isiXhosa.

The lesson topic: Ohms Law

- **The introduction of the lesson**

- (i) **Teacher C1 (TC1)**

The introduction of the lesson was done in English. The teacher started by asking a question which was meant to recap what had been done in the previous lesson. There was no response from the learners. Learners became quiet and tense. Several learners tried by various means to avoid eye contact with their teacher. The teacher tried to rephrase and explain the question using simpler English. When learners still did not respond, the teacher tried to guide them towards the answer. A few hands went up, and most of the learners who tried to respond to the question gave one-word answers. Finally the teacher told the learners the correct answer that they were expected to give, and then he introduced them to the topic of the day.

- (ii) **Teacher C2 (TC2)**

The teacher introduced the lesson in English only. He started by recapping what had been done in the previous lesson. During this period, learners were now very quiet. Most of the learners tried to avoid eye contact with their teacher by looking down. Sensing that this was not working, the teacher asked one of the learners, who seemed to be competent in both English and isiXhosa, to give a summary of what had been learnt in the previous lesson. There was a sign of relief on the faces of the learners when their colleague was explaining to them

- **The explanation of terms**

- (i) **Teacher C1 (TC1)**

During the lesson all writing on the board and in the learners' notebooks took place in English. Verbal interaction between the teachers and the learners also took place in English. However, some of the learners were seen and heard

whispering among themselves in isiXhosa. The teacher delivered his lesson in English only, but from time to time he would pause to ask probing questions to check whether the learners were operating on the same wavelength as him. If the learners seemed to be lost, he would try to simplify his explanations. If the problem persisted he would just say to the learners, 'You need to do something about your English because Physical Sciences must be taught in English'. This was the general trend throughout the lesson. Lack of a clear picture of what was taught led the learners to appear lost and helpless. The learners seemed to find it difficult to express their thoughts in the LoLT.

(ii) Teacher C2 (TC2)

During the lesson all verbal interaction between the teacher and the learners, as well as all writing on the board and in the learners' note books, took place in English. When the learners seemed to be lost, the teacher would try to simplify his explanations. When the problem persisted he would ask one of the learners who was competent in English, to explain to the whole class. At the end of this explanation there would be a sigh of relief from the other learners. These learners would be heard whispering in a mixture of English and isiXhosa, saying 'Tshini, ayiselulala iPhysical Sciences when explained in isiXhosa!' (What, Physical Sciences is so easy when explained in isiXhosa). This was the general trend throughout the lesson: the teacher would use peer interpretation from the LoLT (English) to the home language (isiXhosa) to bridge the gap in the learning and teaching of Physical Sciences, in which learners fluent in both English and isiXhosa were asked by the teacher to interpret for their classmates who did not understand.

- **The asking of questions**

- (i) Teacher C1 (TC1)**

Questions were asked in English. Even when learners seemed not to understand the questions asked in English, the teacher did not make any effort to ask any of the learners to attempt to translate the questions into isiXhosa; however, learners would be heard discussing the questions among themselves in isiXhosa, after which a few hands would then be raised. This seemed to indicate that most of the learners did not understand the questions asked in English, but that when the questions were translated into isiXhosa by other learners in the class, at least some learners were then able to understand to a certain extent.

When the learners answered questions, this was usually done in a very brief manner and with a clear lack of confidence in the use of English. The teacher also avoided giving her learners questions that required them to reason and to support their points with arguments.

- (ii) Teacher C2 (TC2)**

Questions were asked in English only, and the teacher encouraged his learners to attempt answering in English. However, if a learner seemed eager to try but was limited by his or her knowledge of the language (English), the teacher would encourage the learner to respond in isiXhosa ('Tell us in Xhosa,' the teacher would say), but to speak very slowly so that the teacher would also get an idea of the content of the learner's response.

At times the teacher would ask learners who were more fluent in both English and isiXhosa to interpret the question for the whole class so that all learners could at least follow what was going on. In this way the teacher was able to get a majority of learners to participate. The teacher may not have been a Xhosa speaker himself, but he was able to use peer interpreting to make up for learners' lack of English language skills.

- **The provision of feedback**

- (i) **Teacher C1 (TC1)**

This was done in English only. The teacher also encouraged his learners to give feedback from group work, home work and assignments in English.

- (ii) **Teacher C2 (TC2)**

While this teacher encouraged his learners to use English when giving feedback, he also gave an opportunity to those learners who could clearly express themselves only in isiXhosa to use their home language. At such times learners fluent in both English and isiXhosa would translate from isiXhosa to English for the benefit of the teacher as well as other learners in the class.

- **Recapping**

- (i) **Teacher C1 (TC1)**

The recapping of the lesson was done in English. It was obvious that a few learners were following this, but also that the majority of the learners in the class had understood very little of the lesson. The teacher may have noticed this too, because he said to them, 'The topic might seem complicated now, but once you begin to solve problems and answer questions from past exams, things will begin to fall into place.' The teacher did not make an effort to get learners to interpret from English to isiXhosa; instead he advised the learners to work hard to improve their English language proficiency, which he said was the vehicle by which Physical Sciences was taught and examined.

- (ii) **Teacher C2 (TC2)**

The teacher recapped the lesson in English. All the important concepts and terms were mentioned, but without much elaboration. No code-switching was done during the recapping of the lesson.

- **Conclusion**

- (i) Teacher C1 (TC1)**

In concluding the lesson, the teacher gave the learners a collection of questions from different past exam papers to answer in small groups. He also gave a few questions which he said would lead them to their next topic. All the questions that the teacher gave to the learners were in English.

- (ii) Teacher C2 (TC2)**

The main points/highlights of the lesson were summarised in English. Learners were given a collection of questions from previous examination question papers.

School D: Classroom observation

The language profile of the teachers and learners involved in the study

Both teachers of the classes observed were isiXhosa home-language and English second-language speakers. The proficiency of the teachers was, therefore, at different levels in the two languages. The teachers were all proficient in isiXhosa. The medium of teaching and learning for the content subjects such as Physical Sciences was English. However, in practice the observed situation appeared to be quite different.

All learners who were doing Physical Sciences in the classes studied were found to be isiXhosa mother-tongue speakers. These learners came from isiXhosa-speaking communities, and they had not been exposed to much English at an early age, which meant that they were not likely to be proficient in English, the medium of teaching and learning.

The learners were found to speak the same language (isiXhosa) as their teachers, so it meant that there was no teacher–learner language barrier in respect of the first language (isiXhosa).

General conversation in the classroom

Both before and during the lesson, it was observed that learners conversed among themselves in isiXhosa only. Conversation between teachers and learners was also in isiXhosa. The teachers mostly gave instructions, insisted on discipline, greeted the learners and shared jokes with them in their home language (isiXhosa). Judging by their gestures, behaviour and attitudes, it was clear that most of the learners enjoyed being addressed by their teacher in isiXhosa.

The lesson topic: Ohm's Law

- **The introduction of the lesson**

- (i) Teacher D1 (TD1)**

The introduction of the lesson was done in English. The teacher introduced the lesson by asking the learners a question based on what had been learnt in the previous lesson. However, there was no response from the learners. The teacher immediately switched to isiXhosa and translated the introductory question into isiXhosa. The response that came from learners was nothing more than a chorus. Those learners who responded did so in isiXhosa. The teacher affirmed that the response given was correct.

- (ii) Teacher D2 (TD2)**

The introduction of the lesson was done in English. However, the teacher immediately switched to isiXhosa to give a brief summary of what they had done in the previous lesson. Still using isiXhosa, the teacher tried to motivate the learners for the lesson of the day.

- **The explanation of terms**

(i) Teacher D1 (TD1)

Verbal interaction between the teacher and the learners took place in both English and isiXhosa. The lesson was delivered in a mixture of English and isiXhosa. There was little agreement between the teacher's response in the interview and how the two languages (English and isiXhosa) were employed during the lesson presentation. When the teacher was being interviewed, she said that she used English only when she was teaching as per the school language policy, but when she was teaching she was observed to be using both isiXhosa and English interchangeably. The teacher would switch to isiXhosa, explain a few things and then switch back to English again. Each time she did this, she would remind the learners that Physical Science was supposed to be taught in English, and was only switching to facilitate their understanding of the important concepts, otherwise they were supposed get used to English if they wanted to pass the examination.

Teacher D2 (TD2)

During the lesson all writing on the board and in the learners' note books was done in English. Verbal interaction between the teachers and the learners took place mostly in English, but the teacher would also switch to isiXhosa in order to bridge the gap between the low English skills of the learners and their understanding of content. Whenever the teacher came across some new words or unfamiliar terms, she would immediately switch to isiXhosa so as to facilitate concept development. This was consistent with what the teacher had said when she was being interviewed about her classroom language practices.

- **The asking of questions**

- (i) **Teacher D1 (TD1)**

The teacher would start by asking the questions in English and then translate the question to isiXhosa if there was no response from the learners. When questions were asked in English, learners did not respond. Even when the teacher translated the questions into isiXhosa, very few learners put their hands up in an attempt to answer the questions – the teacher insisted that they should use English because ‘Assessment is carried out in English’. Some of the learners could be seen whispering among themselves, completely uninvolved in the whole proceedings, maybe because of the language (English) issue. Most of the questions that were asked were close-ended and did not challenge the critical thinking of the learners.

- (ii) **Teacher D2 (TD2)**

The teacher used both English and isiXhosa when asking questions. The teacher was using questions taken from previous exam papers. The questions would first be read in English, and then immediately translated into isiXhosa, whether the learners understood or did not understand the question. While the teacher encouraged her learners to use English when answering questions, the learners were not restricted to answering in English only. However, an answer was sometimes given in isiXhosa; this answer would then be discussed and translated into English. Most of the questions asked did not provoke critical thinking because the questions were close-ended.

- **The provision of feedback**

- (i) **Teacher D1 (TD1)**

This was done both in English and in isiXhosa. However, the teacher also encouraged his learners to give feedback in English if they could from group

work, homework and assignments, as this would prepare them for the examinations.

(ii) Teacher D2 (TD2)

The recapping of the important terms, laws and concepts of the topic was done in English. However, the teacher later on used isiXhosa to facilitate the learners' understanding.

- **Recapping**

(i) Teacher D1 (TD1)

The recapping of the lesson was done mostly in English, with isiXhosa used only a few times. The teacher seemed to be content with sticking to the medium of instruction despite the fact that her learners seemed completely lost because of their limited competency in the English medium.

(ii) Teacher D2 (TD2)

The recapping of the lesson was done mostly in a mixture of English and isiXhosa. The teacher extensively alternated between the two languages. The recapping of the important terms, laws and concepts of the topic was done in English. However, the teacher later on used isiXhosa to facilitate learner understanding.

- **Conclusion**

(i) Teacher D1 (TD1)

In concluding the lesson, the teacher gave the learners a collection of questions from different past exam papers to do in small groups, and she told them that they needed to improve their English competence. She said that they could only do this if they stuck to English as they discussed and answered the questions.

When the teacher was giving these instructions to the learners on how to tackle the assignment questions, she used isiXhosa.

(ii) Teacher D2 (TD2)

The main points/highlights of the lesson were summarised in English. Learners were given a collection of questions from previous examination question papers.

4.5 Themes/patterns emerging from the three data sets (teacher interviews, learner interview and observations)

The objective of identifying emergent themes from the three data sets was to identify common or different themes to be able to theorise about the findings.

4.5.1 Data source: Classroom observation

- In lessons in which presentation was done in English only, there was non-participation by learners because teaching was marked by one-way communication. Even when the teacher asked questions in these lessons, the responses given by the learners were few and mostly weak. These teachers seemed to be aware of the language challenges of their learners, and avoided asking challenging questions, but this reduced the lesson to a teacher-centred one. It can be said that learning in a second language is a challenge for learners who do not have a firm base in the language, but also for the teachers who have difficulty getting the learners to interact.
- However, it should also be added that another contributory factor to the non-participation of the learners could be that some learners are in fact simply less gifted in the subject than others. Another contributory factor could be the limitation of the teachers' skills in presenting the lessons.

- Furthermore, even though most of the teachers were code-switching in their teaching, passive behaviour by learners was still observed. This seemed to suggest that the learners, besides having an English challenge, were also struggling with the subject matter. The learners were not able to engage in critical discussions, leading teachers to avoid asking probing questions. This both resulted from teacher-centred presentation of lessons and contributed to the lessons being even more teacher-centred. Despite the use of code-switching by teachers, the lessons were still teacher-centred.
- Schools have tended to adopt English-only policies even though learners in these schools are isiXhosa first language speakers. On the face of it, one could query why schools that are dominated by isiXhosa first language speakers have adopted English as their LoLT, but close analysis would reveal contradictions between learning/teaching policy and assessment policy (which is done in English only). Factors such as National Department of Basic Education Assessment policy seem to have influenced schools to adopt English as LoLT. Since assessments are in English, it is fitting to have a language policy that emphasises the use of English as the LoLT. After all, questions cannot be explained to learners or translated into isiXhosa during examinations.
- One of the main objectives of the teachers in using code-switching is to enable learners to participate in discussion, and also to allow learners to assist in the teaching. However, classroom observations revealed that learners still remained passive even in those lessons in which teachers code-switched between English and isiXhosa. The ways in which teachers delivered their lessons as well as the learners' limited understanding of the subject could have contributed to the passiveness of the learners during the lessons.
- It was interesting to note that learners were quite active and talkative during group discussion. It was observed that learners contributed freely during peer group discussions. However, it should be pointed out that it is possible that these learners might not in all cases have been discussing only the subject at hand, but

could have been discussing their own interests which had nothing to do with subject task. When the researcher moved closer to some of the groups which appeared to be discussing the subject in a lively manner, it was noted that the “active contribution” of the learners seemed to die, and only one learner in the group could be seen jotting on paper what other members of the group appeared to whisper to her/him. This could have indicated that learners might not have been discussing the class task in the first place and so when the researcher approached them, they wanted to make it look as if they were now writing down their points, or they might have been genuinely discussing the class task, but felt that the researcher would not approve of their use of isiXhosa during discussion.

- The main language that was used during these group discussions was isiXhosa. English was rarely used by the learners. When used, it was never, as far as the researcher could hear, in a complete English sentence, but one or two English words would be thrown in amidst an isiXhosa sentence.

4.5.2 Data source: Interviews

- The language policy is out of alignment with the *de facto* practice of most, or at least many, teachers in that examinations and other assessments are in English only, when many learners and teachers are in fact dependent on isiXhosa to help them grapple with the conceptual content of an already-challenging subject.
- English is associated with assessment, further and tertiary education, universal communication and employment. Even though learners were struggling to understand Physical Sciences when presented in English, they still preferred it as the LoLT because they said that it prepared them for assessments and for further education. They also said it was the language required in most companies, which meant that they became more employable if they could speak English.
- Teachers’ choice of LoLT is influenced by factors such as National Department of Basic Education Assessment policy as well as the language profile of the

learners (and at times, teacher language profiles as well). The responses obtained from the interviews with the eight teachers revealed that they preferred to teach in English because this is the language used for examinations and for assessments. In fact, teachers felt *obliged* to teach in English because they had in mind assessments and examinations. Both their responses and the observations also revealed, however, that despite these concerns, most of the teachers tended to teach much of the time in a language that was best understood by the learners. On the other hand, teachers' language practices in class were also influenced by their own competence in the language(s).

4.6 CONCLUSION

In this chapter the data were analysed, and the findings of this study presented and discussed. The findings revealed that:

- The use of English as the LoLT was a barrier to the learning and teaching of Physical Sciences on the part of learners and teachers for whom English is only an additional language in which they have little grounding.
- In all cases where teachers' own language proficiency allowed them to code-switch, they practised code-switching to facilitate their learners' understanding of Physical Sciences content.
- The teachers and learners in this study preferred English as the main medium of instruction (MOI) in the learning and teaching of Physical Sciences.
- Nevertheless, both learners and teachers suggested that isiXhosa should be used to explain abstract terms.

CHAPTER 5: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summing-up of the study as a whole, which attempts to draw some conclusions and suggests recommendations in areas that need attention, including possible further research.

5.2 Summary of findings

The problem which gave rise to this study was the researcher's concern for the low academic achievement in Physical Sciences by learners who are first language speakers of isiXhosa, but who are learning Physical Sciences through the medium of English. Language is an important factor to be considered in the low performance by learners in national Physical Sciences examinations, as revealed by several research studies.

The study was designed to investigate the language practices (and perceptions) of teachers and learners in the teaching and learning of Physical Sciences. Four research questions were drawn up in line with the aims and objectives of the study. The main research question of the study was: How do educators and learners use isiXhosa and English in the teaching and learning of Physical Sciences in the FET phase? The study revealed that most of the teachers did not use only English when they delivered Physical Sciences lessons, but instead, they used both English and isiXhosa. The teachers explained (during the interviews) that they used both languages in order to facilitate the learning and teaching of Physical Sciences, since their learners were not competent in English (the LoLT). Out of the eight teachers that were interviewed and observed, only two teachers were observed to *present* their lessons in English only. However, this was not unexpected because these two teachers were not isiXhosa speakers. It was interesting to see how these teachers, despite at least one of them

believing strongly in the importance of using English as the LoLT, still promoted the limited use of both English and isiXhosa in the learning and teaching of Physical Sciences through the use of peer educators, where learners who were fluent in both English and isiXhosa were asked to explain in isiXhosa to their classmates.

While learners said that they preferred to be taught in English, the classroom observations revealed that the learners seemed to develop an interest in the learning of the subject and to participate more when they were taught in isiXhosa. However, without some form of testing it was not possible to tell whether or not learners learnt better if taught in isiXhosa. They rarely used English during group discussions; in fact, isiXhosa was the dominant language during those discussions and in classes in which lessons were presented in English, the learners did not participate at all.

The research questions also led to the review of literature relevant to the study. The literature reviewed discussed *inter alia* the Language in Education Policy in South Africa, code-switching, and additive and subtractive bilingualism. It was interesting to observe additive bilingualism being revealed through the way teachers delivered their lessons. Teachers extensively used code-switching during their teaching. Here it was observed how isiXhosa was used by the teachers to facilitate the learning of Physical Sciences, which is mainly taught through English, an additional language for these learners. This was in line with the South African LiEP which officially promotes the maintenance of the mother language and access to an additional language (additive bilingualism). The extensive use of code-switching by both teachers and learners in the learning and teaching of Physical Sciences revealed additive bilingualism in the sense that the mother tongue (isiXhosa) of the learner was used as the medium of instruction together with English, the LoLT; in other words, isiXhosa and English were used as dual media of instruction.

It should also be stated that, while this study did not reveal subtractive bilingualism in the learning and teaching of Physical Sciences, the learners had, one way or another, been exposed to subtractive bilingualism. It should be noted that the Grade 11 of 2012 are not the beneficiaries of the new changes in language policy that are contained in the

new Curriculum and Assessment Policy Statements (CAPS). This means that these learners were subjected to mother tongue (isiXhosa) during their Foundation Phase education, followed by a sudden switch to English as the LoLT in the Intermediate Phase.

The findings of the classroom observation and interviews with teachers and learners revealed the following:

- English is a barrier to the teaching and learning of Physical Sciences for learners who are not first language speakers of English and who have a poor English background. Teachers said that a majority of learners who come from rural communities do not understand English in its simplest form. When such learners are taught in English, they don't learn at all. Worse still, these learners are not able to express their understanding challenges because they cannot express themselves in the LoLT.
- Both teachers and learners who participated in this study endorsed English as the language for teaching and learning Physical Sciences.
- Teachers and learners extensively code-switched in order to facilitate the learning of Physical Sciences. They did this in order to lower the "English barrier" and so facilitate the teaching and learning process.
- Teachers code-switched due to the fact that the learners' (and even the teachers') English proficiency was low. Classroom observations revealed how seriously handicapped in English the majority of learners were. The majority of learners could hardly string together a meaningful and complete sentence in English. They also could not understand a simple instruction if it was given in English. Therefore the teachers saw code-switching as the best available strategy that could be used to facilitate the learning and teaching of Physical Sciences.
- At the same time, teachers did not feel comfortable relying on code-switching because the examinations would be written in English only. Teachers felt that it

was important to teach in English because there was no code-switching in examinations, so learners should be prepared in reading and understanding instructions in English. Some teachers were not sure whether code-switching was officially allowed or not, and so they felt obliged to teach in English, even though they could see that their learners had serious learning challenges through the medium of English.

- In lessons that were dominated by English-only lesson presentations, learners did not actively participate. In addition to the fact that the learners were not able to express themselves (or to even ask questions) in English, this non-participation also seemed to be due to the fact that these lessons were also teacher-centred. Not only were the learners not able to express themselves, but they seemed to understand very little that was presented in English.

5.3 Conclusion

The language of instruction used for teaching content subjects such as Physical Sciences is an important factor in the academic achievement of learners. Learning Physical Sciences through the medium of English may create a significant learning barrier for English second language speakers.

The LiEP states that a learner has a right to choose his/her language of learning and teaching. Where the language of instruction is different from the learner's home language, there should be language supporting structure so that learning is not affected. However, there is a gap between the LiEP and the implementation process. Schools that have drawn up their school language policies in line with the LiEP, may just have it on paper, without really implementing these policies. A learner is expected to fit into the school programme, even if s/he has a language challenge. Language structures meant to support learners may be there on paper, but may well not be put into practice.

Many teachers have not been adequately trained and have not been staff-developed so that they can implement the language policies of their respective schools. Meeting the

requirements of all the learners as far as language issues are concerned requires teachers to be proficient in the LoLT as well as in the home language(s) of the learners. Also, the teachers should have received some form of training on how to use both the LoLT and the home language of the learners in the learning and teaching of content. However, this is not the case and as a result, learners do not really have much say when it comes to choosing the language they want to use in their learning; the learners just have to fit into the language structure already in place in the schools.

The research has also shown that the learning and teaching of Physical Sciences in both English and isiXhosa is a daily phenomenon. While code-switching is recommended, however, it is still debatable whether or not the code-switching used in the teaching of the Physical Sciences by teachers, most of whom are not trained on the use of languages in the teaching of sciences, is effective and really promotes the learning and teaching of the subject. Teachers need to plan how they are going to use code-switching in their classes, in what situations, and to achieve what objective(s). However, the teachers that were observed in this study were found to be switching between English and isiXhosa without proper planning and without any clear objectives on what they intended to achieve.

This can be best explained by the fact the teachers are not developed, trained and equipped with skills with regard to the use of languages, (isiXhosa and English). In most cases they just switched between English and isiXhosa whenever it was convenient for them to do so. At times it was difficult to say whether the teachers were code-switching so as to lower the English language barrier and facilitate the process of learning and teaching, or whether they were doing so because they themselves were not competent enough in English to teach in it effectively.

5.4 Recommendations

- English as LoLT is clearly a barrier to the learning of Physical Sciences. Teachers should be allowed to use isiXhosa with confidence and a comfortable

conscience to facilitate learning and to supplement English-based teaching and learning.

- English may be the preferred language of learning and teaching (LoLT) in many South African schools, but the home language of most of the learners (in this case isiXhosa) should be utilised where possible to improve learners' academic achievement.
- Code-switching should be recognised as a resource that may promote the effective learning of science subjects.
- English second language learners should be encouraged to code-switch in class between English and their home language in situations where this clearly has the potential to assist them in understanding the complexities and abstractions of the subject content.
- The permissibility of code-switching should be included when drawing up national curriculum and assessment policy statements and guidelines, and other learning resources.
- Physical Sciences teachers need to be developed, trained and equipped with the necessary language skills so that they can improve their teaching of Physical Sciences.
- The development of isiXhosa scientific terms/vocabulary and isiXhosa teaching and learning resources should be prioritised.

5.5 Suggestions for further research

In this study, only a small sample of eight teachers and sixteen learners in four schools in one province (Eastern Cape Province) was considered. A larger data sample to generate generalisable, quantitative results should be explored by extending the scope of the study to a larger sample of teachers and learners for whom the medium of

instruction is English second language, in many schools in all nine provinces of South Africa.

On the other hand, a detailed qualitative study in terms of more prolonged, structured and detailed observation of teaching and classwork using English, code-switching, and following this with systematic interviews in which participants could be asked to reflect on the (preferably videoed and transcribed) observations should also be carried out.

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ANNEXURES

Annexure 1

Classroom observation schedules for Grade 11 Physical Sciences learning and teaching

Classroom observation schedule			
SCHOOL:		Date:	
Use of language by the teacher during introduction of lesson			
Teacher uses English only	Teacher uses English and switches to isiXhosa when necessary	Teacher uses English only, even when learners do not seem to understand	Teacher uses isiXhosa only
Use of language by the teacher in explaining new terms and new concepts			
Teacher uses English only	Teacher uses English and switches to isiXhosa when necessary	Teacher uses English only, even when learners do not seem to understand	Teacher uses isiXhosa only
Use of language by the teacher in asking questions			
Teacher uses English only	Teacher uses English and switches to isiXhosa when necessary	Teacher uses English only, even when learners do not seem to understand	Teacher uses isiXhosa only
Use of language by the teacher in giving feedback, recapping and concluding the lesson			
Teacher uses English only	Teacher uses English and switches to isiXhosa when necessary	Teacher uses English only, even when learners do not seem to understand	Teacher uses isiXhosa only
Use of language by learners (participating in discussion, and asking questions for clarity)			
Learners use English only	Learners use English but switch to isiXhosa when necessary	Learners seldom use English	Learners use isiXhosa only

Annexure 2

Interview Guide for Teachers

A Personal details

- (i) Age group
- (ii) Gender
- (iii) Highest qualification
- (iv) Teaching experience
- (v) Specialisation subject
- (vi) Up to what level did you study Physical Sciences?
- (vii) Did you get any special training in Physical Sciences after leaving college/University?
- (viii) Home language and other languages (estimate how proficient in each)

B Language in Education Policy (LiEP)

- (i) To what extent are you aware of the South African Language in Education Policy?
- (ii) Is there a language policy at your school? If yes, what does it emphasise and how effective is it?
- (iii) What role did parents play in formulating this language policy?

C Physical Sciences teaching

- (i) Which language do you mostly use to teach in your Physical Sciences lessons? Why do you use this language?
- (ii) What problems do you encounter in teaching Physical Sciences though English?
- (iii) What do you think may be the possible causes of the problems you mentioned above?

- (iv) What steps do you take to solve (or minimize) these problems? How well do they work?
- (v) What do you understand by code-switching?
- (vi) Do you find that you use more than one language, and switch back and forth from one to the other when teaching?
- (vii) Which language do you think best helps your learners understand Physical Science concepts? Why?
- (viii) If you use code-switching, how do you *feel* about this practice?
- (ix) I asked you a few minutes ago what steps you take to solve problems that you encounter in teaching Physical Sciences through English. Now that you have had a bit longer to think, are there any other techniques you might like to mention?
- (x) Are there any further points you would like to make about the question of language in the teaching of Physical Sciences.

Annexure 3

Interview Guide for Learners

A Learners' personal details

- (i) Age
- (ii) Gender
- (iii) Home language/s

B Language used in the learning of Physical Sciences

- (i) What is the official language of learning and teaching at your school? How competent are you in this language?
- (ii) Which language/s does your Physical Sciences teacher in fact use in teaching this subject?
- (iii) What do you like about learning through the medium of this language/these languages?
- (iv) What *don't* you like about learning through the medium of this language/these languages?
- (v) Which language/s do you and your classmates use to discuss Physical Sciences in the classroom? When you answer the teacher's questions? When you do homework or classroom assignments in Physical Sciences? If you use different languages in these different situations, why do you do so?
- (vi) What particular problems do you find in learning Physical Sciences through the medium of English?
- (vii) Which language best helps you to understand when your teacher explains scientific terms?
- (viii) In which language do you prefer to be taught Physical Sciences? Why?

Annexure 4

Letter to school principals

University of Fort Hare
Faculty of Education

Dear Sir/Madam (Principal)

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH WITH PHYSICAL SCIENCES EDUCATORS AND GRADE 11 LEARNERS IN YOUR SCHOOL.

I am registered for masters' degree in the Faculty of Education at Fort Hare University and a Physical Sciences educator at St Christopher's Private School. I am writing this letter to request for permission to conduct research with FET phase educators and Grade 11 Physical Sciences learners in your school.

My investigation is entitled: The use of English and isiXhosa in teaching and learning Physical Sciences in four King Williams Town schools: A case study in the King Williams Town Education District of the Eastern Cape.

The names of schools, educators and learners in the study will be treated as confidential. Your permission to allow me conduct research in your school will be highly appreciated. I can be contacted on mfo_ka_sibanda@yahoo.co.uk or 0829545009.

Thank you in advance

Yours faithfully

Busani Sibanda (Researcher)

Annexure 5

Letter to the Director: Research Strategy Development (Education Department Zwelitsha)

Faculty of Education
University of Fort Hare

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH PHYSICAL SCIENCES EDUCATORS AND LEARNERS.

I am registered for masters' degree in the Faculty of Education at Fort Hare University and a Physical Sciences educator at St Christopher's Private School. I am writing this letter to request for permission to conduct research with FET phase educators AND Grade 11 Physical Sciences learners in purposively selected schools in King Williams Town District. My investigation is entitled: The use of English and isiXhosa in teaching and learning Physical Sciences in four King Williams Town schools: A case study in the King Williams Town Education District of the Eastern Cape.

Your permission to allow me conduct research in your school will be highly appreciated. A copy of a consent form, observation guidelines and interview guidelines for physical Sciences educators and grade 11 learners, are attached. I hope it meets your approval. The names of schools, educators and subjected advisors in the study will be treated as confidential, but the results of the research can be forwarded to your office should you wish me to do so. Your permission to allow me conduct research in King Williams Town will be highly appreciated.

I can be contacted on mfo_ka_sibanda@yahoo.co.uk or 0829545009.

Thank you in advance

Yours faithfully

Busani Sibanda (Researcher)

Annexure 6

Consent form for the participant

I , hereby give my consent to become a participant in this study. I fully understand and agree to the terms and consenting to be a participant in this study.

.....
Participating teacher/learner

School Contact details:

Address:.....

.....

.....

Telephone numbers (School).....

Signed this day of 20 at

Witness.....

Parent (if student).....