The influence of language on the teaching and learning of Natural Sciences in Grade 7

by

ZONGEZILE GUDULA

Student Number: 3081578

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Supervisor: Prof M. S. Hartley

DECLARATION

Student no: 3081578

I, ZONGEZILE GUDULA, declare that "The influence of language on the teaching and learning of Natural Sciences in Grade 7" is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signed at …………………………. on the ………… day of …………………2017

………………………………………………………………………
Z. Gudula

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DEDICATION

The strength and courage to go through this thesis is a blessing from Almighty GOD. I thank GOD for the choosing me for this kind of honour. I dedicate this study to my daughter, Xabiso and my son, Zinzani, for their love, support and understanding throughout this long undertaking. I, also dedicate this work to my wife, Nosange Gudula, for her undying love, encouragement and support under the trying times of long weeks of absence. I also dedicate this study to my late mother for the love of education until her last breath.

Abstract

It has been noticed in many schools that Grade 8 learners arrive in the secondary school with a big gap in their understanding of the meaning of science concepts. In science cluster meetings teachers identified science terminology of the Grade 8 learners as problematic because learners tend to ascribe different meanings to science concepts that were dealt with in previous grades. Research conducted at the Grade 7 level to investigate the use of science language and terminology seemed the best way to understand this predicament. This study was aimed at understanding the meaning, use and application of language dealing with concepts in the Natural Sciences classes at the end of primary school. This study was underpinned by the critical theories of critical pedagogy and critical literacy. The study took place in three schools in one of the townships in the Eastern Cape. The sample for this study was Grade 7 Natural Sciences class from selected primary schools. Natural Sciences lessons at three schools were observed, one class per school. The teachers from each of the observed classes were interviewed for their perception of issues around language and science in their classes. The study aimed at providing some insight into the use of language and terminology in Grade 7 Natural Sciences classes and add some answers to the concerns of secondary school teachers regarding Grade 8 learners' language and understanding of science concepts. The study found that educators would like to see Language Policies in the Education Department being changed to accommodate the African learners who are the majority in the country. As a result of LoLT being the second language, teaching and learning experiences a lot of misconceptions in Natural Sciences in Grade 7.

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CHAPTER 1

RATIONALE OF THE STUDY

1.1   Introduction

This chapter provides the rationale of the study and describes the background of the study. It also outlines the context where the study was conducted to give an idea of the nature of the research problem. The research question to be answered is highlighted as well the significance and the limitations of the study. The aim of this chapter is to make the intention and rationale of the study known.

1.2 Background to the study

Many developed countries of the world owe their Growth Domestic Product (GDP), which is the measure of the country's wealth, to Science and Technology. Mathematics is the complimenting subject that helps to enhance the cognitive thinking abilities. The above-mentioned field of learning is a challenge to many people and it needs to have its challenges eliminated and a larger intake of students accommodated in the Higher Education institutions.

The challenge that engulfed South Africa is the disappointing performance of the learners at the school level in Mathematics and Sciences. It has been recognized for decades that there is widespread underachievement in Sciences and Mathematics education in South Africa (de Lange, 1981; Taylor & Vinjevold, 1999; Asmal, 2000; Howie, 2001; Reddy, 2006). However, problems associated with Science and Mathematics education are not confined to this country, but are international phenomena (Driver, Guesne & Tieberghien, 1995) and international research has shown that issues of language are key areas contributing to high failure rates in these subjects (National Centre for Curriculum Research and Development, 2000). In turn, recent research on science literacy suggests that teacher education and professional development strategies should assign a more important role to language in the learning and teaching of science (Yore & Treagust, 2006), while a number of investigators have reported on strategies for improving reading, writing, discussing

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and doing science (Hand, Prain & Yore 2001; Heselden & Staples, 2002; Marlow, 2005).

The majority of South African learners study a wide variety of school subjects using a language that is not their mother tongue (Probyn, 2004). However, they need to understand what needs to be learnt in all these subjects even though they experience difficulties when they switch from mother tongue instruction to the English language of instruction. Language and thinking are key aspects that are associated with gaining insight to problems that learners have to solve in class. In the Eastern Cape, isiXhosa is the most widely spoken indigenous language and home language to 83.8% of the population, yet the official medium of instruction in the majority of schools from the beginning of Grade 4 (ages 9-10) to Grade 12 is English (Probyn, 2004).

Most researchers recognize the language problems associated with science education. For instance, Yore & Treagust (2006) mention a three language (home language, instructional language, science language) problem which exists for most science language learners. Learners come to school with informal ways of talking and teachers have to move them from informal spoken and written language to formal language (Setati, Adler, Reed & Bapoo, 2002). Chimoro (2004) argues that children bring into the classroom socio-cultural characteristics from their environment which may create a wedge between what they are taught and what they learn. To change learner's misconceptions, Black (2006) suggests that teachers need to be competent, patient and make connections between what learners learn in science classrooms and what they already know.

A survey carried out during 1998 in rural Grade 7-12 schools in the Eastern Cape (Muwanga-Zake, 2007), revealed that teachers did not seem to know their shortfalls in teaching science. For example, teachers claim that they do not teach science practical activities because they do not have apparatus. The survey results suggested that the teachers' problems, such as the inability to teach practical activities were underpinned by the teacher's lack of understanding of science concepts and processes, the knowledge and skills the teacher is supposed to transfer to learners (Muwanga-Zake, 2007). Understanding of concepts and processes can be directly related to learners being able to read and write (Gudula,

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2014). The latter statement suggests that there is a deeper concern about language that should be attended to.

1.2.1   Learner performance in Science at national, provincial and district levels

South Africa is facing a challenge in terms of a shortage of human resources in scarce skills areas. As it stands, a good quality education is the country's way-out. Subjects that are the hope for the development of the economy of the country are those that require abstract thinking like Mathematics, Physical Sciences, Engineering, Accounting, etc. Dreadfully, these are the subjects that many learners display that they are not coping with.

Post-1994, a change of curriculum was introduced with an aim of finding a suitable curriculum for all the people of South Africa, moving away from apartheid based form of curriculum. Outcomes Based Education (OBE) system was introduced and later it was changed to National Curriculum Statements (NCS). Many challenges ranging from understanding the curriculum itself and terminology used were confusing to educators to the extent that learners were confused too. A decline in the country's pass rate was recorded. One of the subjects that reflected a downward trend is Physical Sciences as many learners achieved between 0% and 29% (i.e. between level 1 and level 2).

NCS was then revised to make it simpler and was changed to Curriculum and Assessment Policy Statement (CAPS) but the state of affairs of Physical Sciences up to 2014 remained unchanged. To get the understanding of this state of affairs of Physical Sciences, an analysis of results of four years became necessary. Figure 1 below shows the performance distribution in Physical Sciences:
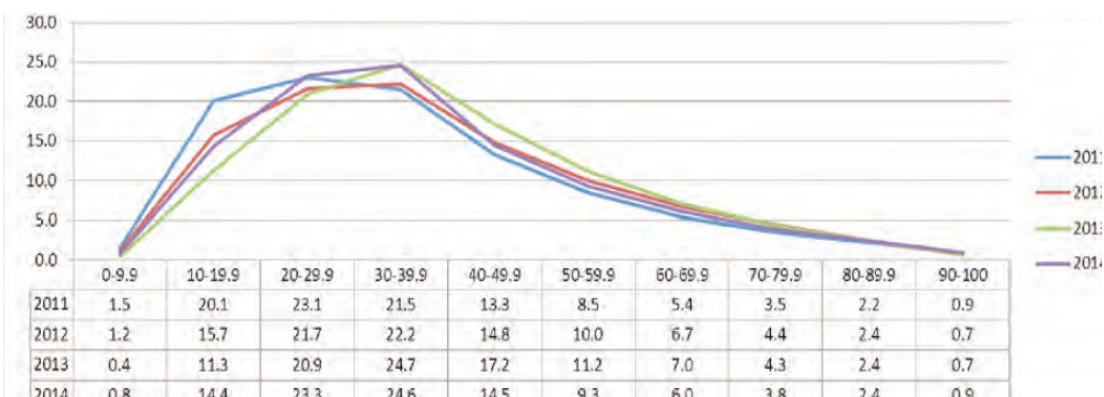

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2011	1.5	20.1	23.1	21.5	13.3	8.5	5.4	3.5	2.2	0.9
2012	1.2	15.7	21.7	22.2	14.8	10.0	6.7	4.4	2.4	0.7
2013	0.4	11.3	20.9	24.7	17.2	11.2	7.0	4.3	2.4	0.7
2014	0.8	14.4	23.3	24.6	14.5	9.3	6.0	3.8	2.4	0.9

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Figure 1: Performance distribution curves in Physical Sciences 2011-2014

Figure 1 shows that a large number of learners achieved between levels one and three over the four-year period. From level four to level seven, the learners who achieve in this category decreased drastically. The causes of these trends do not just emerge from Grade 12 but are a build up from lower grades and that manifests itself in Grade 12. Something needed to be done to identify where the problem starts and a way to rectify it. A national strategy in the form of Annual National Assessment (ANA) was devised for lower grades. ANA revealed similar trends in Mathematics and English as subjects in Grades 3, 6 and 9. Mathematics and English serve as a base of understanding of sciences, especially Physical Sciences which starts as Natural Sciences in the Senior Phase. English, on one hand, is a language of teaching and learning; therefore, learners should have a good command of the language in order to be able to understand and manipulate scientific concepts. On the other hand, Mathematics helps learners in the enhancement of skills of manipulating numbers, developing a logical approach and easy handling of data. All the afore-mentioned about English and Mathematics, are encompassed in Natural Sciences because every skill is needed to accomplish better understanding of concepts and achievement of a better results.

Figure 2 and Figure 3 below shows performance levels of Grade 6 learners in English language and also Mathematics obtained from 2011 Diagnostic Report of the Annual National Assessment. In the Eastern Cape, for instance, 67% of learners in language obtained 'not achieved' and only 2% obtained 'outstanding'. This breakdown is not done according to race; this is the whole population of learners in Grade 6 in the Eastern Cape. Other provinces experience the same predicament as Eastern Cape as shown in Figures 2 and 3 below. For Mathematics in the Eastern Cape, 71% learners in Mathematics obtained 'not achieved' and only 1% obtained 'outstanding'. This trend is transferred to the secondary schools and they adopt this problem as part of the challenges that they face from Grade 8 -12.
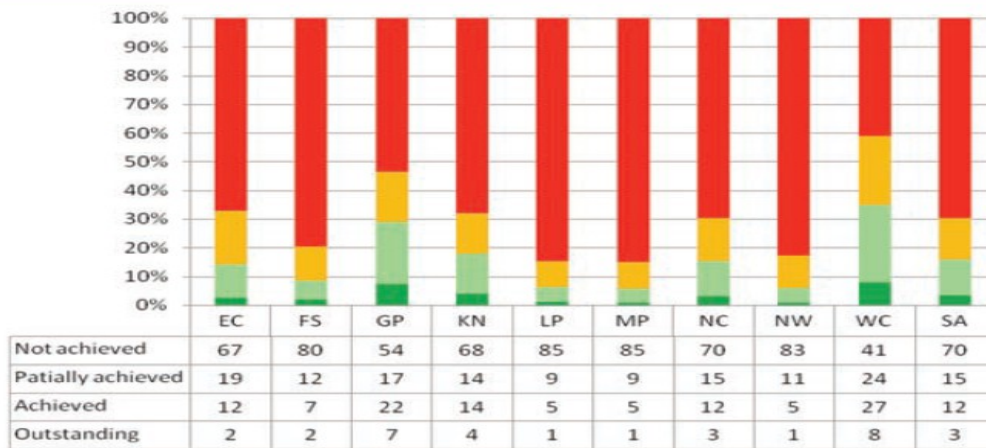
	EC	FS	GP	KN	LP	MP	NC	NW	WC	SA
Not achieved	67	80	54	68	85	85	70	83	41	70
Patially achieved	19	12	17	14	9	9	15	11	24	15
Achieved	12	7	22	14	5	5	12	5	27	12
Outstanding	2	2	7	4	1	1	3	1	8	3

Figure 2: Performance in Grade 6 languages by level

	EC	FS	GP	KN	LP	MP	NC	NW	WC	SA
Not achieved	71	74	53	64	80	83	73	82	45	69
Patially achieved	20	16	23	21	14	12	17	14	26	19
Achieved	8	8	17	10	5	4	7	4	19	9
Outstanding	1	2	6	4	1	1	3	0	11	3

Figure 3: Performance in Grade 6 Mathematics by level

The table that follows below is an analysis of Grade 12 learner performances in the Eastern Cape 2002 to 2012. This table is obtained from The Learner Attainment Improvement Implementation Plan 2013-2015 ((LAIS):

Table 1: Analysis of Grade 12 Learner Performance

PROVINCE OF THE EASTERN CAPE: ANALYSIS OF GRADE 12 LEARNER PERFORMANCE											
CENTRE		ACADEMIC YEARS									
No	DISTRICT	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
7	Research district	57.4	66	58.7	59.5	65.3	59.9	60.5	60	66.9	63.7	68.9

Table 1 shows the district where the research was done and that over a period of eleven years the learners pass rate never progressed beyond the 60% range. The shaded areas highlighted the years where the pass rate was below 60%. It is for this

reason that this study was focused to the start of the Senior Phase in order to understand the root of the problem.

1.2.2 Language policy issues in school

Language policy in Education is unfair to the majority of learners in South Africa. Macdonald and Burroughs (1991) attest to the uprooting of fun in lower classes of education as children learn through play and talk with other children even if they are from different backgrounds. It is understandable that solving language policy issues is not a solution to all education challenges in South Africa because "language" policy is largely influenced by politics (Hawes, 1979).

African children were given the first four years of study in home language as a language of instruction and there-after English or Afrikaans became their language of instruction. In 1991 an amendment was made to the 1979 Education and Training Act which gave a hollow choice of language of instruction to parents to choose which language they want their children to be taught in. That choice had its purpose defeated by the lack of resources like textbooks and other learning support material. New policy needed to be developed that would suit everyone in the population of the country. As one of the Government's policy, Affirmative Action had to be applied to African languages to promote the development of these languages. Speakers of these languages had to be actively involved in promoting them. One of the vehicles used to promote African languages was that learners had to take on three African languages as a compulsory component of the curriculum.

According to my understanding, this problem did not only affect rural schools, but also urban schools. I agree with Muwanga-Zake (2007) when he advises that in the Eastern Cape, there is a need to consider solutions such as using English second language as the teaching medium. I did not agree with him when he said: "African Blacks suffer additional problems in that there could be no direct translations of concepts in the local language". Any language can be developed to a point where it is possible to make it a medium of Instruction.

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1.2.3 Language Issues in Science

Internationally there has been increasing research and recognition in recent years of the central role of language in learning science (Miller, 2006), and on the introduction of reading and writing in science literacy (Yore & Treagust, 2006). These researchers believe that for someone to be judged as scientifically literate they must be proficient in the discourses of science, which includes reading, writing and talking science. Others feel that science education becomes ineffective if it does not support learners in acquiring language skills (Yore, Bisanz & Hand 2003; Wallace, Hand & Prain, 2004). In fact, Wallace, Hand and Prain (2004) believe that reading and writing are essential activities that all students of science need to engage in to completely focus on their scientific understanding.

The study by Wallace et al (2004) presents the challenges facing education planners such as subject advisers in implementing changes in the syllabi that would result in the elimination of the language problems on the cognitive development of English second language learners. Furthermore, implications of English as a language of learning and teaching (LoLT) in South African schools have a distinctive presence. It was also considered to ascertain whether there are any prospects of using an African language as a language of learning. After outlining the problems faced by second language speakers of English when learning in a language that is not their mother tongue, a suggestion for the need to address the problems that arise and the shift from the English for social contact, to English for specific school subjects was provided.

Some studies, for example, Meyer (1985), have produced evidence to show that English is the exception rather than the rule. What is required is an acknowledgement of the factual situation which is that neither the students nor the teachers in the majority of schools are capable of using English at a sufficiently high level. One solution is to adopt a mixed language approach (allowing the use of two languages of instruction) (Rollnick & Rutherford, 1993). Ideally, small group discussion should proceed in the mother tongue (in the case of Eastern Cape, isiXhosa) and learners should be encouraged to ask questions in the mother tongue. The transition from isiXhosa to English should be made gradually so that students are not required to operate beyond their level of competence. There should be a

readiness to provide explanations in isiXhosa at any stage in the interests of a high level of comprehension.

1.3 Interventions in Science education in South Africa and Eastern Cape Province

To address the problem of underperformance in Mathematics and Sciences, the Department of Basic Education (DBE) in conjunction with the Department of Higher Education and Training (DHET) and Department of Science and Technology (DST) collaborated to improve the outcomes of the learners in the country. The Eastern Cape Department of Education came up with a strategy called Learner Attainment Improvement Strategy (LAIS). LAIS had a three-year period of implementation which had its own objectives that are as follows:

- To rollout a program of action for LAIS over a period of three years.
- To deal decisively with the factors that cause the education system in the Eastern Cape to have poor learner outcomes.
- To delineate the roles and responsibilities of the various levels of education management from school to provincial level.
- To promote collaboration particularly at district level
- To profile the Multi-Disciplinary Team concept
- To promote the sustainability of the gains of LAIS by assisting the underperforming schools while motivating the good performers to soar to greater heights.

The Eastern Cape Department of Education undertook the following strategies to address the challenges for science:

1. Incubation classes which took a few learners from a large pool of learners and, therefore, only catered for 'bright sparks'. Unfortunately, most learners were struggling with physical sciences.

2. Winter and Spring Schools which were marked by overcrowded classes and did not cater for individual attention for learners.

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3. Dinaledi program which supported and developed the schools that were already performing better. In the entire Eastern Cape province, only 60 schools were included in this program.

4. Science festivals which were held in Grahamstown. Unfortunately, not all learners were able to attend the festival as it was far from many schools in the province.

5. Nelson Mandela University (NMU) program for FET physical science educators which aimed at developing educators in physical sciences.

6. 1 +4 program which was aimed at developing foundation phase educators in numeracy which serves as a base for physical sciences.

7. University of the Western Cape Programs which were run by Science Learning Centre for Africa in the Eastern Cape Province from 2010 to date. This program included the following:

- Advanced Certificate Education (ACE) in FET physical science which was a course that was offered to FET physical science educators and equipped them with the content gap, development of science clubs, and understanding of nature of science and scientific knowledge.

- The program took the educators with ACE to BEd Honours' level where they studied and gained an in-depth understanding of science and Science Education through teaching and learning by doing practical activities (hands-on).

- To find out about and address the local challenges in education, an approach to increase research muscle, a pool of Masters students is being trained to be home-grown Science Education researchers.

- Accredited short courses which certified Natural Sciences educators by providing them with the foundation of the content in each of the Natural Sciences knowledge areas.

1.4 Context of the study

The researcher is a Physical Sciences teacher in Grades 10, 11 and 12 and also teaches Natural Sciences in Grade 8. The school, where the researcher taught, is situated in the Eastern Cape in a township near a rural area. The school starts from

Grade 8 to Grade 12 with a variety of subjects grouped into learning streams. From Grade 10 to Grade 12 the streams were divided as follow: -

- Stream of Languages
- Stream of Mathematics and Sciences,
- Stream of Humanities and
- Stream of Business and Commercial Management (BCM).

Subjects needed for Grade 8 and Grade 9 are, Languages, Mathematics, Natural Sciences, Economic Management Sciences, Life Orientation, Creative Arts and Social Sciences, for each learner to learn to qualify for progression to the next phase. It was in Grade 8 Natural Sciences where the researcher personally noticed the challenges experienced by learners concerning the grasp of science concepts due to the lack of command of the language of teaching and learning. A question arose as to where the learners lost the essence of the concepts, "in English as a subject or the teacher's use or lack of use of scientific language in the science class?" The feeder schools were from both the township and the rural area, with the majority of learners coming from the nearby rural area. There were other surrounding high schools that the feeder primary schools also supplied with learners. Grade 7, the focus of this study, is at the primary school whereas Grade 8 to Grade12 is at the secondary school. One phase, Senior Phase, has Grades in two school levels, Primary School and Secondary School and that causes a disjuncture in the flow of understanding of the learners in the phase. Secondary school educators in my school did not have an understanding of what was happening in the primary schools because of their focus in the secondary school.

This study explored the issues of language and how it influenced Natural Sciences as experienced in the researcher's school and the surrounding schools in an attempt to find a solution for the ongoing dilemma concerning learners being disadvantaged by language-related challenges. A better command of the language of teaching and learning is essential to participate in the various fields of the sciences.

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1.5 Research Problem

As a teacher of Natural Sciences in Grade 8, the researcher noticed that learners coming from Grade 7, from different schools, experienced difficulties in understanding science concepts. Some learners show an acceptable level of understanding of English as a language but they lack a grasp of science concepts and this led to learners failing tests. Learners tended to view the Physical Sciences part of Natural Sciences, as difficult and many of them did not select it as one of their subjects in Grade 10.

Learners start their Grade 8 in the secondary school in Senior Phase having been in a class of Grade 7 that was located in the primary school. Teachers in the secondary school do not know what is happening with the learners in the primary schools and the same learners find it difficult to connect with the syllabus of the two grades in the secondary. Even though the policy document for Natural Sciences in the Senior Phase (Grades 7-9) is clear about the content to be taught, learners showed the content knowledge gap when they arrived in the secondary school. Learners were often familiar with one or two sections of the Senior Phase Natural Sciences curriculum, either "life and living" and/or "earth and beyond". They often lack knowledge of the Physics and Chemistry part. This knowledge gap caused a backlog to Grade 8 teachers because the curriculum demands that at a certain time a given amount of work should be completed. Most of the terms became new to the learners as the Grade 8 teacher introduced them whereas the policy document for syllabus coverage clearly states that these terms should have been taught in earlier grades.

This is where this study comes in, to find out about the proficiency of teachers and learners in the language of instruction in the Grade 7 classes. This study seeks to understand the challenges experienced by both teachers and learners in relation to the language when teaching and learning Natural Sciences occurs.

1.6 Research questions

Given the research problem highlighted in section 1.5 above, this study will be directed at answering the following research main question:

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What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

   (i)   **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

   (ii) **What were the teachers' perceptions of the influence of language in their Natural Sciences classes?**

1.7 Significance of the study

This study could be significant for a number of reasons. The outcomes of this study could serve to inform science teachers, curriculum advisors and curriculum planners about the role that the language plays in the teaching of science. The study could provide some insight into language and terminology in Grade 7 Natural sciences and add some answers to the concerns of secondary school teachers regarding Grade 8 learners' language and understanding of science concepts. This study could also add to the baseline data available with regard to issues of language and science at the primary school.
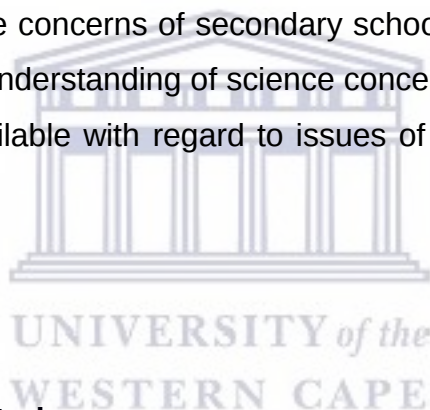
1.8 Limitations of the study

This study was located to three schools and it is therefore difficult to generalise the outcomes across the Eastern Cape. The sample was relatively small, namely one class per school, and therefore it was not representative of a wider population of the district or the province. Since the study was done over a relatively short period, it did not lend itself to a full-scale understanding of the whole situation. The study was done at different time intervals which made it difficult to compare similar topics taught as outlined in the work schedule of the subject.

1.9 Structure of the thesis

Chapter 1:   Introduction

Chapter one introduced the study. It provided the background and context of the study which foregrounded the research problem and research questions. It also provided the significance and limitations of the study and gave an outline of the structure of the thesis.

Chapter 2:   Literature review

This chapter provided the theoretical basis of the study and presented a review of studies in the area of language and science.

Chapter 3:   Research Methodology

The methodology outlined the collection, presentation and analysis of data.

Chapter 4:   Findings and Discussion

In this chapter, the findings were presented and discussed.

Chapter 6:   Conclusion and recommendation

This chapter provided a summary of the thesis and presented the major findings of the study. It also highlights the implications of the study and recommends areas of future study.

Chapter 7:   References

This chapter acknowledged the references used in this study and is presented using the 6th version of APA.

1.10   Conclusion

This chapter dealt with the rationale of the study. The aim was to give an overview of the study in relation to the research question. The context of the study and the research problem leading to the research question were clearly outlined and discussed. The significance and limitations of the study were identified. The next chapter will present the literature review for the study.
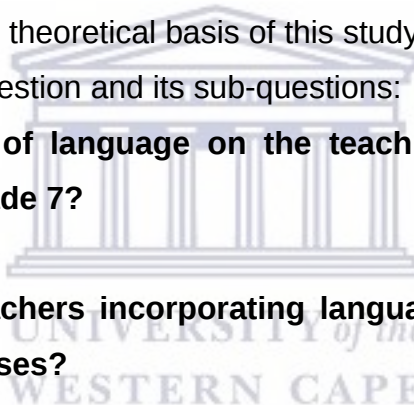
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review chapter provides the theoretical framework of the study and reviews existing literature on the topic of this study. The objective of this chapter is to portray the path of previous studies and how this study is linked to them. It also gave me the opportunity to learn from previous efforts and stimulated me to identify gaps and shortfalls in the field. Boote and Beile (2005) put it clear that a good review is one which helps the researcher to learn from other scholars and stimulate new ideas.

This chapter provides the theoretical basis of this study in its endeavour to answer the following research question and its sub-questions:

What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

(i) **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

(ii) **What were the teachers' perceptions of the influence of language in their Natural Sciences classes?**

2.2 Theoretical framework

This study is underpinned by the critical theories of critical pedagogy and critical literacy.

2.2.1 Critical pedagogy

Critical pedagogy is a philosophy of education and social movement that combines education with critical theory (Giroux, 2010). The focus is on a critical pedagogy in teacher education because of the goal of preparing citizens for participation in a democratic society. It is a process-oriented educational movement, guided by passion and principle, to help students develop consciousness of freedom, recognize

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authoritarian tendencies, and connect knowledge to power and the ability to take constructive action (Giroux, 2010). Shor (1980) describes critical pedagogy as habits of thought, reading, writing, and speaking which goes beneath surface meaning, first impressions, dominant myths, official pronouncements, traditional clichés, received wisdom, and mere opinions, to understand the deep meaning, root causes, social context, ideology, and personal consequences of any action, event, object, process, organization, experience, text, subject matter, policy, mass media, or discourse.

This study has its focus on revolutionising the education policy concerning language of teaching and learning in South Africa. Since the nation is the so-called Rainbow Nation, the majority of African-language speaking people have not been considered to be taught through their own languages. The way in which African children are taught needs to be looked at in a very close way. Critical pedagogy in this study is a theoretical framework suitable for that sought of an intended paradigm shift. The Nation has a duty to transform its people by critically looking at the factors that affect its people's well-being. Critical theory is a school of thought that focuses itself on the role of critique of the societal and cultural way of life. It applies knowledge from the social sciences and the study of historical background of the society of concern. Theorist, Max Horkheimer (1937), described a theory as critical insofar as it seeks to liberate human beings from the circumstances that enslave them.

With critical theory in mind, a need to understand the learners' views and understanding of their current level of knowledge was at the centre of this study. This view opened the doors that may lead to the consideration of looking into an introduction of new ideas. These ideas may revolutionise the ways in which the science lessons are conducted. The literature highlights language ability as a contributing factor to effective critical thinking skills (Feuerstein, 2007; Nisbett, Peng, Coi & Norenzayan, 2001). Critical thinking skills are regarded as important for problem-solving which strengthens the link between academic language proficiency and critical thinking (Facione, 2009; Halpern, 2007; Halx & Reybold, 2005; Vandermensbrugghe, 2004).

Critical theories generally share a social and cultural analysis with an activist component based largely on the critique of oppressive and dominant economic and political forces. They have a desire for social justice and equality, and a need to

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represent marginalized perspectives (Tripathi, 2008). Kellner (2003), claims that critical theory of education must be rooted in a critical theory of society, and should be central to social critique and transformation. Paulo Freire (1970) emphasises that essential task for critical understanding is the valorisation, and not the idealization, of popular wisdom that includes the creativity of a people and reveals the level of their knowledge regarding reality. This then makes it critical that this study makes an impact and stimulates the creativity of those responsible for the changes to be made in the education sector regarding science education. The heart of this study is to understand what is happening in the classes of science at different schools in the Senior Phase concerning the use of science concepts.

2.2.2 Critical literacy

This study also has to do with teachers and learners paying a particular attention to text details. The correct use and understanding of a text is explained under the theory of critical literacy. Critical literacy is, according to Coffey (2008), an instructional approach, stemming from Marxist and Freirean perspective. It is the ability to read texts in an active, reflective manner in order to better understand power, inequality, and injustice in human relationships. According to Robinson & Robinson (2003), a text is defined as a vehicle through which individuals communicate with one another using the codes and conventions of society.

Students can evaluate whose knowledge is being privileged in texts and de-construct the message of those meanings. As readers, learners must also evaluate the social construction of a text and question the factors that may have influenced the author to create the text in a specific manner (Coffey, 2008). Moreover, using critical literacy, teachers should encourage students to look at texts from other perspectives and re-create them from the standpoint of marginalised groups in order to analyse the power relations and social inequities promoted by the texts. Science education is no different from other fields that require learners to pay attention to text detail. Natural Sciences is the body of knowledge that equips the society with adequate information that is used for the betterment of economic wealth in that society. For the learners to develop the power to be critical when reading a text, they should be able to analyse what each science concept means and be able to develop the necessary understanding of that concept. How the society will benefit from the concept

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knowledge of the learners depends on the development of the skill of critical analysis of the text in the subject of Natural Sciences.

2.3 Factors impacting on this study

2.3.1 Learning capacity of learners

Science learning requires learners to have a certain learning capacity in order to be able to grasp its content and context. "Mathematical/Logical Intelligence", as described by Gardiner (1999), involves planning, sequencing, and problem-solving. A child with a language disorder may not have these basic abilities required to complete mathematical problems, equations, and formulae. Science also involves formulae, laws, and experimentation. If the child is unable to sequence events, follow directions, or arrive at conclusions, science theory will be abstract, and hard to understand (Merkel-Piccini, 2001).

In South Africa in the primary school classes, Senior Phase in particular; all learners have to learn at least Natural Sciences (Department of Basic Education, 2011). This policy document prompts the teachers to find teaching strategies that will allow inclusivity of all learners despite their capacity to learn science. Merino and Scarcella (2005) argue that in order to learn science, students need to master the academic literacy skills specific to that discipline. Using a constructivist approach, they define academic literacy as the body of knowledge, strategies and skills necessary to accomplish the academic tasks of a specific discipline in a particular context. Teachers have a task of guiding the learners to master the basic academic literacy skills by offering extra attention to the learners they identify as having science learning barriers. Deducing from Merino and Scarcella's statement, teachers should be equipped with the skills to identify and address the learners' shortfalls so as to get them in line with the mainstream learners that are capacitated for the logic-demanding subject.

2.3.2 Language level used by teachers

For the learners, whom the language of instruction is a second language, there is an added burden of translating the language of instruction to their home language when being taught. The same learners are also faced with the added burden of thinking

answers in their own language and then translating them into the language of instruction before they actually answer them. The language changing within a lesson with the aim of creating an understanding of a concept or phenomenon is referred to as code-switching. Code-switching refers to alternations of language within a single conversation, often involving switches within a single speaker turn or single sentence (Rose & Dulm, 2006).

The Progress in International Reading Literacy Study (PIRLS) of 2006 is an international study of reading literacy which is conducted every five years and 40 countries participated, including South Africa. Approximately 30,000 Grade 4 and 5 learners were assessed and alarming findings were reported, namely, that South Africa's Grade 4 and 5 learners achieved the lowest mean scores compared to the other participating countries (Pirls, 2006). Due to many factors, this problem persists right through to secondary school level of education. Pretorius (2002) argues that poor matriculation pass-rates in South Africa suggest a reading-to-learn barrier to academic performance which results in poorly equipped students entering higher education institutions.

Since this study has its focus on a class that is at a primary school level, it is proper to point out the way the primary school teachers are viewed internationally and to throw a prompting thought-provoking view that may be applying to South Africa. There is an assumption that primary teachers are generalists who have an ability to provide instruction in all key subject areas. In contrast, there seems to be a parallel discourse increasingly promoting the need for specialist teachers in the primary school setting. In England it has been argued that the idea of the generalist is outdated and does not reflect practice (Alexander, Rose & Woodhead, 1992) whilst, in the same breath, Masters (2009) claimed that, ideally, every primary school teacher would be an expert teacher of literacy, numeracy and science, thus explicitly prioritizing the development of teacher competencies in some subject areas over others. This statement gives rise to the fact that teachers, at least in the Senior Phase should all a have measurable amount of content and methodological knowledge of science that will give learners a fair chance of being eager to learn science when they get to secondary school level.

Teachers have to be considerate when asking questions and use words that would be of easy reach to these learners. There used to be what was called higher grade and standard grade for different cognitive levels of learners (Van der Berg, 2007). The same format could be used but this time focus should be on the difference in language. Care has to be taken by the teachers to have a strategy to use when approaching a lesson taking into consideration the language proficiency of learners.

According to Sullivan (2008) in a recent study by Bryan Brown, an assistant professor of Education at Stanford, and Kihyun Ryoo, a doctoral candidate in Stanford's School of Education, students who learned the basic concepts of photosynthesis in "everyday English" before learning the scientific terms for the phenomenon fared much better on tests than students taught the traditional way. For instance, words like "sugar" at the beginning of the lesson can be used and changed into "glucose" later. Also, the use of "energy pigments" initially and subsequently introducing "chlorophyll" and "energy pouch" as a temporary stand-in for "chloroplast", is a strategic approach in the introduction of scientific terms. Examples given above show that science teachers should not only teach science content but also teach language within the lesson. In the study mentioned above, the method used to teach learners is called "content-first" approach. The results reveal that although learning the language of science remains a primary hurdle, students taught using "content-first" approach demonstrated an improved conceptual and linguistic understanding of science.

Teachers often talk to learners about the connection between words they know and the ones scientists use. For example, a teacher might explain that "sorting" the animal kingdom into two major categories—invertebrates and vertebrates—is the same thing as "classifying" them, to a scientist.

2.3.3 Language of teaching and learning

The teacher, as the immediate curriculum developer, has a responsibility to use suitable level of language of instruction to accommodate the learners whose home language is not the language of instruction. It is important for the teacher to use the language of science consistently and correctly without causing confusion by trying to simplify the scientific terms. The science language, generally, leans widely towards

the English language in South Africa. Science is also taught in Afrikaans in South Africa but it is not available in any of other languages related to Black Africans like Zulus and Sothos (Gudula, 2014).

Although it is increasingly acknowledged that proficiency in academic English requires more than 3 years to acquire; the nature of academic English language proficiency is not well understood (Cummins, 1984). The latter statement justifies that it is not always a case of learning difficulties that a learner does not achieve as expected. In most cases, the lesser time the learner is exposed to the English language, the more the learner is likely not to achieve as expected. It is often taken for granted that learners are able to systematically analyse a question creating a clear picture of what concept it refers to.

Okebukola (2008) notes that most African elementary schools have no formalised reading programmes. Reading is subsumed in the English language lesson and taught by the language teacher. Thus, largely, reading is taught as a tool to reinforce other language skills rather than as a discipline. Warwick (1999), berating the worrisome situation, notes that African children lack opportunities for catching up with the rest of the world in terms of satisfying employment and political choices as a result of their low literacy levels and limited horizons. This situation may persist well into the 21st century, unless there are massive changes.

Howie (2003), for example, believes that the most significant factor in learning Science and Mathematics isn't whether the learners are rich or poor. It's whether they are fluent in English. While there is surely some truth to the view that weak language proficiency in English spills over to learning in other subject areas, it is necessary to acknowledge the strong and complex relationships between language, socio-economic status and school functionality in South Africa.

When it comes to science, as there are these arguments, learners also have conceptual problems. Although there are many problems that are presented by concepts, there are four areas that are the most occurring in social science texts, namely, ambiguity, vagueness, unfamiliarity and emotive words. Most learners are faced with these challenges to the extent that the meaning of the question is lost to them (Rossouw, 2003). Internationally, there are many learning barriers that the

learners experience as individuals, different from each other. Learning barriers associated with learners' inability to express their views are usually leaning towards language challenges. Language barriers can have long-term effects on learner's academic performance (Elsworth, 2013).

2.3.4 Language of Instruction

The issue of language of instruction has been a matter of debate for a long time in South Africa. The language of instruction is the language that is used as a Medium of Instruction in schools as accepted by the Department of Education in South Africa. Before the passing of the Bantu Education Act of 1953, the home languages of African speaking learners were used as languages of instruction for the first four years of schooling. After 1953, the home languages were to be the medium of instruction up until the eighth year of schooling, and after that half of the subjects were to be taught in English and the other half in Afrikaans (UNESCO, 1953; McKibeen and Brice, 2001). Furthermore, the government of the time encouraged the African Languages board to develop vocabulary and terminology of the African Languages in subjects such as science, geography etc., but they never got support as the nationalist government went on a deliberate campaign to deny black children authentic models of English and also not giving support to the African Languages Board (Heugh, 1995). The language of instruction, after that, favoured the English-speaking and Afrikaans-speaking learners, who happened to be 'White people', since each group was allowed to have their children learn with their home languages as language of instruction. African learners had to abandon African languages as languages of instruction and adopt English language as their language of instruction.

As colonialism in Africa matured, so also did the entrenchment of language policies and practices which elevated the position of colonial languages as languages of instruction. As compared to the British, the French from the start, tended to be very partial to the use of French as language of instruction, from the earliest age of schooling. The Belgians had always stressed the necessity for a broad basis of elementary instruction in the vernacular and by 1954, for example, the percentage of the total Congolese population in schools was 9.4 per cent as against 4.5 per cent in British territories and 2.7 per cent in French areas" (Foster 1965).

As Africans moved to a period of developing their education, free of the colonial bondage, they did not give much consideration to the African languages for the language of instruction. Brock-Utne (2006) likens the above statement, hypothetically speaking, to wanting to give education without considering the medium of instruction, which is like wanting to give water to a village but not considering the pipes. These statements show that either the interests of the policy makers are elsewhere, that is not education, or poor capabilities to plan and manage are a factor.

Malekela (2003: 111) made a statement that, "to continue using English as a medium of instruction in post-primary education is a torture to most of Black children". When a country gets independence from a colonial oppressor, it is expected that favour will be a priority towards those that were oppressed. Language change is one of the main concerns together with political change and economic change but the language issue is neglected. Desai (2003) argues strongly that in South Africa, mother tongue education is seen as a given advantage for English-speaking, and to a lesser extent, Afrikaans speaking learners. It is taken for granted that these learners will learn best through their primary languages. However, when it comes to considering people who speak African languages, the debate rages furiously. I agree with Desai since many argue that in science, for instance, there is not enough vocabulary that would be in isiXhosa. My belief is that with enough time, resources and good motivation, vocabulary can become available because African languages are means of communication like any other language. Languages develop, including African languages.

The reasons offered during the colonial period for the limited and temporary use of local languages were articulated thus:

1. There are too many African languages to be able to justify rationally and economically their use.
2. African languages have limited demographic and geographical significance, therefore, it is wiser to use global languages.
3. African languages have limited lexical capacity to deal with the realities of modern society, science and technology.
4. African languages do not make for so-called "societal unity."

These reasons have been inherited and are propagated now, quietly, by African elites.

2.4 Recent studies in language and science

In this section different studies that have been done in relation to Science and language, language of teaching and learning science in particular are considered. It is imperative that we understand science and its nature together with who learns it. It is believed that this combination, nature of science and the recipient of science lessons can give a brighter idea in understanding the role of language of learning and teaching (LoLT) in South Africa.

As a matter of fact, without understanding the language used to carry science through it is going to be very difficult to understand the terminology and concepts of science. Therefore, what is it that the teachers must understand about science that needs to be understood by the learners they teach? It is also very important to relate the language used to carry science through to the recipients of science learning, that is, their home language or a second-language to them. These questions lead to the need to understand the nature of science.
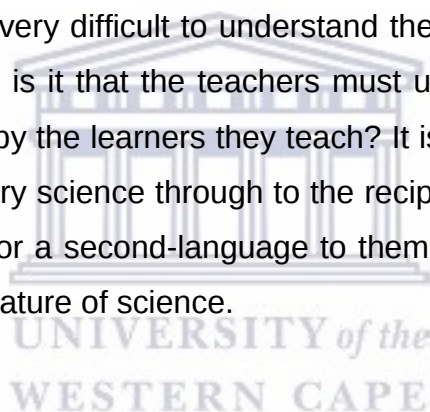
2.4.1 Science has a language: Science is a language

2.4.1.1   Nature of Science (NOS)

It is understandable to try to have knowledge about the nature of science and then pick up the scientific concepts and terms that are important to the essential teaching and learning of science. These concepts form the basic understanding of Science and they are the back bone of science since research is highly involved in making the world we live in known to us. The terms such as experiment, hypothesis, apparatus, method, observation, inference and observation are all English words but they are of special importance to science (National Science Foundation, 1998).

According to Lederman (2006) scientific knowledge, as research on Nature of Science has the following characteristics:

- The distinction between observation and inference.

- The relationship and distinction between scientific laws and theory.

- Scientific knowledge is, at least partially, based on and/or derived from human imagination and creativity.

- Scientific knowledge necessarily is subjective and can never be totally objective.

- Science as human enterprise is practiced in the context of larger culture and its practitioners are the products of that culture. Science, it follows, affects and is affected by various elements and intellectual spheres of the culture in which it is embedded.

- Scientific knowledge is never absolute or certain: it is subject to change.

- Scientific knowledge is empirically based.

Nature of science refers to the values and beliefs inherent to scientific knowledge and its development (Lederman, 1992). Although disagreements exist among philosophers of science, historians of science, scientists, and science educators regarding a universal definition for NOS, these disagreements are irrelevant to Grade 12 students (Abd-El-Khalick, Bell & Lederman, 2000). It can be argued that the seven aspects of NOS referred to in this investigation are accessible to and relevant to Grade 12 students' everyday lives. It can further be argued that the aspects are at a level of generality that avoids any contentious arguments. The aspects of NOS referred to here, involve an understanding that scientific knowledge is tentative, subjective, empirically based, socially embedded, and depends on human imagination and creativity. Two additional aspects involve the distinction between observation and inference and the distinction between theories and laws.

The point that is being made about the nature of science is that there is a relation between learning science through theory and practical where the connection between the two is language. The learner may do an experiment to investigate a certain concept, say acceleration, but the procedure that the learner has to follow will be in the language of teaching and learning that the society has chosen. This becomes a challenge when the language of instruction is the second language to the learner. The studies done on the nature of sciences show clearly, as stated above, that science has a lot of terminologies that is unique to it.

In one study by Abell, Martini & George (2001), two sections of an undergraduate course in elementary science education were observed during an extended investigation, in which students made observations of the moon and tried to develop explanations for what they saw. Students worked in groups, were engaged in many aspects of the process of science, and were asked to reflect on their own learning regarding the moon. Eleven student journals of the experience, along with interview transcripts from these students, were analysed for student learning regarding observation in science, the role of creativity and inference in science, and social aspects of science.

Major findings included:

- Students recognised that observations are key in science but didn't recognise the role that observation plays in science.
- Students recognised that their own work involved observing, predicting, and coming up with explanations, but they did not generally connect this to the process of science.
- Students recognised that collaboration facilitated their own learning but did not generally connect this to the process of science.

This research highlights the pedagogical importance of making the nature and process of science explicit: even though students were actively engaged in scientific processes, they did not get many of the key messages that the instructors implicitly conveyed. The researchers also recommend asking students to reflect on how their own understanding of the nature and process of science are changing over time. This is where language articulation comes in, in order to drive a point about the observation made home.

In another study by Moss (2001), five 11th and 12-th grade students, with a range of academic achievement, taking an environmental science class, were interviewed six times over the course of a year. The class was project-based and engaged students in data collection for real scientific research. Interviews focused on students' views of selected aspects of the nature and process of science. The researcher coded and interpreted transcripts of the interviews. Major findings included:

- In contrast to previous studies, most students understood that scientific knowledge builds on itself and is tentative. Students also seemed to understand science as a social activity.

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- Many students didn't know what makes science to be science and had trouble distinguishing science from other ways of knowing.
- Many students viewed science as merely procedural.
- Most students didn't understand that scientists regularly generate new research questions as they work.
- Despite the authentic, project-based nature of the course, there were few shifts in student views of the nature and process of science.

This research supports the view that explicit instruction is necessary to improve student understanding of the nature/process of science. The researcher suggests that this can be done by having students develop their own descriptions of the fundamentals of the nature and process of science. The researcher also suggests that teachers need to focus on helping students understand the boundaries of science, perhaps by explicitly discussing how science compares to other human endeavours. The above studies depict just a few of the characteristics of the nature of science as practiced in the classroom. There is actually more than these characteristics that are needed to ensure the understanding of the teaching and learning of science. In the following subsection, I will look at some of the studies that connect science knowledge delivery to the language in which science adopted as a popular language and the language of the learners, as Home-language.

2.4.1.2   Attitudes of Language Learning

Attitudes refer to the sets of beliefs that the learner holds towards members of the group and also towards his own culture (Brown, 2000). Language attitude is an important concept because it plays a key role in language learning. For example, research conducted by Gardner (2001) about attitudes and motivation showed correlation with linguistic performance of learners, emphasizing the role of attitudes and motivation as determinant factors in language learning. It is also generally agreed among researchers that positive attitudes facilitate the learning process, though attitude does not determine the behaviour (Khanna & Agnihotri, 1994). In education, attitudes are considered both as input and output. Attitudes have a positive correlation with success in learning the second language because they facilitate learners' motivation to learn the language (Gardner & Trembly, 1994). They added that individual attitudes towards the language that they learn meet important

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needs as they satisfy certain functions such as achieving high grades in language examination.

Setati & Adler (2000) point out that, for learners to think, they have to talk but their fluency in expression and complex thoughts expression are limited if they are prohibited from using their mother-tongue. Learners are not capable of showing their potential to learn the content as they reach a deadlock in expressing what they mean. As a stand point, I fully support the call made by Hornberger (2002) that as many languages as possible should be recognised to increase the linguistic resources to ensure teaching and learning goals are done. This call can ensure that learning with understanding is achieved instead of getting learners to memorise and rote learn. Keeping up with language policy rather than allowing learners to express themselves in their home language (which in many instances is the same as the teacher's), robs the learners of an enormous opportunity for their understanding to flourish.

Teachers have a tendency to teach learners to formulate patterns of learning by creating mnemonic devices. This approach promotes rote learning more than understanding of scientific concept. One concept may mean one thing in one learning area and mean the other in another learning area. For instance, "Power" in History may mean being in position of influence, control or authority but in science, it means a rate at which work is done.

2.4.1.3   Motivation and Language Learning

Motivation is the most used concept for explaining failure or success of a learner. Also motivation has been regarded as one of the main factors that influence the speed and amount of success of foreign language learners (Gardner, 2006). For instance, Gardner (2006) reported "Students with higher levels of motivation will do better than students with lower levels" (p. 241). He further added that "If one is motivated, he/she has reasons (motives) for engaging in the relevant activities" (p. 243). In another development, Elliot, Kratochil and Cook (2000) see motivation as an internal state that arouses to action, pushes us in particular directions, and keeps us engaged in certain activities. They added that learning and motivation are equally essential for performance and they enable us to acquire new knowledge and skills.

Furthermore, motivation provides the drive for showing what we have learned, and that more motivated people achieve higher levels but Harmer (2004) cautioned that the motivation that brings students to the task of learning English could be affected and influenced by the attitudes of a number of people. In teaching, motivation is one of the factors that influence success or failure in learning a language, particularly a second language or foreign language (Gardner, 2006). In the same breath, Petty (1998) argued that if students do not want to learn, their learning efficiency will be slow such that they may learn virtually nothing. However, if you know how to motivate students, you can increase their learning capabilities and capacity. Apart from motivation and attitudes, research shows clearly that the home environment, especially the home language, has a part to play in students' poor performance in subjects that have a language of their own (Suleiman, 1999; Mapuri, 1999).

2.4.2 International studies on language of instruction

It is not difficult to assume that a clear command and understanding of a language that is used as a medium of instruction boost the confidence of a learner in the subject delivered, for example science. This leads to the understanding that everybody becomes comfortable with the language that is a mother-tongue and, therefore, learning science in the mother tongue would be a dream come true for the black South African child. This is an important fact since I agree with the view that language has symbolic investment and serve as a location of identity formation (Bourdieu 1991, Weedon, 1987). The latter statement purely indicates that language builds the cultural identity and it symbolises the continuity of culture. Text is considered as a social strategy historically located in a network of power relations in particular institutional sites and cultural fields (Luke, 1996). Voice can be considered as the capacity for semiotic mobility, that is, the ability to create favourable conditions for a desired endorsement across social spaces (Blommaert, 2005). This understanding puts value to the importance of language. Increased awareness of language and new ways of communicating that involve the continual negotiation of languages, language varieties and registers are feature of contexts of socio-political change (Heller 1982).

What is important about these insights is what they reveal about the nature of literacy within processes of participatory development and governance: most significantly,

that it is one of many semiotic resources on which people can draw, that it is inextricably bound up with these other forms of semiosis, and that written texts may be produced in two or more language varieties within the same discourse 'event' (Blommaert, 2005). Future research would need to provide more clarified, complex and context sensitive understandings of contemporary multilingual realities. It would need to investigate how particular literacies, languages and other semiotic and technological resources might be used productively to shape agency within local and wider structures of power, and the kinds of knowledge and skills which learners could use to secure material and symbolic aspects of citizenship, for themselves and those they interact with.

Studies that have attracted much attention in developed countries such as United States, United Kingdom, Canada and Australia in an attempt to unravel the causes of learners' poor performance in science focused mainly on learner diversity in terms of racial, language, cultural backgrounds and socioeconomic status (Marshall 2002, Lemmer, Meier & Van Wyk, 2006, Norman, Ault, Bentz & Meskimen, 2001). For example, studies in United States suggest that the minority racial and cultural groups of Black and Hispanic science students displayed poor academic performance as compared to White American students of the dominant race and culture (Lee & Luykx 2006). These recent studies together with earlier ones that were documented in the long history of research among the minority racial and cultural groups of Maori in New Zealand, Aboriginal children in Australia, Afro-Caribbean descent in Britain and Inuit in Canada. Hodson (1993) established common factors, same as mentioned above, that cause poor performance in science. Together they emphasize that many science educators are challenged both professionally and personally by the populations of learners from diverse racial and cultural backgrounds they encounter in their science classes (Marshall 2002, Lemmer et al, 2006). The reason could be because too often, the educators' knowledge of science and/or learner diversity is insufficient to guide learners from diverse backgrounds to meaningful science learning which results in poor performance in science by learners (Trowbridge, Bybee, & Powell, 2004). Science learners who come from different racial or cultural backgrounds to those of their science educators and/ or dominant race or culture, experience racial or cultural alienation and discontinuity which lead to poor performance in science (Marshall 2002, Lemmer et al 2006:19).

Related to these, are two separate survey studies. For example, an earlier one which was done in England that focused on science learners from a broad range of language communities, particularly immigrants (Strevens,1976). Another recent study in the United States concentrated on Spanish speakers where the medium of instruction was not their mother tongue (Lee & Luykx, 2006). Both studies showed that learners who were taught in English for whom it was a foreign language performed poorly in science as compared to those who were taught in English which was their mother tongue. It was further established that if English was a foreign language to the science educator, the educator also often found that new techniques made demands upon his/her spoken English which he/she could not meet. Together, these studies may suggest that learners' limited proficiency in a second language constrains their science achievement when instruction and assessment are exclusively or predominantly in a second language. This is because learners who come to a science lesson taught in a second language usually bring their attitudes, cognitive styles, social and linguistic skills that have been developed in their first language (Lemmer et al 2006).

A wide range of possible communication problems between the educator and the learner emerge when science is taught in English to learners whom it is a foreign language which may lead to poor performance (Marshall 2002). For instance, non-English speaking learners need to develop English language and literacy skills in the context of content area instruction while content area should provide a meaningful context for English language and literacy development.

Babaci-Wilhite (2013) reviewed the debates on the choice of language of instruction in formerly colonized countries, giving special attention to the United Republic of Tanzania. The research explored the relationship of language of instruction to local debates on quality learning, cultural identity, as well as the influence of global actors and development discourses on language of instruction choices. A particular attention was given to:

1. The strong evidence for superior learning when the medium of teaching and learning is a local language;
2. The implications of these language of instruction policies for quality education, cultural identity and rights in education.

The paper is based on empirical research in Tanzania made in 2007 to 2012. The focus in this paper was on the recent changes in language of instruction in Zanzibar. In 2010, Zanzibar began the implementation of a policy that changed important aspects of the curriculum in primary and secondary education, which among other changes replaced the current language of instruction - Kiswahili with English in the subjects of Mathematics and Science from Grade 5. Tanzania made an early choice to use Kiswahili as the language of instruction in primary grades, but that policy has been contested for many years, partly due to pressure from global agents such as the World Bank and other international institutions such as International Monetary Fund, British Council and donors mainly from English speaking countries such as the United Kingdom and the United States. In the United Republic of Tanzania, the researcher interviewed government officers, academics, policymakers, NGOs' staff and journalists to elicit their understanding of the aims of language and educational policies. Teaching and learning in classrooms were observed with a focus on how the language of instruction affects the quality of both.

Before the colonization of Africa, the usual practice was that each social group educated its children in its own language. Throughout the colonial period (1885-1962), education was formalized and the use of the colonial language as a language of instruction was promoted by both colonial administrations and Christian missionaries (Kimizi, 2007). In East Africa, a movement to promote Kiswahili began in the 1930s. Between 1930 and 1964 an Inter-Territorial Language Committee promoted the standardization and development of Kiswahili in Tanzania, Kenya and Uganda. A few years after Tanzanian independence, in 1967, Kiswahili became the medium of instruction throughout the primary school system in Tanzania (Brock-Utne, 2008).

For observations on language use and proficiency in the classroom, a particular attention was given to the language that was used in various classroom situations and how this affected student interest, participation and comprehension was given. Among other important findings, the observation revealed that the teachers were heavily relying on the curriculum guidebook, often reading from it verbatim in order to ensure that they taught according to the new curriculum. The times for observations were synchronized according to the Grades taught (i.e. 1, 2, 3) as

well as between the different schools, which had different teaching times, some conducted in the morning and others as afternoon sessions. The observation revealed the understanding more clearly that the language of interaction was not English. In most situations, teachers refused to answer questions in English. They clearly preferred to express themselves in Kiswahili, and this included the teachers of English.

In Tanzania, the National Kiswahili Council, in Kiswahili Bakita (Baraza la Kiswahili la Taifa) was founded in 1967 by a government act. It was given a budget and a staff with the mandate to develop Kiswahili and make sure the language is used properly in the media. However, the promotion of Kiswahili had begun much earlier, in the early 1930s. It had been given the status of the official language for the inter-territorial East African Language Committee in Tanzania, Kenya and Uganda. After independence, the work of promoting the language was continued at the Institute of Kiswahili Research (IKR-TUKI) at the University of Dar es Salaam. In the 1980s, the government gave consideration to implementing Kiswahili as a language of instruction, but in the end did not follow through and do it at all levels. The arguments were that Kiswahili was not ready to be a language of instruction because of a lack of books and terminology (Babaci-Wilhite, 2013). The Chief Academic Officer at the National Kiswahili Council said on November 5th, 2008, that in the 1980s those kinds of arguments were accepted, but currently the same argument is used even when everything is ready. Since 1980s both book publishers and the National Kiswahili Council have engaged in the development of scientific terminology. It was concluded that there were enough dictionaries. A fresh attempt was made to convince the government. This raised the question of why the country would not use its language, Kiswahili, when it has National Kiswahili Councils (in Dar es Salaam and in Zanzibar) that has developed all the necessary terminology (Babaci-Wilhite, 2013).

The researcher concluded that language plays a critical role in cognitive learning and in the development of logic, reason, critical thinking, and new knowledge (Bostad, 2012; Babaci-Wilhite, 2013). This curriculum reform in Zanzibar is ill-founded and needs to be reassessed. The government should reconsider its decision to institute English as the language of instruction in Grade 5 and 6 and institute Kiswahili in secondary schools. This would help students to develop their learning and problem-

solving skills, which together contribute to the development of critical thinking and observational skills. The acquisition of knowledge and confidence related to use of Kiswahili would contribute to sustainable development.

2.5 Global Perspective

Placing the discussion on the broader context, it is significant to conceptualise English within a global perspective as a socio-political, economic and educational language. English is now the first language of about 400 million people in Britain, the United States of America and the Commonwealth countries. It has become the dominant global language of communication, business, aviation, entertainment, diplomacy and internet (Guo & Beckett, 2007). Undeniably, today English is increasingly becoming the dominant global language whereby both the West and the East have become equally busy promoting it (Imam, 2005).

Throughout the language policy discussion, therefore, it is important to ask ourselves whether language policy is such an important global issue. Gandara and Gomez (2009) found out that nation-states have frequently used language as an instrumental and symbolic tool for the process of building a solitary national culture. Language therefore is a key element of ethnic and national identity. Gandara and Gomez (2009) further contend that ethno-cultural identity and language are inextricably connected, and language choice and language use always have socio-political and socio-economic consequences. Focusing on the English language policy within the historical context, it would seem that, socio-political and economic roles of English language have been evolving over time across nations. Spring (2007), for example, found that in the 21st century English language plays a different role in the global economy than it did during the 19th century when it was used as an instrument of cultural imperialism. Today, English serves as a vehicle for participation in the global economy. In fact, English is now chosen as a language to learn rather than the language that is imposed by outside forces (Spring, 2007, Rubagumya & Kiliku, 2011).

In Africa, due to the character of most colonially defined states and intuitive polices imperialist powers, the languages of Europe, specifically Portuguese, Spanish, Dutch, English and French became the languages of power (Alexander, 1999).

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During the period of decolonization, all the fledgling nations of Asia faced the language identity question. Language became one of the keys to nation-building and identity, and an instrument of coherence and control (Imam, 2005). Ironically, in Africa, English changed its form from being the language of oppressor to becoming the language of national unity and liberation (Alexander, 1999). Politically, countries like Singapore, Malaysia, India and Sri Lanka, vigorously surge forward in the promotion of English language parallel with additional indigenous languages (Imam, 2005). In Africa, however, the argument was based on the declaration that the choice of indigenous language "would unleash a separatist dynamic which would destabilise, mostly, the very plurilingual African states" (Alexander,1999:5). Hence it is evident that the domination of English language across the world has political and cultural approvals from the powerful and influential ruling classes regardless of the critical observation of the scholars and the ordinary people.

Wolff (2002) argued that the African language question in education is a creation of Africans themselves, as Africans are not ready to "throw off the yolk of colonialism". Whereas some countries insist on using foreign languages in education, the practicability of this policy is questionable. Wolff (2002) cited experiences from Kenya where officially the Medium of Instruction after Grade 4 is English, yet in most schools English and either Kiswahili or another African language are juxtaposed. Malawi is another African country where the answer to the medium of instruction in schools has remained elusive. In a recent national symposium on Language Policy for Education (Kamwendo, Mtenje & Sandhaus, 1999), the need for more use of mother tongues in Malawian primary schools was emphasised. Since 1964, teaching in Malawi has been conducted in English and Chichewa, which are alien to many Malawi nationals. Such a practice is not only pedagogically untenable but also politically undemocratic (Kamwendo, et al,1999).

Even though South Africa and Tanzania are considered to fare well in terms of respecting both linguistic rights and the human right to education, there exist challenges as regards these two countries' language of instruction (Brock-Utne, Desai and Qorro 2003). Desai (2003) shows that in South Africa, English is the medium of instruction after Grade 4; however, in the Western Cape Province, for instance, should teachers and learners share isiXhosa as mother tongue, they use this language for verbal classroom interaction in order to bring about more effective

learning. In spite of that, all written tests are done in English; the effective learning made possible in isiXhosa is never tested in isiXhosa. According to my understanding, what happens in the classrooms in the Western Cape is not surprising since the teacher is the one in closest proximity to the learning of the child. Weighing the importance between allowing the child to understand the concepts taught and sticking to the principle of using LoLT becomes the crucial decision making for the teacher. Code switching becomes the choice.

What the teacher says and what the learner hears have to be harmonised, beginning from hearing of the concept during the introduction of the lesson to the learner making meaning of the new familiarised concept. The teacher has to make means to ensure that the learner even if it means the teacher has to use codeswitching. The awareness of the fact that, as King and Chetty (2014) realised, the relationship of the teacher's codeswitching and the learners' acquisition of content, like science, is a complex one and that awareness has to be on the forefront of the teacher's thought when trying to unpack a concept. This statement confirms the point that language on its own, without content of focus, may not serve the intended purpose if language of the content (terminology) is not taken into consideration. My thoughts were that focus might be on how an explanation of a concept may be imparted correctly instead of focussing on imparting the accurate conceptualisation.

Research conducted by Mansfield (1985) and McCloskey (1983) focused on the ways in which teachers and teacher trainees understand the subjects they teach. The studies revealed that they often have misconceptions or gaps in knowledge similar to those of their pupils. This makes it very difficult to disagree with Conant (1963) on the point that "if a teacher is largely ignorant or uniformed he can do much harm" (p. 93) because conceptual errors become predominant. In the primary schools there is a large number of teachers who were trained at that time. One of the respondents is a young teacher who is trained in the newly structured system that focuses itself on developing subject specialists and ensuring correct teaching methodology. The young teacher showed depth in the content knowledge and determination in realisation of the objectives of the lesson with minimal or no misconceptions at all.

In the absence of the specific content terminology, it is a partial solution to Bantu-ize the English term by affixing it indigenously, adding "i" in front of that term, "i-test

tube". This does not change meaning of naming but gives a chance to give meaning to a more complex phenomenon when codeswitching. As it stands there is minimal to no scientific terminology to ensure that isiXhosa learners learn science in their home language (King & Chetty, 2014).

2.6 Conclusion

This chapter gave consideration to the theoretical frameworks that underpinned the study and highlighted research that is related to the research area. In the next chapter the research methodology representing an outline of how data was collected, is discussed in depth.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter provided the research instruments used, the sample that will be taking part in the study and the methodologies that will be applied. It provided the justification for the choices of instruments and sample and introduced the research design that was applied to collect the research data to answer the following main research question and sub-questions:

What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

(i) **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

(ii) **What were the teachers' perceptions of the influence of language in their Natural Sciences classes?**

3.2 Research design

This study used a mixed method design as both the qualitative and quantitative approaches were employed because together they complement each other. Strauss and Corbin (1990) give a definition of quantitative research as any study that is capable of giving results in the form of statistical data or other means of quantification. Creswell (1998) refers to qualitative research as an inquiry that explores a social or human problem. The choice of the mixed-method approach was to strengthen the understanding of the reasons behind the rationale that led to this study.

3.2.1 The population

It can be argued that resorting to an accessible population in a research study is a form of convenience sampling, that is, sampling that involves selecting "a sample that suits the purposes of the study and that is convenient" (Gall, Borg, & Gall, 1996:227)

for a variety of reasons. For this study, the choice of three schools selected was about accessibility and the proximity to the area where the researcher worked.

3.2.2 Sample

The sample for this study was one Grade 7 Natural Sciences class from each of the three schools selected for observation. The teacher from each school teaching Natural Sciences formed part of the sample of this study. Table 2 below, provides the number of learners that took part in each school. These classes were selected because Grade 7 is still in the primary school. The aim of using the class in the primary school was to observe the language used by the teachers when teaching science before learners got to the secondary school. The number of learners in each class depended on the class of the chosen school.

Table 2: Sample for the study

Participants	Number			Technique	Criteria
	School 1	School 2	School 3		
Learners	1 Grade 7 Class	1 Grade 7 Class	1 Grade 7 Class	Purposive	The three schools were randomly selected
Teachers	1 Teacher	1 Teacher	1 Teacher	Purposive	The three teachers were from the selected schools

Determining the proper sampling method is often a daunting task for those employing social scientific research methods. According to Lindgren (1993), competing theories of proper sampling render what constitutes a good sample unclear. Sometimes the guiding advice to sampling selection methods is indirect or abstract to how properly an appropriate sample can be constructed and what the sample can claim to reflect (Lindgren, 1993; Rao, 2000). The type of sampling used in this study was chosen to be purposive sampling. Purposive sampling allows the researcher to choose the respondents that will suit the nature of the study. Richards and Morse (2007) indicate that purposive sampling occurs when the researcher selects a sample because of its

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particular characteristics. For this study the samples were logistically in close proximity of the researcher. According to Patton (1990), the logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the study.

3.3 Data Collection Plan

The study took the route of observation of teachers teaching a lesson of Natural Sciences in the Senior Phase.

Table 3: Data collection plan

Research Question	Method	Instrument	Respondent	Analysis
Teachers' use of scientific terminology	Direct observation and video-taping	Observation checklist	Learners and teachers from the three sample schools	Excel and coding manually
Teachers' perceptions of their use of scientific terminology	Interviews	Interview schedule	One teacher from each of the sample schools: 3xteachers	Coding manually

The study consisted of the following two steps. In the first instance the selected Grade 7 Natural Sciences classes from each of the three schools were observed by the researcher. At each school the teacher's interaction with his/her learners was video-taped as well as observed using an observation schedule. Each lesson was observed for the application of English as a language of instruction to teach the scientific concepts.

The second step of the study involved interviews with the teachers of each school after the lessons were observed. Table 3 above presents a summary of the data collection plan used in this study.

3.4 Research instruments

The research instruments were used to collect data as informed by the research collection plan. The approach used in this study was mixed method, that is, quantitative and qualitative approach. For the quantitative approach, an observation checklist provided data and for the qualitative approach an interview schedule and data from the observation schedule were used. All interviewees were asked the same questions in the same order. These questions were meant to further investigate what was observed in the classroom so as to triangulate the data with the statistical analysis.

3.4.1 Classroom Observation

The learners' responses to the questions during the lesson and during recapping of the lesson were observed. The lesson was videotaped as it progressed, for analysis at a later stage. After the video tape was analysed using observation checklist, the interview questions for the interview schedules were formulated.

3.4.1.1   Observation checklist

An observation checklist (Appendix 1) was used to collect the data in the classroom. This collection was further reinforced during the observation of the video-taping of each lesson in each class. The checklist had items that were the focal points of the observation. Some questions required "yes" or "no responses while others required the frequency of use of each item. The checklist was designed to reveal the degree to which the language support teachers give while implementing the science literacy strategy and to also establish the language used by teachers and learners in the classroom during a science lesson.

3.4.1.2   Advantages of classroom observations

Many types of research can only measure elicited behaviour because specific tasks are presented in a controlled environment. In contrast, observation enables the researcher to examine non-elicited behaviour as and when it occurs (Wray, Trott, & Bloomer, 1998). This is of critical importance for it allows a more holistic view of how language is being used in context. In agreement, Seliger and Shohamy (1989) add that observations allow the study of phenomena at close range with many of the contextual variables present, a feature which is very important in studying language behaviours. In the same vein, Gall, Borg & Gall (1996) concur when they point out that the inclusion of observation in a researcher's report provides a more complete

description of phenomena than would be impossible by just referring to interview statements or documents. Another advantage of observations is that they are more flexible than controlled experiments which may be affected by extraneous variables or unplanned events (Wray et al. 1998). Observations can also be relatively easier to administer if the researcher is using pre-recorded or broadcast material as one is spared the practical difficulties of data collection (Wray et al. 1998).

3.4.1.3   Disadvantages of classroom observations

One disadvantage of observations is that the presence of the observer may alter the subjects' behaviour. This means that if subjects are being watched, they change their normal behaviour. This is what is known as '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. However, measuring the magnitude of the observer effect can be a tricky affair, so it needs to be minimised at all cost.

Observations can also be intrusive if data-collecting instruments such as audio-tapes or video-tapes are used. Wray, Trott and Bloomer (1998) point out that it is often impossible to collect data without the subject knowing that you are doing so. Yet the presence of a tape-recorder, experimental equipment or even simply the presence of the researcher may have an effect on the linguistic behaviour of the subjects. Since this study used video-taping, it was imperative that the video-taping be treated with high caution; for example, letting the subjects get used to the idea of video-taping.

3.4.2 Interviews

Interviews are defined as purposive conversation in which one person asks prepared questions (interviewer) and the other answers them (interviewee). Structured and semi-structured interviews are two basic types of interviews (Frey & Oishi, 1995). This study followed a type of semi-structured interviews because the questions that were asked might require follow-up questions. Each interviewee was asked the same eight questions. The questions were aimed at fulfilling the research question.

3.4.2.1 Interview schedule

For the interviews, an interview schedule (Appendix 4) was used. The schedule had questions that were related to the use of language by teachers, the suitability level of language used in teaching Grade 7, the level of English language used by learners when answering questions and if the language used by teachers took cognisance of

the language of science. Interviews were also used as data gathering techniques in this study. Gay & Airasian (2000) refer to them as a purposeful interaction, usually between two people, focusing on one person trying to get information from the other. They mention that interviews permit the researcher to obtain important data that cannot be obtained from observation and they can explore and probe participants' responses to gather more in depth data about their experiences and feelings. And they can also examine attitudes, interests, feelings, concerns and values more easily than using observation.

3.4.2.2   Advantages of interviews

Since interviews are personalized, interviewers permit a level of in-depth information gathering, free response and flexibility that cannot be obtained by other procedures (Seliger & Shohamy, 1989). That is the reason that interviews were included in this study. Another advantage of interviews is that data that have not been foreseen can be probed and obtained. One would not be able to obtain such information using the questionnaire, for example. In addition, interviews allow the respondent maximum freedom of expression thereby allowing ample and often unexpected information to emerge (Seliger & Shohamy, 1989). Finally, interviews build trust and rapport between interviewer and respondent, thus oiling the extraction of information which respondents might otherwise be indisposed to give (Gall et al., 1996).

3.4.2.3   Disadvantages of interviews

The disadvantage of administering interviews for a research purpose is that they are costly and time-consuming (Seliger & Shohamy, 1989). This is true especially if one needs to interview a large sample. Fortunately for this study, there were only three interviewees which were an easily manageable number. Another challenge that the interview method poses for the researcher is that it is difficult to standardize the interview situation so that the interviewer does not influence the respondent to answer certain questions in a certain way (Gall et al., 1996).

3.5 Data Analysis

To analyse means to break down a whole into its components or constituent parts. One comes to understand the integrity of the whole through assembly of the parts, (Schwedt, 2007). The collected data for this study were analysed from the video-tape utilizing the observation checklist prepared. Observations made from each school

were carefully treated as it represented the school it was collected from. Comments made for each item on the observation were analysed so that they added value to the findings that discussed in the following chapters.

Data collected through the interviews were treated and analysed according to the in-depth light the data shed on the topic at hand because interviews bring in the experience and feeling of the interviewee. In this study, the questions on the interview schedule were designed to look critically at the current state of language policy of Education and to give a chance for a voice of teachers to be heard. The schools were coded S_1, S_2 and S_3 for the purpose of identification in the citation of the interview quotes where the teachers from each school were interviewed. The teachers were coded T_1 from school S_1, T_2 from school S_2 and T_3 from school S_3. A transcript was made from the observation video tape where each response was written and numbered. The numbered responses were coded as numbered lines (L_1, L_2, L_3, etc.). The quotation on the findings and discussion of findings appears as, for example ($T_1S_1L_5$) where necessary. This coding made it easy to trace any quotation mentioned in the analysis and discussion of the findings.
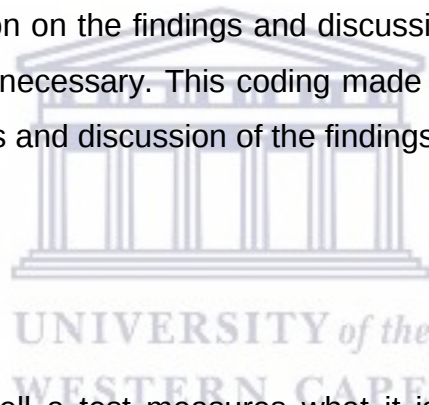
3.6 Validity of data

Validity refers to how well a test measures what it is supposed to measure. The observation has been done through videotaping of the sessions. For the interviews, the interview questions were made to focus and align with the research question of the study. The interview sessions were audio-taped. The data from the observation and interviews were collected and analysed and provided the necessary triangulation for the study. The triangulation ensures the credibility and the validity of the data obtained for the study. Methodological triangulation is when one approach is followed by another, to increase confidence in the interpretation (Smith, 2009).

3.7 Reliability of Data

Reliability is generally understood to concern the replicability of research and obtaining of similar findings if another study was using the same method (Lewis &

Ritchie, 2003). The researcher ensured that the data was not tampered with and the teachers understood the rationale behind the study so that they conduct their lessons freely. The participating teachers were promised that the researcher would show them the transcribed data to allow them to check if the information gathered was accurate. This approach ensured that if any other research comes along to repeat the study, the same result will be obtained. All the research instruments were approved by the researchers' supervisor.

3.8 Ethics

The researcher made sure that the rights and welfare of the participants in the research were protected. Clearance was sought from the University of the Western Cape Ethics committee and Eastern Cape Department of Education. Informed consent was also sought from the schools, teachers, parents and learners to be observed and the teachers to be interviewed. The confidentiality and anonymity of the research respondents were respected. Participants were also made aware that if they did not feel comfortable that they did not have to answer questions and that they could withdraw from the project at any time. The collected data were being made available to the participants.

3.9 Conclusion

This chapter outlined the methodology used to collect the data to answer the research questions. The research design of the study was made known. The sampling technique was clarified and justified. It also provided an explanation of the rigor in terms of validity and reliability. In the following chapter the findings of the collected data are presented in the form of tables and graphs.

CHAPTER 4

FINDINGS AND DISCUSSION

4.1 Introduction

In the previous chapter the methodology employed to collect the data were presented. This chapter presents the findings of the data collected and presents the data to address the following main research question and sub-questions:

What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

(i)   **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

(ii)   **What were the teachers' perceptions of the influence of language in their Natural Sciences classes?**

In this chapter the findings are presented to report on the teachers' and learners' use of scientific terminology including the proper naming and explanation of apparatus used during the lesson in all the three sample schools. The findings also reported on the examination of teachers' perception of the use of scientific terminology in the sampled interviewees.

4.2   How did the teachers make use of scientific terminology in their Natural Sciences classes in each of the three participating schools?

In order to address the above research question, the observations at each of the three schools will be presented below.

4.2.1   School 1

In school 1, the observation was in Grade 7 Natural Sciences class of 75 learners. The learners were a mixed class of boys and girls between the ages of 12 and 14. All the learners in the class were isiXhosa speakers. The lesson was conducted by a female teacher of between 50 and 55 years of age. The topic of the lesson was 'Acids and Bases'. The lesson was video-taped by the researcher and observed at

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the same time. A thorough analysis was made through the observation of the lesson from the video-tape made during the lesson presentation.

4.2.1.1 Language used by the teacher

a.   **Introduction and explanation of topic**

The teacher greeted the class the usual way, "good morning class". She arranged some items on the table which were to be used during the lesson. The teacher told the learners that on the day the lesson was on acids and bases. She mentioned that some acids and bases are used in our homes and they are called household acids and bases. During the progression of the lesson the teacher had different household acids which she held up and showed to the learners and asked names of the items she had in front of the learners, for example, lemon, orange, vinegar and tartaric acid. Learners were able to identify the items correctly. The teacher then explained to learners that the group of items they named were acids. The teacher asked 'how do acids taste?" One learners answered, "they taste sour". Immediately after hearing the answer, the teacher rephrased the answer and said, "yes, acids have sour taste". The teacher was tapping on the leaners' daily experience.

The teacher then held out other items that were not identified from the table and asked the learners to name them. The items were powder soap, bicarbonate of soda and handy andy purpose cleaner. Learners correctly identified the second group of items. The teacher explained that those items were bases. The teacher asked the leaners, "what are they for?" The answer from the learner was," cleaning". The teacher then said "these are our cleaning agents and that is why we are not tasting them, otherwise they taste bitter". The teacher asked the learners "how does handy andy feel in the hands?" One learner answered, "like a soap". The teacher then explained that the soap is slippery. The teacher kept on reminding the learners that the lesson was on acids and bases.

b.   **The use of isiXhosa during the lesson**

The teacher used English when explaining the science concepts without trying to change to other language. In the course of the lesson, the teacher mentioned

isiXhosa words even though they were not meant to explain the science concepts but to control the class or to instruct a learner to do something.

When the learners started to talk to each other, noise started to be on the rise, the teacher said, "makungabikho mntu uthethayo kaloku" ("quiet please"). Immediately, learners paid attention to the teacher again.

Twice during the lesson, when the teacher noticed that the same learners are responding to her questions, she commented in isiXhosa, "Hayibo! Baph'abanye?" (where are the other learners, why are they not answering?). After a while she then said, "Hayi, ndiyoyika ngoku, kuphendula abantu abanye!" ("No, I am afraid now, the same people are answering").

When the time came for the learners to make use of the apparatus, the teacher asked for one learner to come in front of the class to make use of the indicators called litmus paper. The teacher explained to the class that litmus paper is used to identify whether a substance is an acid or a base. The teacher called another learner, "khawuze ke uzokuphakamisa" ("come hold up the beaker"), to help raise the beaker for other learners to see whilst the first learner used litmus paper to identify the clear liquid in the beaker. On one occasion, the teacher pointed at one learner to answer a question but another learner who thought the teacher meant him stood up to answer, the teacher quickly intervened saying, "ndifuna wena" ("I want you"), pointing at the correct learner. The learner stood up to answer the question. While the learner was standing, she did not answer and the teacher waited for her to speak when eventually the teacher urged her to speak saying, "Hayi kaloku, thetha".

As the teacher moved to a concept of pH scale, she asked for learner to come to the chalkboard to develop a pH scale drawing. A male learner came forward and a pH scale was developed with the guidance of the teacher and other learners who got the idea from the textbook. When the learner stood back from the board, the teacher asked "Ugqibile tata?" ("are you finished young man?"). The learner was not sure whether he finished or not and the teacher called another learner who finished it up. The other learner tried to write on the tight corner of the chalkboard and the teacher instructed him to write on the visible-to-all space of the chalkboard, "khawusebenzise eli cala libonakalayo". The learner changed the spot to write on the blackboard.

The lesson was coming to an end and the teacher was linking the conceptual understanding to everyday life. The teacher wanted the attention of the learners and she said, "mamela!" ("listen!"). She then started to explain the effect of acid on the teeth of people. She was asking a question about the cause of tooth decay. She said, "what is it that makes our teeth dirty, kubekho that tart (pointing to the teeth in her mouth)?"

c.   **Use of science concepts**

The lesson progression had new terms introduced which the teacher needed to explain. She explained to learners that not all acids could be tasted as they are "**corrosive**" in nature. She did not give the specific meaning of the word "corrosive" but she just gave how dangerous an acid can be. The teacher came up with a word "**alkali**" and she described as a **soluble base**. She further explained that a soluble substance is a substance that dissolves in water.

The teacher held out a beaker with a clear liquid and explained to the learners that the liquid is a **solution** since something have been dissolved in water. She explained that if an acid is dissolved in water, she further explains, the solution is an **acidic solution** but it is the alkali dissolved in water then the solution is an **alkaline solution**. The teacher raised the second beaker with another hand and both solutions were held out. She asked which one is an acid and which one is a base since were both not labelled. Learners could not guess because both solutions were colourless. She took that opportunity to introduce two types of **indicators**, namely, litmus papers and bromothymol blue. The teacher gave a definition of the indicator as a substance that indicates whether a substance is an acid or a base. The teacher mentioned another new term which is the **pH scale.** She described the pH scale as something that is used to determine whether a substance is neutral, acidic or basic.

d.   **Conceptual errors**

There were two occasions where the definitions or description of term was not satisfactory. An idea was planted in the minds of the learners by the teacher that "harmful" means corrosive and corrosive means cannot be tasted, felt or smelled. A definite meaning of the word was not given. The teacher was trying to give a picture of different measures of strengths of different acids.

When an indicator, bromothymol blue, was used in the acid the teacher allowed the learners to say acid becomes yellow in a bromothymol blue instead of "bromothymol blue becomes yellow in an acid". Considering the fact that it is the indicator that changes colour when put in an acid, the latter statement qualifies to be a misconception. Similar statement was said when bromothymol blue was used in a base. The figure below gives a summary of the findings presented above.

Figure 4: Language used by the teacher

4.2.1.2 Learners' involvement in the lesson

a. **Learners' questions**

Throughout the lesson there was not a single question asked by the learners, hence, it is noted that learners did not question any concept, term or misunderstanding. That makes it to be 0% of questions asked by the learners. That trend of silence carried on even when the teacher asked questions, only some learners raised their hands indicating their willingness to answer. The teacher never asked if any learner had a question.

b. **Learners answering questions**

The teacher asked many questions - 36 in total. There were 32 questions answered correctly by the learners. The questions answered by the learners were those that were asked to introduce the topics. Other questions were asked to support the concept or term raised in the introduction of aspects of the lesson, for example, indicator or pH scale.

The questions answered by the learners were grouped into two categories, namely, Lower Order Questions (or literal comprehension questions) (LOQ) and cognitive questions which were further divided into Lower Cognitive Questions (LCQ) and Higher Cognitive Questions (HCQ)

Figure 5: Categorisation of questions answered by learners

As indicated in Figure 5 above, a breakdown of questions answered by learners was categorised according to levels of difficulty – from a literal or lower level to a cognitive or higher level. The Cognitive Questions were divided into two levels. It was noted that the teacher asked many questions and at three different levels. The researcher grouped the data into two categories and three levels as follows:

Lower Order Questions (LOQ)

In this category, questions that were from the content were asked and a few examples from the lesson observed were:

- What do we call soluble base?
- What kind of solution do bases form?
- What kind of solution do acids form?

For the duration of the lesson, 23 LOQ's were asked out of a total of 36 questions posed to the learners. Hence, 64 % of the total number of questions were lodged at the Lower Order Question category

Lower Cognitive Question (LCQ)

This level of questions answered was more basic type of questions like recall word-for-word material previously presented and the examples were as follows:

- What happened when powder soap was mixed with water?
- Why do you say it is a base?
- How do bases feel between fingers?

There were seven questions in this category that the learners answered and these questions made up 19% of the questions asked in the lesson. The next level in this category was Higher Cognitive Questions

Higher Cognitive Question (HCQ)

These were the questions that were open-ended, interpretive and evaluative. These were the few examples: -

- Why do we use a tooth paste?
- What do bases do?

The questions of this level were 6 and they were 17% of the total number of questions answered.

There were about four questions answered incorrectly by the learners. The four questions answered incorrectly were 11% of the asked questions during the lesson.

C. **Learners speaking isiXhosa**

No learner communicated in isiXhosa with the teacher during the entire lesson. All the learners who answered questions seem to have understood the language of learning and teaching (LoLT) and they never deviated from it.

Figure 6: Learners' Involvement in the Lesson

4.2.1.3   Use of Teaching and Learning apparatus

a)   **Naming of the apparatus**

As the lesson progressed, the teacher used the apparatus at her disposal. The teacher named all seven apparatus used to assist in understanding the concept of acids and bases. Learners repeated the names of each apparatus after the teacher every time they were named.

b)   **Explaining the apparatus**

  The teacher explained each apparatus as they were introduced during the advancement of the lesson. The learners were instructed to repeat the explanations after the teacher. The teacher wrote the explanations on the chalkboard.

c)   **Frequency of teacher using apparatus**

On her own, the teacher used six apparatus. The teacher used the apparatus to demonstrate the nature of substances and also demonstrated the colour changes of indicators in acids and bases.

d)   **Frequency of learners using apparatus**

Learners used one set of apparatus to identify acids and bases using indicators. The better part of the lesson teacher demonstration and question and answer approach.

e)   **Learners recording findings**

In the whole lesson, the teacher did not ask the learners to record the findings. While the experiments were being done, the researcher looked around and noticed that

learners were not recording the results. Learners sat and listened looking like they were ready for questions from the teacher.

f. Learners assisting each other

It was during the one time that the learners worked with the apparatus they had a chance to assist each other. One learner was testing a chemical using litmus paper and the other was holding the beaker for the ease of access and visibility for other learners.

Figure 7: Use of Teaching and Learning apparatus

4.2.2   School 2

In school 2, the observation was in Grade 7 Natural Sciences class which consisted of 54 learners. The learners were a mixed class of boys and girls between the ages of 12 and 14. All the learners in the class were isiXhosa speakers. The lesson was conducted by a male teacher of between 40 and 50 years of age. The topic of the lesson was 'Introduction of Periodic Table of Elements'. The lesson was video-taped by the researcher and observed at the same time. A thorough analysis was made through the observation of the lesson from the video-tape made during the lesson presentation. Notes were made on the observation checklist to ensure thorough analysis of the lesson presentation. At this stage, a detailed description of the events of the lesson is the main focus.

4.2.2.1   Language used by the teacher

a.   Introduction and explanation of topic

The teacher entered the classroom and the learners stood up to greet the teacher. The teacher greeted the learners and then instructed them to sit down. This initial part of communication between the teacher and learners took place in English. The teacher introduced the topic of the day as the 'Periodic Table of Elements'. He started the lesson by connecting the previously known properties of materials like tensile strength and compressive strength with the present topic of Periodic Table. In the course of trying to elucidate the pure substances and mixtures, the teacher made an example of samp and beans as it is known by the learners from their

backgrounds. With that example, he explicated that the samp and beans is an example of mixtures. He managed to provide the understanding of the concept of elements as pure substances to the learners.

The teacher introduced two arrangements of the Periodic Table which were "Group" and "Period". He gave the "Group" as the vertical arrangement of elements and the "Period" as a horizontal arrangement of elements. He further explained to the learners about the scientist, Dmitri Mendeleev who was responsible for the arrangement of the element of the elements in the Periodic Table. He reminded the learners about the concepts of atomic number and mass number of atoms of elements.

The teacher then introduced the categorisation of the elements in the Periodic Table as arranged according to metals, semi-metals and non-metals. The teacher talked about a property of the metals but did not go deeper. He did not tell about the properties of non-metals and semi-metals. The teacher got to the properties of the individual elements in the Periodic Table and, through question and answer method of teaching, extracted their physical properties.

b.   **The use of isiXhosa during the lesson**
The teacher explained the science concepts in English without trying to change to other language. As the lesson progressed, there was a use of isiXhosa words as mannerism, for instance, "Yha, nhe?" which can be translated as "isn't it?". Another word was "xa ucinga" and it refers to a word that emphasises that the teacher is looking for thought out answer from the learners.
The teacher clearly asked the learners to give a word in isiXhosa that has the same meaning as metal. The word "intsimbi" was mentioned by the learners and the teacher.

c.   **Use of science concepts**
The teacher introduced a number of concepts that come out of the Periodic Table. **Element** was the first concept that the learners needed to understand. He explained to the learners that elements were pure substances but the researcher did not hear the definition of an element. **Group** and **Period** were the next concept to be introduced. Group was defined as the elements that are vertically arranged in the

Periodic Table. Period was defined as the elements that are horizontally arranged in the Periodic Table.

The teacher ensured that the learners understood where to find **metals**, **semi-metals and non-metals** in the Periodic Table. The properties of these items were not explained, it was just the understanding that they were there that was emphasised. The semi-metals were pointed out as the elements that had properties of both metals and non-metals. The teacher missed the opportunity to explain the properties of metals, semi-metals and non-metals to the learners. Electrons in the energy levels were not mentioned when an **atomic number** was introduced. The teacher also introduced the important concept of mass number and how to read it when an element was presented from the Periodic Table.

d.   **Conceptual errors**

The lesson progressed with a sizeable share of conceptual errors and omissions which contributed to the tainting of the lesson. The teacher said to learners "in Biology, Science is divided into three, it's Life and Living which is called Biology, Physical Science and Chemistry". The latter statement did not make sense; it basically causes confusion. In actuality, Natural Sciences is divided into Life and Living, which in Further Education and Training (FET) is called Life Sciences, Energy and Change (Physics), Chemistry and Earth and Beyond. The Physical Sciences the teacher mentioned comprised of Physics and Chemistry but it is not part of Biology.

The teacher also said, "everything in 'Life and Living' is made of cells". 'Life and Living' involves the whole bio-diversity which includes soil and water that are not made of cells. With that statement, the teacher implied that everything studied under 'Life and Living' was a living organism, that is it breathed and grew.

The teacher mentioned the "atomic number" but he explained it as describing the number of atoms in its orbit. But the 'atomic number' is defined by the number of protons in the nucleus of an atom. He was not differentiating between atom and electrons or protons, resulting in the misconception of atomic number.

The teacher mentioned that "an element has atoms in the energy levels". This afore mentioned statement constitute a misconception. The element is made up of a large number of atoms but in the energy levels of the atom there were electrons.

The teacher asked a question referring to an element of atomic number that is after that of sodium but he said "what is the name of groups of elements next to sodium".

Figure 8: Language Used by the Teacher

4.2.2.2   Learners' involvement in the lesson

a.   **Learners' questions**

Throughout the lesson there was not a single question asked by the learners, hence, it is noted that learners did not question any concept, term or misunderstanding. That makes it to be 0% questions asked by the learners. That trend of silence carried on even when the teacher asked questions; only some learners raised their hands indicating their willingness to answer. The teacher never asked if any learner had a question.

b.   **Learners answering questions**

The teacher asked many questions - 31 in total. There were 30 questions answered correctly by the learners. The questions answered by the learners were those that were asked to introduce the topics. Other questions were asked to support the concept or term raised in the introduction of aspects of the lesson, for example, Group elements.

The questions answered by the learners were grouped into two categories, namely, Lower Order Questions (or literal comprehension questions) (LOQ) and cognitive questions which were further divided into Lower Cognitive Questions (LCQ) and Higher Cognitive Questions (HCQ)

Figure 9: Categorisation of questions answered by learners

As indicated in Figure 9 above, a breakdown of questions answered by learners was categorised according to levels of difficulty – from a literal or lower level to a cognitive or higher level. The Cognitive Questions were divided into two levels. It is noted in the findings according to the data that the teacher asked many questions and at

three different levels. The researcher grouped the data into two categories and three levels as follows:

Lower Order Questions (LOQ)

In this category, questions were from the content and a few examples from the lesson observed were:

- What is the atomic number of hydrogen?
- What is the mass number of sodium?
- What is the element, a pure substance or mixture?

For the duration of the lesson, 27 LOQ's were asked out of a total of 31 questions posed to the learners. Hence, 87,1 % of the total number of questions are lodged at the Lower Order Question category. 30 questions were answered correctly and they were 96,77% of the total number of questions answered. One question was incorrectly answered and it was 3,23% of the total number of questions answered.

Lower Cognitive Question (LCQ)

This level of questions answered was more basic type of questions like recall word-for-word material previously presented and the examples are as follows:

- What element in Period two is a product of photosynthesis?
- How are mixtures separated?

There were four questions in this category that the learners answered and these questions made up 12,9% of the questions asked in the lesson. The next level in this category was Higher Cognitive Questions

Higher Cognitive Question (HCQ)

These were the questions that were open-ended, interpretive and evaluative. These were the few examples: -

- Discuss the differences between metals and non-metals.
- Explain the trend found in the period of the Periodic Table.

No questions of this level were answered and they are 0% of the total number of questions answered.

There were no questions answered incorrectly by the learners since no questions asked in this category.

c.   **Learners speaking isiXhosa**

Learners in this class kept their communication to an English language. The moment when they had to answer a question posed to them by the teacher and he demanded that they answer in isiXhosa. The teacher was asking the learners to translate "metal" to isiXhosa word and the answer given by learners was "intsimbi". If the teacher had not asked for isiXhosa word, the learners would have spoken only English the entire lesson.

Figure 10: Learners' Involvement in the Lesson

4.2.2.3   Use of Teaching and Learning apparatus

a.   **Naming of the apparatus**

As the lesson progressed, the teacher used single apparatus at his disposal. The teacher named the one teaching tool he used to assist in understanding the Periodic Table, the textbook.

b.   **Explaining the apparatus**

Since there was no other teaching tool used in the class except the text book, there was no reason to explain what the textbook is. The only time the teacher named the textbook was when he instructed them to open it, otherwise there were no scientific apparatus available for that lesson.

c.   **Frequency of teacher using apparatus**

The teacher used the textbook to identify elements, groups and periods in the Periodic Table. He used the textbook also to ask questions that he took from it. The teacher used the textbook three times in all.

d.   **Frequency of learners using apparatus**

Learners used textbook the three times their teacher used it. There was no other apparatus the learners used during the lesson.

e. Learners recording findings

In the whole lesson, the teacher did not ask the learners to record the findings. No experiments were being done and no results were necessary for the learners to record.

f Learners assisting each other

There was no need for the learners to assist each other since there were no experiments done for the learners and by the learners themselves. Learners were just sitting and listening to the teacher without interacting with each other.

Figure 11: Use of Teaching and Learning apparatus

4.2.3 School 3

In school 3, the observation was in Grade 7 Natural Sciences class that consisted of 55 learners. The learners were a mixed class of boys and girls between the ages of 12 and 14. All the learners in the class were of isiXhosa speaking culture. The lesson was conducted by a female teacher of between 20 and 25 years of age. The topic of the lesson was 'Energy change'. It covered potential energy and kinetic energy The lesson was video-taped by the researcher and observed at the same time. A meticulous analysis was made through the observation of the lesson from the video-tape during the lesson presentation. Notes were made on the observation checklist to ensure thorough analysis of the lesson. At this stage, a detailed description of the events of the lesson is the main focus.

4.2.3.1 Language used by the teacher

a. **Introduction and explanation of topic**

The lesson started with the connection of the previous lesson and the current lesson. The teacher asked the learners what the previous lesson was about. Learners

answered that it was about **renewable and non-renewable resources**. The teacher asked the learners what "**energy**" means. Learners gave the definition of energy. She then asked what "potential" means.

The teacher announced that the lesson of the day was about **potential energy.** She stressed that there is a relationship between potential energy and **kinetic energy.** The teacher told the learners that the unit for the measurement of energy is **joules** with a symbol **J**.

b.   **The use of isiXhosa during the lesson**

The teacher did not change the language of learning and teaching. There was no code switching during the entire lesson.

c.   **Use of science concepts**

In most of the lesson the teacher introduced and explained the science concepts. She carefully picked the definitions of the concepts. The relationship between potential energy and kinetic energy was explained to the learners. The teacher defined potential energy as the energy possessed by a body or an object. Kinetic energy is the energy the body has as a result of motion. She further explained that if a rock is at a higher position above the ground, it has higher energy. As the rock starts to move, it has kinetic energy. She made a few examples to illustrate how the energy conversions occur.

d.   **Conceptual errors**

The teacher made one notable conceptual error, where she repeatedly told the learners that symbol for kilojoule is "capital letter KJ", but it should be small letter k and capital letter J (kJ). The teacher told learners that there were only two types of energy, all other energies are the making of the two.

Figure 12: Language used by the teacher

4.2.3.2   Learners' involvement in the lesson

a.   **Learners' questions**

Throughout the lesson there was not a single question asked by the learners, hence, it is noted that learners did not question any concept, term or misunderstanding. That makes it to be 0% of questions asked by the learners. When the teacher asked questions, many learners raised their hands indicating their willingness to answer. The teacher asked if any learner had a question but they responded with "no".

b.   **Learners answering questions**

The teacher asked many questions - 22 in total. There were 18 questions answered correctly by the learners. The questions answered by the learners were those that were asked to introduce the topics. Other questions were asked to support the concept or term raised in the introduction of aspects of the lesson, for example, "what is energy?"

The questions answered by the learners were grouped into two categories, namely, Lower Order Questions (or literal comprehension questions) (LOQ) and cognitive questions which were further divided into Lower Cognitive Questions (LCQ) and Higher Cognitive Questions (HCQ)
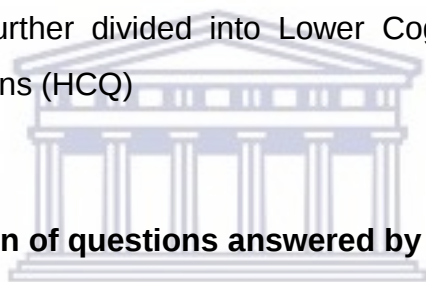
Figure 13: Categorisation of questions answered by learners

As indicated in Figure 13 above, a breakdown of questions answered by learners was categorised according to levels of difficulty – from a literal or lower level to a cognitive or higher level. The Cognitive Questions were divided into two levels. It is noted in the findings according to the data that the teacher asked many questions and at three different levels. The researcher grouped the data into two categories and three levels as follows:

Lower Order Questions (LOQ)

In this category, questions from the content were asked and a few examples from the lesson observed were:

•   What is joule converted to make it bigger?

•   What is the symbol for joules?

•   What is the symbol for kilojoules?

For the duration of the lesson, 9 LOQ's were asked out of a total of 22 questions posed to the learners. Hence, 40,91 % of the total number of questions were lodged

at the Lower Order Question category. 18 questions answered correctly made 81,82% of the total number of questions answered. Four questions were incorrectly answered and they constituted 18,18% of the total number of questions answered.

Lower Cognitive Question (LCQ)

This level of questions answered was more basic type of questions like recall word-for-word material previously presented and the examples were as follows:

• Define potential energy?

• What energy conversion takes place when a rock falls from a hill?

There were ten questions in this category that the learners answered and these questions made up 45,45% of the questions asked in the lesson. The next level in this category was Higher Cognitive Questions.

Higher Cognitive Question (HCQ)

These questions were open-ended, interpretive and evaluative. These were the few examples: -

• Discuss the differences between potential energy and kinetic energy.

• Explain what will happen to the stretched spring if it is let go.

There were three questions of this level that were answered and they were 13,64% of the total number of questions answered.

C   Learners speaking isiXhosa

During the entire lesson, there was no learner who deviated from speaking English. There was not a single word of isiXhosa used by learners when answering questions.

Figure 14: Learners' Involvement in the Lesson

4.2.3.3   Use of Teaching and Learning apparatus

a.   Naming of the apparatus

The teacher used a chart as a tool to elaborate on the delivery of the lesson. The teacher also used a bottle of cool drink and a packet of chips to explain further about daily use of energy measurements.

b.   Explaining the apparatus

The teacher showed the learners how to read energy measurements on the day-to-day consumables explained to the learners. She explained the amounts of energy carried by liquids and solids. She made it clear to the learners about the high energy foods and low energy foods. She even compared the energy measurements between liquids only and between solids only.

c.   Frequency of teacher using apparatus

The teacher used the chart to show the different object that are capable of converting potential energy into kinetic energy. The examples she used on the chart were the stretched elastic bands that could have high potential energy whilst stretched. The rubber bands could make objects move when released, constituting high potential energy converted to kinetic energy. She also used a picture of a rock on the hill that had high potential energy whilst at the top and as it rolls down the kinetic energy increases.

d.   Frequency of learners using apparatus

Learners did not use the apparatus since the teacher did not have any apparatus for the learners to manipulate.

e.   Learners recording findings

Since there was no apparatus to manipulate and no actual experiment done, the learners had nothing to record as findings. There was also nothing to discuss because there were no findings.

f.   Learners assisting each other

During the lesson there was no observation of the learners assisting each other. Learners participated only in answering questions. There was no discussion of questions involved during the lesson.

Figure 15: Use of Teaching and Learning apparatus

The following sub-section will cover the interviews that were conducted with the participants.

4.3 Summary of lesson implementation in Grade 7 Natural sciences

4.3.1 Teachers' use of language

Teachers tried with all their effort to eliminate conceptual errors or keep them minimal. Some science concepts, although spelt the same, were defined differently in science and in English and that made it difficult to totally eliminate misconceptions. Six misconceptions out of 23 science concepts explained in three lessons, on average, show that some teachers were better prepared for the lessons than others or their command of the English language influences the understanding of the scientific concepts. The confidence shown by the teacher when explaining the concept gave the impression that the teacher is confident about what he/she was saying. The belief is that, if the teachers would have the freedom of choice on the language best suitable for the learners they teach, there would be less misconceptions. For the teacher, policy issues are restricting the use of Mother-tongue. There was little room for the use of Mother-tongue because of the lack of scientific terminology in any of the African languages in South Africa. Even if the teacher used code switching to clarify a point, it is imperative that the teacher revert to LoLT so that leaners do not lose the ethos of using English in the science lesson.

The teachers were from two sets of age groups, where teachers S1T1 and S2T2 were at the age of approximately 50 years old and teacher S3T3 was at the age between 20 and 25 years of age. Teachers S1T1 and teacher S2T2 made five conceptual errors combined compared to one error that was made by teacher S3T3. The error made by teacher S3T3 was in the writing out of a symbol for unit that was pronounced and explained correctly. It appears that the younger generation of teachers is capable of reaching the learners and therefore it would be wise to train younger teachers to deal with the not-so-distant age group of learners.

The other five errors made by the other two teachers were errors that deformed the kind meaning of concepts and understanding.

For example;

Steel is an element. [S2T2]

Steel is not an element, it is actually a mixture of two elements, namely, iron and carbon. That kind of mixture is called an alloy. Those errors could only be eliminated by means of thorough lesson preparation. With Curriculum and Assessment Policy Statements (CAPS) comes an Examination Guidelines document that outlines the accepted formulae and definition of terms. The aim of the use of the document is to eliminate the misconceptions and to ensure that teachers and learners are scientifically and conceptually correct.

Teachers S1T1 and S2T2 used codeswitching once each to explain a concept whereas teacher S3T3 did not use any word that was not an English word. Teacher S1T1 used isiXhosa several times as a matter of mannerism that had nothing to do with explaining a concept. Teacher S2T2 restricted the use of isiXhosa to the low of three times as mannerism. This behaviour of keeping codeswitching to the lowest minimum as possible spelt the focus of the teachers was in minimising language mistakes in the LoLT. It felt strange to me that the learner and the teacher engaged in their second language and yet so little codeswitching, specified at explaining concepts, was used in all the three schools. An element of doubt was created in me that it is possible for Grade 7 learners to thoroughly grasp the science concepts in a school where home language is not English.

4.3.2 Use of practical activities and science language

In science, doing practical activities has an influence in improving linguistic skills especially when teaching science to learners in their second or third language. The practical activities housed a number of opportunities for teachers to explain the science concepts first hand. One lesson out of the three had some practical activity, which on recapping the lesson, learners got the chance to verbally engage expressing their understanding of what they saw. For example, in lesson one from school one (S1), the teacher used a number of apparatus and learners engaged by naming acids and bases as the equipment was being shown to them. Learners could also describe the taste of some acids like lemon.

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It is paramount that more practical activities, in the form of experiments and projects, be utilised extensively at the early grades of learners' schooling. Intercommunication among learners was encouraged, leading to linguistic development and improve vocabulary. The frequent use of apparatus compelled learners to grasp the names of the equipment used and the names of the equipment form part of the vocabulary development.

The writing skill should be developed during the science practical activities. It is acquired as the learners record scientific steps and analysis of results obtained. During the lessons, learners were not given a chance to actually write, which would form part of science language development and development of language in general. All the findings the learners got from the practical activities and experiments were communicated verbally, in at least one lesson. For example, school one (S1) teacher made learners to be verbally engaged as explained above but could give learners a chance to write down their observations. Two schools, school 2 and school 3, did not use science apparatus but charts have been used as teaching aids. The learners of school 3 relied on visual aids used by the teacher to get an idea of the concept understanding. School 2 did not use any teaching aids, not even a chart but only a book. These lessons limited the chances of the learners to develop their linguistic skills and scientific vocabulary.

4.3.3 Learners' Involvement in the lesson
According to CAPS, the involvement of learners in a lesson is essential to optimise learning. Learners should answer questions and also ask questions relating to the lesson to ensure that they understand the taught concepts. In all three lessons from the three schools, learners were asked questions that they answered, mostly correctly. The summarised analysis of questions, as figures 5,9 and 13 attest to the learner involvement through answering questions. Learners, in all three schools did not ask questions. The latter statement could mean that the learners have understood what they were taught or that they were not confident enough to express their lack of understanding. The common trend of learners not asking questions is scary because the culture of curiosity is at a risk of being diminished and eventually

become extinct. Asking questions is a sign of wanting to know and scientists, by nature and nurture, possess and develop that trait.

In School 1 there were 75 learners and 36 questions were asked, in School 2 there were 54 learners and 30 questions asked and also in School 3 there 55 learners and 22 questions. All this means is that the teachers used the question and answer method of teaching learners but could not ask many questions that require learners to explain. Learners responded to short answer questions, low order questions.

4.4 Teachers' perceptions of their use of scientific terminology in their Natural Sciences classes.

4.4.1 Introduction
Interviews were conducted with the individual teachers of the schools that participated in the study. The interviews were aimed at obtaining deeper understanding of how teachers feel about teaching Natural Sciences in Grade 7 in English. The interviews followed the methodology planned outlined in the Methodology section. Teachers expressed their understanding of policy and had a chance to express their feelings for or against the language policy of the Department of Basic Education (DBE).

4.4.2 Teachers' viewpoints of their involvement in the Natural Sciences classes

Teacher 2 of School 2 felt that it was interesting to teach Natural Sciences in English whilst Teacher 3 of School 3 felt it was a bit stressful. Teacher 2 might have felt that way because he saw an opportunity to familiarise Grade 7 learners with English language and consequently science language whilst on the other hand Teacher 3 felt that the learners were up to the proper knowledge of English. Teacher 1 had the feeling that the language policy was a barrier to optimisation of science.

> Although at a later stage it would be a barrier because questions are asked in English unless everything would be changed. [I1T1]

This teacher felt that even if the learners could be taught science in isiXhosa most of the time, the policy of the Education Department would not change its assessment policy because she taught in isiXhosa and allow her to asked science question in isiXhosa. The teachers agreed that the knowledge of scientific terms is essential if one was to be good in science. The issue of being confined to one language of teaching science was bothering the teachers.

The readiness of the change of language of teaching science was doubted because the teachers felt that there was not enough isiXhosa vocabulary for science.

> Unless (a plethora of) scientific terminology can be made available
> in isiXhosa, I would teach Natural Sciences in isiXhosa. [l1T3].

The teachers felt they might not take the route of teaching science in IsiXhosa even if they were offered the opportunity but if isiXhosa would have enough science vocabulary they would gladly take that opportunity enthusiastically. The other hindering factor in the temptation of teaching science in isiXhosa is the fact that the assessment would not be in the language they were taught in. Teachers strongly believed that if learners were taught in isiXhosa they should be assessed in isiXhosa. Teacher 2 had a view that learners would be better off in English language in secondary school if they continued the trend of using English language.

Even though the teachers' belief is that learners should learn science in English maintaining the scientific terminology without change, they would explain concepts in isiXhosa if a need arose. Teacher 1 emphasised that she would not abandon codeswitching when she saw that learners had a problem understanding a concept. Practical examples were recommended because concretising an idea make understanding easier. Visualising and concretising an idea makes conceptualisation realised and that is where apparatus other learning and teaching support material (LTSM) come in. Whatever scientific idea or a concept to be taught, it can be concretised and/or visualised in the laboratory setup. Textbooks were the LTSM that was mostly available in schools because the government supplied it.

4.4.3 Use of English and IsiXhosa as LoLT

When asked about how they feel about teaching Natural Sciences in English, teachers from schools 1,2 and 3 expressed a feeling of disappointment because they were teaching a child of African origin in a foreign language. They felt that the learners seem to be out of touch and they get lost when teachers speak English. Teacher 2 expressed that it feels very interesting to teach Natural Sciences in English. When asked why he feels it is interesting, he said,

Because it is my belief that, especially the primary school learners, they should understand the language skills of Natural Sciences. For them to understand the linguistic skills for Natural Sciences means they will have very good basics for Natural Sciences as they progress to upper grades.

[Individual Interview 1, Teacher 2, I1T2]

According to Teacher 3,

It is a bit stressful because some of the terms used in Natural Sciences are difficult for them to understand. [I1T3]

The other view, from teacher 1 is that it is bad to be confined by language policy to teach Natural Sciences in English only, because learners have language barriers. The teacher pointed out that;

Language of Teaching and Learning is the Second Language to the learners. [I1T1]

Teachers 1 and 3 expressed a level of worry concerning the fact that learners have to familiarise themselves with the terminology of science.

When asked if they would teach Natural Sciences in isiXhosa if they were given a chance, all the teachers unanimously confirmed that they would take that opportunity. They had a concern though; the assessment questions would be asked in English and that would cause a problem since the teacher would not be there to explain what the question is about. The teachers felt that, in the current state of education policy, they would not go that route. Furthermore, teacher 3 verbalised that;

Unless (a plethora of) scientific terminology can be made available in IsiXhosa, I would teach Natural Sciences in isiXhosa. [I1T3].

Teacher 1 showed understanding of the subject policy concerning Grade R to Grade 3. She felt that if the age of the learners is considered, it is right for them to develop their Mother-tongue but it will be a problem to introduce English to them in Grade 4 because by the time they get to Grade 5 they will not have grasped the language.

4.4.4   Learners and English Language

Learners were the participants who should be actively involved in their lesson. Their participation depended on them answering and asking questions and most preferably where the type of lesson allowed them to be hands-on. To improve communication between the teacher and learner, the use of appropriate language use was essential.

Teachers 1 and 2 recognised the need for learners to try to constantly speak English when in school so that they get used to it. Teacher 2 held the view that;

If the learners continue in that trend, they will be better off in English language when they get to FET. [I1T2]

Teacher 3 was asked if she would allow a learner to answer a question in IsiXhosa. She indicated that she would. She accentuated that

…….at the end of the day, it is the view of the learner that is important not the language necessarily. The language comes after the child understands. [I1T3]

4.4.5   Explanation and demonstration of concepts

In each lesson, there were many sub-views that came up in the course of the lesson under the main concept. The question asked was, "How was the concepts explained or demonstrated if learners showed signs of not grasping them".

Teacher 1 responded;

I won't say I stick to English, most of the time I use English but when I see that they have a problem with what I'm saying I code switch. [I1T1]

Teacher 2 insisted that conceptualising is very important. Sticking to the concepts as outlined in each subject enhances the familiarity with the terminology of that particular subject. If the learners did not understand a concept, the teacher concretised the concept by taking them to the site or performing an experiment. Teacher 2 also warned that whilst observing integration of learning areas, care should be taken into consideration that every learning area has its language of understanding. For instance, "Power", in History could mean all the responsibility of making decisions regarding most important issues or changing decisions made by others. In Science "Power" means the rate at which work is done or energy is transferred.

Teacher 3 responded with what she called the easiest way to communicate,

Using practical examples of things that they experience every day, pictures that they can see and the visual aids they can touch. [I1T3]

Teacher 3 believed that language was not the real barrier to learning as she understood. She indicated that manipulating the teaching aids served as a means of communicating the understanding of the concept to the learners.

4.4.6. Teacher Support and Learner Support Material
The teachers were asked about the support they were getting from the stakeholders of the school. Teacher 1 gave a positive response that the school gave support where they could and could afford but she had a longing for more.

…but there are so many things that we do not have that they are unable to support us with, for instance we don't have laboratory but with the few apparatuses that we have we make use of them. [I1T1]

The teacher expressed satisfaction in connection with the school support when they needed the subject advisors to be called in to help. The school management

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responded quickly to their work related needs. The teacher had a concern though, she believed that the text books and the laboratory apparatuses were not enough. The school had a shortage of textbooks which emanated from the budget allocation that falls short. According to the Education Department, each learner should have a text book to take home for the year. That did not happen in School 2 (S2). According to the teacher,

> We do have text books but not fully, not for all of them, in so much that as much as the department would like we do not give them because they are not enough to take home. [I2T2]

As far as the laboratory equipment, there was none available so much that the teacher had to improvise in order to demonstrate a concept. There were no apparatuses to enable the learners to be hands-on.

Teacher 2 was satisfied with the support he got from the School Governing Body and the Department of Basic Education (DBE). The teacher said that there were enough text books and laboratory equipment in the school and everything else they need in the school they get from SGB and DBE.

> Since apparatuses are supplied by the department (DBE), everything is always available. [I2T2]

The teacher confidently uttered the above statement citing that he uses the equipment conducting experiments and other practical activities. He expressed the importance of use of science apparatus to ensure that learners reach higher grades being prepared enough for practical activities.

When teacher 3 was asked if there was enough support she was getting from the school, she affirmed that she was satisfied with the support she was getting. The teacher felt learners lacked the command of the English language, so laboratory would be of good use to supplement the language deficiency. Practical activities would add a bigger portion of understanding of the concept in question. The teacher felt that language is not much of a barrier in science. She strongly believes that:

What is much of a barrier, is them not actually saying what they are talking about. Which is what they need, for them to understand science they should actually do science in order to see what is actually happening. For instance, you can't talk about mixture of hydrogen and oxygen to get water. The child has to see how you mix hydrogen and oxygen to get water, for them to understand. [I3T3]

When the teacher was asked about assessment of the learners and how they would express themselves when answering questions in a test, she was resolute that it would not be easy for them. She responded that the learners would visualise what they wanted to write but since they have limited English language background they would not be able to satisfactorily express themselves. The teacher was then asked if the learners would be told to answer in any language they were comfortable with, would they be able to answer. Without hesitation, she answered, "yes, they would".

The teacher was asked if the learners had textbooks, she responded that there were no text books for the learners. The learners relied on the notes given by the teacher. She said that even the science equipment is not enough but she managed to perform some demonstration for learners. The teacher felt that the school was not supported by the Department at all and was a lot of shortage of science equipment.

4.5 Themes emanating from the lessons observed

From the study, a number of findings that stood out were picked up. The language proved to be a barrier during the researcher's observation of the Natural Sciences classes at the three participating schools. Teachers also attested to that claim during interviews. English served as a barrier to the teachers who, at times, used IsiXhosa words to replace their struggle for the English version. During the observation of the lesson, the researcher heard the teacher asking the learners to respond to the question after a moment of waiting for a response. At that point learners were talking to each other in isiXhosa, not answering a question. The teacher then said,

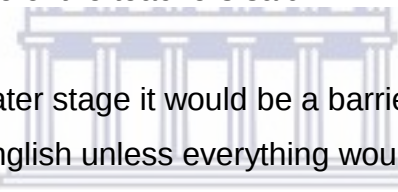makungabikho mntu uthethayo kaloku (quiet please)

The teacher was trying to calm learners down in order to get them to respond to the question she asked. She later tried to get more learners to be part of the lesson and asked them to answer the question after seeing that same learners were answering:

> Hayibo! Baphabanye? (where are the other learners, why are they not answering?). Hayi ndiyoyika ngoku, kuphendula abantu abanye. (I am afraid now, the same people are answering.)

As learners were having their conversation in isiXhosa at the time, they could not come up with the answer which was to be in English. The learners that the teacher was referring to; probably, were not sure about their English acumen.

Language proved to be a barrier to learners who persevered with English in the class and at all times during the observed classes tried to maintain English as a medium of communication between themselves and the teacher.

During the interviews, the teachers put across a view that English language is the barrier to the learning. One of the teachers said:

> Although at a later stage it would be a barrier because questions are asked in English unless everything would be changed. [I1T1]

That statement shows that the teachers are not convinced that it is a good idea to mix the languages during teaching since that move is not policy sanctioned.
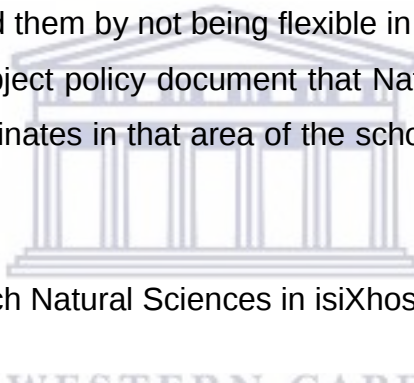
Second issue that stood out is that teachers made use of code-switching in their Natural sciences classes. Teachers emphasized during the interviews that the switching over to isiXhosa was a way to reinforce the understanding of science concepts by learners.

> I won't say I stick to English, most of the time I use English but when I see that they have a problem with what I'm saying I code switch. [I1T1]

Learners responded very well to the question when the teacher explained the question in isiXhosa. They seemed to understand the question in their own language. But as it was said before, the teachers were still feeling restless by the fact that assessment is conducted in English in Natural Sciences. Teachers know their

learners, therefore if they opt for codeswitching, it means that was their way of trying to do justice to the learners despite the fears of assessment being done in English. There were a number of misconceptions during the lessons and the first two lessons had more misconceptions than the third lesson. These misconceptions stay with learners since they came from the teachers as trusted sources of information. The older teachers trained a long time ago had more conceptual errors than the younger teacher. It is unclear whether the lack of focus on the two older teacher contributed to the erroneous teaching or the younger teacher has an advantage of the access to more information systems that keep him/her focussed since the recent training received. Nonetheless, the misconceptions, including those made in other observed and unobserved lessons, make a sizeable bulk that learners take to the Secondary schools.

Teachers had a strong feeling that the government, Department of Basic Education in particular, disappointed them by not being flexible in their language policy. There is no room made in the subject policy document that Natural Sciences could be taught in the language that dominates in that area of the school. Teachers gave a response that:

I would teach Natural Sciences in isiXhosa [l1T3]

if they would be given a chance to do so. The language policy seemed to be frustrating to teachers as they had seen that it was restricting learners' ability to optimally grasp Natural Sciences.

It is a bit stressful because some of the terms used in
Natural Sciences are difficult for them to understand. [I1T3]

Even though teachers had self-seized option to codeswitch, they were still facing a barrier to delivery, a shortage of science vocabulary in vernacular.

It is one thing that the learners seemed to be able to hear when the teacher talked to them in English but being unable to ask questions in all three classes observed. That showed that learners did not have a command of English required for them to express what they think even if they wanted to consolidated what the teacher taught them. Since learners have day-to-day experience, they could not ask the questions

that would bridge that gap between that day-to-day experience and the science they learn in the classroom.

The lack of command of the English language made them lose the confidence they otherwise would have if they would speak isiXhosa. That observation was made during the lesson because as they were speaking among themselves

4.6 Conclusion

This chapter discussed what happened in each of the three Grade 7 Natural Sciences classes and also provided the teachers' perspective of teaching Natural Sciences. The focus of the next chapter is to provide the main findings and the implications of the research.

CHAPTER 5

CONCLUSION

5.1 Introduction

In the previous chapter, discussion of the findings was done looking at the scientific terminology in the classes of Natural Sciences. Teachers' use of language, use of practical activities and science language, learner involvement were discussed together with the teachers' perceptions of scientific terminology in their Natural Sciences classrooms. This chapter provides an overview of the thesis and presents the major findings, and the implications of the study. Limitations and recommendations for future study are also provided.

5.2 Overview of the scope of the study

5.2.1   Chapter 1: Introduction

The situation surrounding learning in the country, zooming in into the province and the district and ultimately to the research sites, needs attention, ranging from the curriculum status, teacher training and learner preparation for intense learning. The language of learning and teaching is at the forefront of the challenges facing education sector in the country. The country faces a challenge of a shortage of human resource with scarce skills. Most of the scarce skills need the citizens of the country to have Mathematics and Sciences in their studies. The learner performance in the areas of Mathematics and Sciences was alarming that if not taken heed of the country might face an upscale problem in the future. The other dilemma the country faces is the matter of many languages but a few are used in the education sector. The language issue put a strain on the sciences since the largest part of the population's languages are not used in schools for Mathematics and Sciences. Having acknowledged the challenges, the country, provinces and districts rallied together to put together many intervention programmes. The study took place at schools in an education district in the Eastern Cape. The primary schools that served as the case studies served as feeder schools to the secondary school where the

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researcher was a teacher. Many of the learners that arrive at the secondary school for Grade 8 seem to have serious backlogs in their understanding of basic science concepts that formed part of the Natural Science curriculum of Grade 7. In order to understand the issues that learners have with science terminology, science concepts and general science language it was important to get a glimpse into the Natural Sciences taught at these three feeder schools. The following research question and sub-questions needed to be answered:

What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

(i) **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

(ii) **What were the teachers' perceptions of the influence of language in their Natural Sciences classes?**

This chapter also provided the significance and the limitations of the study. The outcomes of this study could serve to inform science teachers, curriculum advisors and curriculum planners about the role that language play in the teaching of science.

5.2.2 Chapter 2: Literature review

This chapter provided the existing literature and the theoretical framework of the study. This study is underpinned by the critical theories of critical pedagogy and critical literacy. Critical theory serves to emancipate the power of the mind to achieve the transformation of society for the better. Critical pedagogy interlinks critical theory with education. Critical literacy is a theory that pays attention to text details. The pedagogical aspect of the teaching and learning have to be the base of the interaction between the teacher and the learner. The 'how' part of teaching science has the lasting impact in the life of the learner because it determines how productive the adult will be as a citizen.

This chapter also looked at comparing the different education systems of different countries from Africa and also other countries of the world. Sometimes these countries have already gone through what we are still going through, that is, a change of curriculum. Change of curriculum becomes difficult in a multilingual country especially when the language dominating is not even an indigenous one.

5.2.3   Chapter 3: Methodology

The research design is a mixed method approach. Both qualitative and quantitative approaches have been adopted for this research as these approaches complement each other. The method of collecting data, stipulating the population for research was clarified. The design of the study took the shape of a case study of three Grade 7 Natural Sciences classes, one each from surrounding feeder primary schools. One class from each school was selected. The data collection plan provided the methodology for collecting the data including observations and interviews. The lessons were personally observed by the researcher and also video-recorded. The observation checklist for observation and interview schedule were developed as instruments for use. The advantages and disadvantages of the instruments were discussed issues of validity and reliability addressed.

5.2.4   Chapter 4: Findings and Discussion

The findings of the study were reported for the three schools according to the research questions and sub-questions. The findings were presented and discussed in terms of the themes that emanated from the study. The observations from one lesson observed at each of the schools were presented and discussed. Teachers' perceptions were obtained in terms of their understanding and interpretations of teaching Natural sciences at Grade 7 level. The presentation and discussion of the findings followed the three themes that the study was based on. Each theme had items that it focussed on which included an introduction and explanation of topic, the use of IsiXhosa during the lesson, use of science concepts and conceptual errors. The first theme was the language used by the teacher. The second theme was involvement of learners in the lessons. The items reported on were learners' questions, learners' answers and learners' language switching during the lesson. The questions asked to and answered by the learners were categorised according to the Lower Order Questions, Lower Cognitive Questions and Higher Cognitive Questions. Third theme was the use of teaching and learning apparatus during the lessons. This theme had the following reporting items, namely naming of apparatus, explaining the apparatus, frequency of the teacher using the apparatus, frequency of the learners using the apparatus, learners recording findings and learners assisting each other. The chapter also looked at the perceptions of the teachers on the use of language of teaching Natural Sciences. The results for this chapter were obtained through teacher interviews. Each teacher expressed his/her views on teaching Natural

Sciences in English. They also articulated their opinions on the use of learners' home language when teaching Natural Sciences.

5.2.5   Chapter 5: Conclusion

This chapter provided an overview of the thesis and highlighted the major findings, implications of the research and limitations of the study. It also provided recommendations for future study**.**

5.3 Major findings of the study

The ethos of learning is in the ease of understanding the subject matter. When learners get what they went to school for, that is learning, therefore the business of the day for them is complete. Teachers have a sacred duty of helping the learners to understand the subject matter. There seems to be a problem when it comes to Black learners entering secondary school level in Grade 8 with understanding subjects that are taught in English, particularly Natural Sciences. The latter statement prompted the following research question, with its sub-questions:

What is the influence of language on the teaching and learning of Natural Sciences in Grade 7?

(i)   **How were teachers incorporating language in their Grade 7 Natural Sciences classes?**

(ii)   **What were the teachers' perceptions of their use of language in their Natural Sciences classes?**

The study found that:

1. The language of instruction in the three schools was English. However, English was a second language to learners who were all isiXhosa speakers. The language proved to be a barrier during the researcher's observation of the Natural Sciences classes at the three participating schools. Firstly, it proved to be a barrier to learners who persevered with English in the class and at all times during the observed classes tried to maintain English as a medium of communication between themselves and the teacher. However, from the discussions observed the English language was not a fluent means of communication to learners at this level. Secondly, English also served as a

barrier to the teachers who, at times, used isiXhosa words to replace their struggle for the English version.

2. The teachers made use of code-switching in their Natural sciences classes. Teachers emphasized during the interviews that the switching over to isiXhosa was a way to reinforce the understanding of science concepts by learners. They especially used code-switching during question time when learners gave a wrong answer to a question. It appeared that learners appreciated the fact that the teacher used their mother tongue to explain difficult science concepts. This process proved very effective when teachers wanted to relate the science concepts to everyday events. However, teachers complained that the assessments still had to be written in English which sometimes became a hurdle for learners' explanations and communication.

3. Teachers made use of science terminology to explain the science concepts. The language of science is different to the everyday usage of the English language. During the lessons there were a number of occasions where teachers made use of wrong terminology to explain the science concepts. This happened in more than one occasion in the lessons of two of the teachers but to a much lesser extent in the third teacher's class. The first two teachers happen to be from an older generation than the third teacher. It was not quite clear whether this was attributed to the teachers' being trained in different eras and that the scientific terminology used by the younger teacher were more accessible to her through the science training she received. It was quite evident that misconceptions experienced and propagated by the first two teachers were taken on board by their learners. This could provide support to the notion that when learners arrive at secondary school that they come with wrong interpretations of scientific terminology and science concepts.

4. The language policies of the national department of education seem to be direct, teachers have to conduct their classes and assessments in English at Grade 7 level. Teachers pointed out that the policy forces them to ensure that their classes are conducted in English and that learners reflect on their learning through the English language as all assessments are done in English. Teachers indicated that the policy is enforced by the principal and education department officials. The language policies seem to have a direct impact on teachers' ability to deliver science content through the appropriate use of scientific terminology. This rigorous application of the language policy could

impact on learners' natural ability to understand science as experienced in their environment thus hampering the link between science curriculum taught in the class and the learners' everyday interaction with science.

5. Learners' ability to interact with the teachers during the Natural sciences lessons could also be hamstrung. There were virtually no questions from learners in each of the three classes observed. Even though there were questions among the learners in their groups, it appeared that learners lacked the powers of articulation in English to ask teachers questions of explanation and clarification. In the discussions that learners had during a break in class, they were quite able to ask the questions in isiXhosa but either lacked the confidence or the necessary language and communication skills to formulate a question on the topic. The teachers reported that learners as a rule do not ask questions and that they did not necessarily ascribe it to the language used in the class.
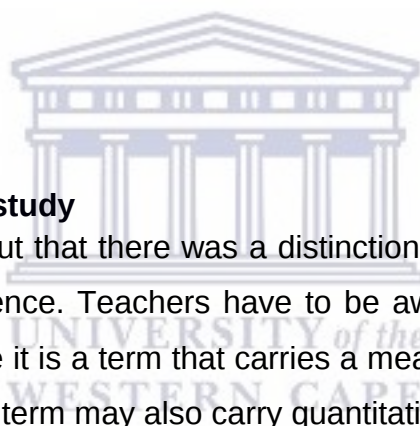
5.4 Implications of the study

The study also pointed out that there was a distinction between general English and the English used for science. Teachers have to be aware that a word in English is just a word but in science it is a term that carries a meaning that might be different to that of everyday us. That term may also carry quantitative data or measurement.

The study also has implications for departmental heads in schools and curriculum advisors to assist teachers when dealing with the language content of Natural Sciences This study provides the science teachers with an understanding of how issues of code switching could support the learning of science and how this could add value to learners' everyday application of curriculum science.

The school principal may find the study as a point of reference in resourcing his or her discussions with the Education authorities regarding the language policy. The principal may use the   content of this study to argue the need for change in the language policy when in the correct platforms for that.

The subject advisors could, when running teacher development programmes, use this study to help teachers to realise that language is an important component of the Natural Sciences classroom and that they need to pay attention to prevent misconceptions.

The content of this study should provide teachers with support when they are not comfortable with the teaching and learning in the second language. This could alleviate the general response of teachers when asked about teaching in English, namely that they throw their hands up and say "what can we do?". This not just a sign of dissatisfaction but a feeling powerlessness to change.

The study has implications for the politicians and Curriculum Planners as it showcases the importance of language as the identity and the signature of the African child. The reality of putting aside the prioritisation of the development scientific terminology in the vernacular of the child of the African origin undermines the dignity and identity of the African child.

The study provides a baseline for future studies into the influence that language have on the teaching and learning of Natural Sciences. Other studies could add to the data provided on this subject and add to the critical mass of information needed to consider mother tongue instruction and the development of African languages.

5.5 Limitations of the study

This study is a case study because it focuses on three schools. The outcomes of the study apply to the three schools and cannot be generalised to other schools. The schools allowed the study to be done in one class each, therefore the sample size was limited. Schools had more than one Grade 7 class but selected one class for the research that could fit into the time-period of the researcher's data collection process.

The researcher did the study in the Second Language to his home language. Even when collecting data, the classes from which the data was collected was supposed to use isiXhosa because the teachers and learners were all from isiXhosa speaking community.

5.6 Recommendations for future research

This study was conducted in three schools that served as feeder schools to the researcher's school. To obtain more a more reliable study of the influence of language in Natural Sciences, it is recommended that future studies should consider a wider sample - for example, all the primary schools in the particular education district. A future study could also look at all the science concepts in Grade 7 and the intermediate phase and then investigate to what extent learners entering Grade 8 had an understanding of these concepts.

5.7 Conclusion

This study investigated the influence of language on the teaching and learning of Natural Sciences in Grade 7. The issue of language is an important one especially for teachers and learners that have a different mother tongue language to English. With the language policy in South Africa as it is, it is vital that a greater consensus is reached about the policy. The Department of Education cannot continue with the policy that says learners should use their home language for the first three years of their schooling and then revert back to LoLT thereafter. Every learner can learn better in own language. What is it that makes Black South African learners different from their South African counterparts of different colour?

South African Government should start taking the people of majority in South Africa seriously and deliver what is deserved by the previously oppressed people. An educational paradigm shift is essential. A change in the educational policies that talk to the plight of the previously oppressed is urgently needed to uplift the standard of living of the people living from hand to mouth. The South African Constitution (2004), in Chapter 2 (1a), outlines the Bill of rights where everyone has a right to education. That right is further detailed by Chapter 2 Section 29(2) of the Constitution that states that everyone has the right to receive education in the official language or languages of their choice in public educational institutions where that education is reasonably practicable. It looks like the Constitutional Rights of Black people are neglected since after 20 years into the Democracy the language policy has not improved in the country. The Bill of Rights further emphasises that there is a need to redress the results of the past racially discriminately laws and practices through education.

This would mean that research into the influence of language at various levels of the education system would serve as an important starting point.

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Appendices

Appendix 1

School1: Observation Checklist for Lesson Analysis (Video-Analysis)
Teacher 1

1	Language Used by the Teacher	Y	TALLY MARKS	Commen
1.1	Did the teacher explain the lesson topic?	√	// (2)	Acids and bas
1.2	Does the teacher speak English when teaching?	√		The lesson is on English Language: Lol
1.3	Does the teacher use isiXhosa during the lesson?	√	//////////(9)	Makungabikho uthethayo kalo 2xBaphi abanyabantu? ndiyoyika ngo kuphendula al abanye; khaw uzokuphakam ndifuna wena; kaloku thetha; khawusebenzi cala libonakala mamela; ugqil tata?
1.4	What is the frequency of code switching by the teacher?	√	/ (1)	Kubekho that
1.5	Does the teacher mention and explain the concepts of science?	√	///////(6)	Corrosive, bas soluble, alkalis acidic /alkaline solutions, indic pH scale. (The corrosive: no p definition of th was given)
1.6	Did the teacher make any conceptual errors/misconceptions?	√	// 2	
2.	**Learners' Involvement in the Lesson**			
2.1	Do the learners ask questions? How many times did learners ask questions?		0	
2.2	When answering or asking questions, do learners speak English?	√	Correctly: //////////// //////////////// (32) Incorrectly;//// (4)	
2.3	How often do learners speak isiXhosa during interaction with the teacher?		0	
3	**Use of Teaching and Learning apparatus**			

3.1	Is the apparatus available for the lesson at hand? Did the teacher <u>correctly</u> name them in English?	√	Correctly named: /////// (7)	
3.2	Did the teacher explain the apparatus to the learners?	√	/////// (7)	Apparatus we explained
3.3	How often did the teacher make use of the apparatus?		//////(6)	
3.4	Did the learners work with the apparatus?	√	/ (1)	
3.5	Does the teacher urge the learners to record the findings of the experiment(s).		0	
3.6	Did learners assist each other?	√	/ (1)	

Appendix 2

School 2:

Observation Checklist for Lesson Analysis (Video-Analysis)
Teacher 2

1	Language Used by the Teacher	Y	TALLY MARKS	Commen
1.1	Did the teacher explain the lesson topic?	√	/// 3	Introduction of Periodic Table elements
1.2	Does the teacher speak English when teaching?	√		The lesson is on English Language: Lol
1.3	Does the teacher use isiXhosa during the lesson?	√	/// 3	The teacher u mannerism "Y nhe?", which v mean "isn't it? ' Intsimbi' for r xa ucinga
1.4	What is the frequency of code switching by the teacher?	√	/ 1	' Intsimbi' for r
1.5	Does the teacher mention and explain the concepts of science?	√	//////////////// 14	Mixtures and p substances; elements; biol physical scien and chemistry groups; atoms atomic numbe mass number; metals; metals semi-metals
1.6	Did the teacher make any conceptual errors/misconceptions?	√	/// 5	
2.	**Learners' Involvement in the Lesson**			
2.1	Do the learners ask questions? How many times did learners ask questions?		0	
2.2	Learners answering questions correctly.	√	///////////////// 31	
2.3	Learners answering questions incorrectly.	√	/ 1	
2.4	How often do learners speak isiXhosa during interaction with the teacher?	√	/ 1	When they answered "int
3	**Use of Teaching and Learning apparatus**			
3.1	Did the teacher <u>correctly</u> name them in English? How often ?	√	/ 1	Text book
3.2	Did the teacher explain the apparatus to the learners? How often?	√	/ 1	

3.3	How often did the teacher make use of the apparatus?	√	/// 3	
3.4	Did the learners work with the apparatus?	√	/// 3	Periodic Table Book
3.5	How many times were learners urged to record the findings.		0	
3.6	Did learners assist each other?		0	

Appendix 3

School 3: Observation Checklist for Lesson Analysis (Video-Analysis)
Teacher 3

1	Language Used by the Teacher	Y	TALLY MARKS	Commen
1.1	Did the teacher explain the lesson topic?	√	1	Potential ener
1.2	Does the teacher speak English when teaching?	√		The lesson is on English Language: Lo
1.3	Does the teacher use isiXhosa during the lesson?		0	
1.4	What is the frequency of code switching by the teacher?		0	
1.5	Does the teacher mention and explain the concepts of science?	√	3	
1.6	Did the teacher make any conceptual errors/misconceptions?	√	1	"There are only t types of energies potential and kine energies"
2.	**Learners' Involvement in the Lesson**			
2.1	Do the learners ask questions? How many times did learners ask questions?		0	
2.2	Learners answering questions correctly.	√	22	
2.3	Learners answering questions incorrectly.	√	4	
2.4	How often do learners speak isiXhosa during interaction with the teacher?		0	
3	**Use of Teaching and Learning apparatus**			
3.1	Did the teacher correctly name them in English? How often ?	√	3	
3.2	Did the teacher explain the apparatus to the learners? How often?	√	3	
3.3	How often did the teacher make use of the apparatus?	√	3	
3.4	Did the learners work with the apparatus?		0	
3.5	How many times were learners urged to record the findings.		0	
3.6	Did learners assist each other?		0	

Appendix 4

Interview Schedule
Name of the School: ....

Teacher   : ....Age (Optional).......................

Gender   : ....Grade:7...............................

Qualifications   : ....

Interviewer   : ....

Date   : ....

1. How long have you been teaching Natural Sciences in Grade 7?

2. How do you feel about teaching Natural Sciences in English?

3. Would you consider Teaching Natural Sciences in isiXhosa if you would be allowed to choose? Explain.

4. Do you encourage your learners to always speak in the language of learning and teaching (LoLT)?

5. How do you explain and demonstrate concepts in each lesson you teach?

6. What kind of support do you get from the school?

7. Is there learner support material for each learner in your class?

8. Do you have sufficient apparatus (Lab resources) in your school? Explain.

Appendix 5

Research Data Transcription Masters Programme 2016

Subject: Research Interview

Interviewee: Teacher1

School: School 1 Senior Primary School

Venue for interview: School 1 Senior Primary School (Principal's Office)

Age: 50 – 55 years (52 Years)

Gender: Female

Qualification: BA / Biology 1

Subject Taught: Natural Sciences

Class: Grade 7

Date: 03/06/2016

Interviewer: Zongezile Gudula (UWC MEd: Science Student 3081578)

Interviewer (Gudula): Feel free to speak a language you want; you are not confined to English. How long have you been teaching?

Interviewee (Teacher 1): I started in 1988, I am not sure whether it's 26 or what. Office phone rings.

Gudula: Ja, I know, it's not a problem, I am going to calculate it. (28 years). And you have been in this grade………? teaching science.

(Line1) Teacher 1: Uuummm, so many years. Let's say 20 years. Teaching science? No, let's say for science it's 15 years. I taught isiXhosa.

Gudula: You taught other subjects. Ok.

(L2) Teacher 1: Yes, yes, but I have been teaching science for so many years.

Gudula: But in this grade?

(L3) Teacher 1: Yes, in Grade 7, you can say 15 years.

Gudula: 15 years. That' a nice experience, that's a nice experience (repeating showing appreciation)

(L4) Teacher 1: (Giggles)

Gudula: How do you feel about teaching Natural Sciences in English only without having to explain (in another language). Just a general feeling. Because we are confined by the policy to teach Natural Sciences in English only.

(L5) Teacher 1: (Uuummm)

Gudula: You are teaching isiXhosa speakers as I have seen in the classroom, all learners are isiXhosa speakers. How do you feel about being confined by policy to teach only in English?

(L6) Teacher 1: When you teach in English, it means there are learners that do not understand what you are saying.

Gudula: They are left out.

(L7) Teacher 1: Ja, they are left out because they have a barrier in this language as it is not their Mother tongue. So it's when I then notice that they do not understand what I am saying I could code switch 'ke ngoku' to the language they understand but bearing in mind that when I talk about terminology of science, I see to it that they master those concepts.

Gudula: So you can explain in isiXhosa but you return back to English to explain them again.

(L8) Teacher 1: Yes.

Gudula: Ok, ja ok. How do you feel 'wena' as a person? Do you feel that you should be given a room to...?

(L9) Teacher 1: Yes. It is bad to be confined to it. As it, you could find out that there are learners left out if you don't.

Gudula: Ok. The authorities could be giving, in their policy, a room like for instance, the Afrikaans-speaking people have got a room for….

(L10) Teacher 1: Being taught in Afrikaans, if it could be allowed even to us that….

Gudula: The researchers make isiXhosa conceptualisation ibekhona (to be developed)

(L11) Teacher 1: Yes. I understand

Gudula: Would you consider teaching Natural Sciences in isiXhosa if you would be allowed?

(L12) Teacher 1: Yes, I would. Although at a later stage it would a barrier because questions are asked in English unless everything would be changed.

Gudula: So, you mean that if you be allowed to teach in isiXhosa and the learners be asked questions in isiXhosa then you would consider it. But in the meantime…...?

(L13) Teacher 1: I wouldn't because they would have a problem to answer question because language would be a barrier to them and I wouldn't be there for explaining further what is required of them

Gudula: You are aware, mos, that when the learners are being taught in the foundation phase the policy says they must be taught in isiXhosa from Grade 1 to Grade 3. How do you feel about that policy, since they come to the senior primary, that is, the intermediate phase having been taught in isiXhosa from Grade 1 to Grade 3?

(L14) Teacher 1: Of course it is right for them to be taught in their Mother-tongue because it is their first time to be exposed to formal learning, so it would them comfortable to be taught in their own language. But it still makes it difficult for them to start English in Grade 4 because when they come to Grade 5 they haven't grasped it, at least when they go to other grades 'ke noko', it's better off.

Gudula: Unless they find a good teacher in that grade. I understand your point.

(L15) Teacher 1: I think it's because we, teachers, concentrate in what we are comfortable because they are comfortable in their language. There is a difference because when you take our kids to the former Model C schools there no code switching there but they understand, meaning that if we could do the same, I don't know.

Gudula: I'm asking this because if they are in the township, they are surrounded by isiXhosa-speaking people all the time, would you say that they should be speaking English all the time on their own, is it possible?

(L16) Teacher 1: Hayi, it's not, it's not possible, kaloku they should also know their language. What kind of people would speak English all the time among isiXhosa-speaking people?

Gudula: So you do encourage them to speak their language when they are playing.

(L17) Teacher 1: Yes, when they are in the school premises we encourage them to speak the language even if the child is sent the office or to any teacher, the child should try and speak the language.

Gudula: Ok. How do you explain and demonstrate concepts in each lesson you teach in terms of language? Do you have that time when you have to code switch and explain them in isiXhosa or you stick to English?

(L18) Teacher 1: I won't say I stick to English, most of the time I use English but when I see that they have a problem with what I'm saying I code switch.

Gudula: So you don't focus on you teaching in English, you looking at the situation.

(L19) Teacher 1: Yes.

Gudula: What kind of support do you get from the school. For instance, you have an HoD, a Deputy Principal and a Principal. Are they supporting you with everything you need to make your lessons a success? What kind of support?

(L20) Teacher 1: I would say the management of the school supports us with what they can afford buying but there are so many things that we do not have that they are unable to support us with for instance we don't have laboratory but with the few apparatuses that we have we make use of them.

Gudula: Does the management call the subject advisors to help you when you have something you want to know? Because I think when the district level talks they say that when the school has problem, they can call them. Do they sometimes come here?

(L21) Teacher 1: Yes, but not specifically for Natural Sciences, for instance we had a problem from teachers for Creative Arts, they called upon their subject advisor and they came. And also for other learning areas when we call they do come and assist us with whatever we do not know.

Gudula: That is how the management is supporting you whenever you need a subject advisor. Ok. Is there learner support material for each learner in your class? That is, if you want to group them to make five groups or six groups, can you afford to make those groups. The learner support material includes text books.

(L22) Teacher 1: We do have text books but not fully, not for all of them, in so much that as much as the department would like we do not give them because they are not enough to take home.

Gudula: So you use them in the class room. You bring them, make them share and you take them back.

(L23) Teacher 1: Yes.

Gudula: That's one way of doing it. So, what about the requisition thing. When you are given time to make an order, you think that the money is enough to order?

(L24) Teacher 1: It's not enough.

Gudula: So that is why…….

(L25) Teacher 1: That is why we don't give them the book to go away with. Not every learner has his or her own book because it would be enough if every learner their own books hence they share them or we give them in class.

Gudula: Is it the same story with the laboratory equipment?

(L26) Teacher 1: Yes, it is the same story, we don't have enough.

Gudula: The one that is there is for demonstration as I have seen?

(L27) Teacher 1: Yes, but we still have a little for using them in groups. There was Imbewu Project, it helped us a lot.

Gudula: I can't promise anything but the information comes forward, we see the Authorities that they want to know what is the situation so that they can take from the information we give to them to see what to do. I know your school is a very good school around the area. Management of the school is very much aware of what is going on, but once it comes to the attention of the Authorities that even this school is having LTSM problems, they will look at what ways of helping they can do. I know that. You don't have sufficient apparatus as you have said?

(L28) Teacher 1: No we don't have enough although we improvise.

Gudula: I would say improvise if I was from the department. Is there anything else that you might like to add that I did not ask?

(L29) Teacher 1: If we can get an assistance as far as laboratory is concerned and be taken to workshops to capacitate us further because we don't know everything, we still want to learn more in order to assist our learners.

Gudula: With these interviews I cannot promise anything (giggling together) because this interview is about how you would like things to be done. Working together is something that I will be looking at deeply. I must thank you for your time. Please do not change the way you are, helping people. I appreciate your attitude

(L30) Teacher 1: Thank you too.

End of the interview.