

**A comparative study of the use of isiXhosa and English as
media of instruction in the teaching and learning of static
electricity in Physical Sciences**

by

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submitted in fulfilment of the requirements for the degree

Masters in Science Education

**UNIVERSITY of the
WESTERN CAPE**

in the Science Learning Centre for Africa

of the Faculty of Education

at the University of the Western Cape

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Declaration

I, Monwabisi Diko, declare that this thesis *A comparative study of the use of isiXhosa and English as media of instruction in the teaching and learning of static electricity in Physical Science* is my own original work and has not been submitted to any other university for a degree. All sources have been fully acknowledged in the text and in the list of references.

Monwabisi Diko

Date



Acknowledgements

I, would like to thank:

- Professor M.S. Hartley, my supervisor who became a chaperone, a mentor, a counsellor and a friend who dedicated to my study even during the most trying moments of our journey. The confidence he had in me, his professional guidance, expertise, dedication and attention to detail, directed this study to fruition. He believed in my capabilities, secured funding and steered the study towards the right direction with his advice.
- Prof Chetty who always pushed me to my full potential...thank you Prof
- Mellisa enkosi sisi (thank you) for your patience. you were always running up and down to make sure that we, as students, have all the documentations sorted out in good time



Dedication

I dedicate this work to my wife, my sunshine Phumla Diko. She has brought so much happiness and love in my life and I thank God every day for such a beautiful miracle and blessing. This study is dedicated to my two sons who propelled the study to greater heights by teaching me to love again, care, laugh, forgive, persevere, focus and never lose sight of my dream.

To my two sons, Ayabulela and Aviwe, thank you boys. To my late grandfather Phillip Mpokolwana Diko, I know that you would have been so proud of me, thank you for always looking out for me. Mnune, Doyi, Xesibel!!



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Abbreviations

1.A.N.C	African National Congress
2.D.C	Direct current
3. DoE	Department of education
4. FET	Further education and Training
5. HIV	Humane immune virus
6. AIDS	Acquired immune deficiency syndrome
7. IIAL	Incremental introduction of African languages
8. L.A.D	Language acquisition device
9. L.T.P	Language Transformation Plan
10. LOITASA	Language of instruction in Tanzania and South Africa
11.MDG's	Millennium development goals
12. MEC	Member of the executive committee
13. MLA	Monitoring learner achievement
14. TIMSS	Trends in international mathematics and science study
15. PRAESA	Project for the alternative education in South Africa
16. UNESCO	

Abstract

This research focused on the use of isiXhosa and English in the teaching of static electricity in a grade 10 science class. This study took place in a rural school of the Queenstown district of the Eastern Cape. This sample for the study were learners that were coming from a background where English is less spoken compared to isiXhosa. They were learning all their school subjects in English as a second language and sometimes even a third language. With this study the researcher sought to establish how learners would achieve in static electricity – an area of the Physical sciences curriculum - when they are taught in isiXhosa compared to English as a medium of instruction. This study was motivated by the poor performance of learners in Physical Sciences. The researcher wanted to establish whether the use of a second language, English, as a medium of instruction when static electricity was taught at school has an influence on the acquisition of knowledge. The researcher took one grade 10 class of Physical Sciences that was not taught by the researcher as sample (whole population). The study found that learners who were taught in isiXhosa performed better in the study of static electricity. The study found out that engaging learners in their mother tongue enhances participation and facilitating learners' understanding of the natural phenomenon of lightning. They were contributing actively in lesson as they were allowed to interact in their mother- tongue. These learners were able to bring forth their background and myths. This was shown by the participants' responses when they were asked about lightning strikes. They also projected their enthusiasm in their results, as they performed better than those learners who were taught in English. This study has implications for fellow science teachers who are struggling with teaching science in the English medium only as many learners fail not due to their limited knowledge but that they are unable to explain fully what they mean in the English language.

Keywords

Language, science education, static electricity, Eastern Cape, comparison, medium of instruction, isiXhosa, learner achievement, learner performance, socio-cultural constructivism

CHAPTER 1

INTRODUCTION

1.1. Background

The researcher is a science educator at a rural school in the Queenstown district in the Eastern Cape. Eastern Cape is one of the nine provinces in South Africa. It is amongst the poorest provinces of South Africa. The researcher conducted this research from the same area. The researcher has been teaching in this area for the last seventeen years. Queenstown district is one of the districts in the Eastern Cape that do not produce very good results in Physical Sciences. The Queenstown district consists of 70% rural areas. The school is situated in a rural area where isiXhosa is spoken by every learner at school and at their homes.

The teaching-staff of my school is mainly isiXhosa, which result in isiXhosa being spoken frequently in the school compound and even in the classrooms. The medium of instruction of this school was English. Code-switching was allowed, but to a very limited extent because the medium of instruction in the school was English. Code-switching was used when a researcher explained a concept that was not easily understood by learners in English. South Africa's history, particularly during the apartheid era, is one that was known across the world. Amongst other unbearable scars caused by apartheid regime to humanity of all colour, the legacy of linguistic damages still lives on in the present day. To fix barriers with the past, each language that exists within South Africa had to be recognized as important as any other, just like each individual that inhabits in South Africa and their entitlements are important as any other. As Pujolar (2007:77) remarks, 'language is no longer a territorial issue, but "civil rights" issue'. The researcher is in full agreement with Pujolar's remarks.

South Africans seem to be prejudiced in terms of jobs; if one speaks a certain language, then it was easy for one to get a job. Out of a huge number of languages and dialects that are within South Africa, only eleven of those languages were given official recognition as the official languages of the state. Subsection 3 of Chapter 1 of South Africa's constitution proposes: Afrikaans, English, IsiNdebele, isiXhosa, IsiZulu,

Sesotho, Sesotho saLeboa, Setswana, siSwati, Tshivenda and Xitsonga as official languages of the Republic of South Africa. One of the reasons for educational disappointments in South Africa is the language in education policy used in schools for speakers of African languages.

At that present moment, English served as an important vehicle for socio-economic interconnection in our country. It also served as a linguistic link for communication amongst black South Africans in a changing society. The reason why, the late former president of South Africa Dr Nelson Mandela and subsequent African liberation leaders mostly use English in their addresses can be interpreted in different ways, including that English confers some attributes of neutrality or that the use of English was an attempt to foster the constitutionally entrenched values for an inclusive society. It can also be seen as an attempt to unify people susceptible to be divided along ethno-linguistic lines. These divisions, according to language, led to different regional radio stations to be categorised into ethnic groups. For example, radio Xhosa for isiXhosa speaking people, radio Zulu, for isiZulu speaking people. The above statements are relevant to English speaking African countries only, because some African countries use French and some Portuguese. In a sense, one can argue that English balances our society. Ideally, because of our location on the African continent, an African language should be playing this role and indeed, current efforts to promote African languages into higher status functions should be encouraged. However, the fact remains that at least in the foreseeable future, English will continue to be a major language in this country and the world at large.

Unlike English and Afrikaans speakers who learn through their mother-tongue, of course there are schools in South Africa that teach all their learning areas in Afrikaans and there are some Universities that use Afrikaans as their language of teaching and learning but African language speakers are expected to learn in second or third language like English. However, problems in education go much deeper than language in education policies. The current policy allows parents and learners to choose the language of instruction, but such a choice only makes sense if there are resources that go with all choices. A new policy has to enable all learners to have meaningful access to education and other facilities, but also has to facilitate better communication across

different groups. A policy favouring African languages has to be adopted by the State but speakers of African languages must also do their bit to promote them. Public awareness campaigns, bilingual materials, good practices are needed and we need to capitalize on existing linguistic strengths rather than deny them; only then will African languages be able to stand on their own. As an act formed to safeguard the use of the official languages of the state, the act declares the following:

As official languages of the state, these languages should enjoy equal status, therefore should be promoted equally. Wherever practicable, citizens have the right to use any of the official languages for formal and informal use. Regional differentiation in terms of language policies and practice is allowed. (Hlazo 2014)

This was the reason under which I decided to conduct this research. If isiXhosa is one of the official languages, isiXhosa speaking learners have a right to learn in their mother-tongue. Secondly, the Eastern Cape Province is largely an isiXhosa speaking province, therefore learners should be allowed to learn science in isiXhosa. Since the first democratic elections in South Africa in 1994 there has been rapidly growing number of learners from ethnically, culturally and linguistically diverse backgrounds flowing into the previously mono-cultural South African classrooms (Fieldgate and Henning, 2007:7-8). South Africa is a linguistically, culturally and religiously diverse country, which is echoed in the origins of the various people calling South Africa home.

There are similar challenges in other countries. For example, in 2010 the United States Census Bureau reported that there were around 13% of the population are foreign born. This included both adults and children. All these people cannot speak English at all (United States Census Bureau, 2012). A lack of proficiency with the English language translates into lower income, higher poverty rates, and limited mobility in the labour. This means that non- English speakers in the United States are poor and they cannot get promotions in the work place because of this lack of proficiency in English. This refers to the adults who are non-English speakers. Therefore, for them learning English is imperative. Learning English is very much important in order for them to fully get into the local economy and work force and for upward socio-economic mobility. Adults need English in order to communicate with their employers, participate in their

children's education, navigate through the legal and governmental systems, stay informed about local political issues, and express themselves when faced with medical, banking, school, or business situations. Opportunities to learn English in the United States changes by state, but are available through community colleges, adult education centres and local organisations that are dealing with people who cannot speak English. This information is bringing to the front the fact that English in the United States is the only language that can help one to access a lot of important staff for an individual. This confirms the dominance of English as the superior language to other languages.

1.2 Context

Contexts are circumstances that form the setting for an event, statement, or idea, and in terms of which they can be fully understood. When overcoming challenges, researchers first need to be aware of the fact that, second language learners have unique learning needs that require culturally responsive as well as sensitive instruction. This situation prompted the researcher to conduct research to determine whether the language of learning and teaching was not contributing to the low level of achievement in static electricity in my school. Physical Sciences seem to trail behind all the other learning areas when school results are analysed both at school level, district level, provincial and national level, in terms of results. This research is trying to find out whether the learning of static electricity in isiXhosa can help the learners improve on their results, thus the improvement will filter up to the national level. This research focused on the difference in achievement of learners who are taught static electricity in English and isiXhosa, their mother-tongue.

In many rural areas in South Africa, lightning deaths are believed to be the result of witchcraft. People are victimised on farms and in villages as they are accused of witchcraft. These communities believe that lightning can be sent through the practice of witchcraft to kill an enemy (Mahapa, 2002). In a study conducted in Namibia, Nanghonga (2012) investigated how eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enables or constrains meaning making in static electricity. The study has revealed that learners possess a lot of prior everyday scientific and non-scientific knowledge and experiences

about lightning that they have acquired outside the school. The study has also revealed that engaging the learners in their cultural beliefs and experiences enhanced participation and facilitated learners' understanding of the natural phenomenon of lightning. Lightning can be defined as a flash of electrical discharge often accompanied by thunder and rain. Learners have many rival explanations from their cultural beliefs.

1.3 Research Problem

Our province is a high risk when it comes lightning and thunderstorms. Static electricity lesson in both languages can help to clear the misconceptions of lightning being associated with witchcraft. This is a very imported concept that leads directly to static electricity and further to electricity as a topic in Physical Sciences. There are about 2000 people around the world that lose their lives each year as direct result of lightning. According to Geerts and Linacre (1999), this is a global annual average of approximate 0, 4 deaths per million of the population. In South Africa an average of 6.3 per million of the population have been confirmed to have lightning related deaths (Blumenthal, 2005). South Africa has an average that is 15 times more than the global average. Blumenthal (2005) reckons this is an under-report of lightning death victims as the pathology of lightning damage to the human body is still poorly understood in most rural areas of the country.



The South African economy also suffers a great deal as a result of lightning strikes. Besides the loss of life, lightning causes an extensive financial loss each year. According to Evert and Schulze (2005), insurance companies lose more than R500 million per year as a result of claims due to loss of electronic equipment or from fires initiated by lightning strikes. In the United States of America, the number of lightning-related deaths over the last century has decreased. This is due to the urbanisation that has happened (Lopez and Holle, 1998). In South Africa, that has not been the case, even though rapid urbanization took place in the last few decades, many people still inhabit the rural areas or in poorly constructed dwellings in the urban areas. There is still poor education about lightning safety as people living in rural areas are still ignorant of how to protect themselves during lightning storms. Hence the country is still experiencing a high death rate from lightning while attributing the deaths to witches who send lightning to others. The above mentioned reasons and the fact that South

Africa is a lightning-prone country (Evert and Schulze, 2005), are the primary reasons for the elevated lightning-related death rates.

Static electricity is very important for the learners in this grade as it encompasses current electricity. These form a major component of the Physical sciences curriculum in the FET phase. Learners do not perform well in this topic. It should be noted however that, for second-language speakers of English, the attainment of better mastery of English should not negatively affect their first language abilities. Teaching strategies should be found for learners to value and not reject their first language and culture yet also embrace, appropriate and claim both cultures and languages as theirs. Mother-tongue based bilingual education should aim at providing learners with good command of English, which constitutes an essential tool for success in the global arena. However, the maintenance of the learner's mother-tongue will remain an important additional pillar for success at local and national level. Therefore, the quality of the teaching of English needs to be reinforced, so as to bridge the gap for those learners who learn static electricity in the second language.

1.5 Research Questions

In order to investigate the above research problem, the following research questions were addressed:

How did the learning of Grade 10 learners compare when taught static electricity in Physical Sciences in isiXhosa and English respectively?

To address the above main research, question the following research sub-questions answered:

1. How were the lessons on static electricity in IsiXhosa and English implemented?
2. What were learners' understanding of static electricity after the lessons in English and IsiXhosa respectively?
3. What were learners' perceptions of the lessons in English and IsiXhosa?

1.6 Significance.

The study is aimed at English Second Language (ESL) learners who lack meaningful understanding of science mainly due to the use of English as the language of instruction. School and population demographics at large show that there is a shortage of professionals with a science background, especially in the Black communities. Therefore, the study aims at arousing learner interest in science by introducing simple and effective ways such as analogies to make science understandable. Also, the study intends to enhance the subject matter knowledge and teaching strategies of ESL teachers who are also hesitant about their ability to teach science effectively due to the lack of subject matter knowledge and constructivist-teaching strategies such as analogies. The focus on the PCK and in particular Topic Specific Pedagogical Content Knowledge (TSPCK) is also significant.

Significance is the quality of worthy of attention. The statistics for Physical Sciences indicates the need for improved Physical Sciences education. Learners who are unable to understand physics concepts often label the subject as difficult and that may not only badly affect their progress in Physical Sciences, but also discourage them from choosing Physical Sciences as a subject and consequently limit their future possibilities in a career in sciences (Hobden, 2005 & Mugler, 2010). This puts the country at a disadvantage as the challenges facing the country cannot be addressed, e.g. the issue of the shortage of skills. Redish (2006) stresses the importance of paying more attention to the facilitation of physics to all learners given that, applicable skills are needed in an increasingly technological world and demanded in the labour market. Therefore, any country, including South Africa, cannot afford to have enough learners entering into a Physical Sciences study field. Unfortunately, the Physical Sciences curriculum is filled to capacity with limited time for learners to conceptualize difficult and related concepts (Hobden, 2005). Therefore, it becomes imperative to pay more attention to the teaching of Physical Sciences due to technological advancement and to supply in the labour market needs (Redish, 2006).

This study provides the baseline information for other studies in future. They can use the findings of this study as the basis of further studies in future involving language of learning and teaching. The future researchers will have this information as the background knowledge and context. This study aims to help minimize the gap in achievement of our learners in science education. Learners will be on the same level

of understanding with those learners whose first language is English, should this language barrier be eliminated by teaching learners in their mother-tongue.

This research is putting forward the importance of isiXhosa as a medium of instruction in the education of the learner. Learners acquire most of their knowledge in the interaction with their immediate environment through the use of their mother-tongue. Learners who use mother-tongue, develop cognitively better than learners who are using a second language. This research has also provided the research problem and research question for future studies. Culturally, electrostatics or lightning strike is regarded as a form of punishment from the ancestors. When lightning strikes, witchcraft is also brought into the fray. This myth is also leading to the senseless killing of innocent grandmothers, as they are always suspected of witchcraft.

The discussion of the relationship between language and culture is clearly explained in the Sapir-Whorf hypothesis. This hypothesis is concerned with the possibility that people 's view of the world may be conditioned largely by their native language. It further states that a 25-year-old person 's mother tongue provides him/her with a series of the categories which form a framework for his/her perception of things (Kaschula & Anthonissen, 1995, p. 17). The hypothesis acknowledges this relationship between language and culture by positing that one could not be understood and appreciated without knowledge of the other. This also strengthens the view that most of language is contained within culture, and that a society 's language is an aspect of its culture (ibid). Different speakers of different languages view the world differently due to the fact that they speak different languages (Kaschula & Anthonissen, 1995, p.18).

1.8 Limitations of the study

This research is a case study. It is limited to Physical sciences learners in a single school in a single district of the Eastern Cape, that is one class of grade 10 in the entire school. One of the limitations or challenges encountered was the fact that there are very few scientific concepts that can be easily translated into isiXhosa.

1.9 Structure of the thesis

This thesis is divided in the following chapters:

Chapter 1: Introduction

The introductory chapter of this study provides the background to this research project. It clarified the research problem, the aims of the research, the research question, the rationale, the significance and limitations of the study. Importantly, it provided an introduction to the succeeding chapters.

Chapter 2: Literature review

The literature review provided the theoretical basis for this study and discussed existing studies related to the topic, and is an attempt to show the relationship between this study and what has gone before (Boote & Beile, 2005). Their view helped me to place my study in a context and show its relevance by making connections with the body of knowledge.

Chapter 3: Methodology

This chapter discussed procedures which were used to gather raw data, with the aim of answering the research questions of this study. All procedures and techniques which were used in the field were made explicit in this chapter. As discussed by Hornberger & Corson (1997) a good scientific study does not only provide details about a phenomenon and its context will also discuss all technical procedures which are undertaken to come up with the study's conclusions.

Chapter 4: Research findings

This chapter represents the findings of the study and serve to represent the data in meaningful and useable formats.

Chapter 5: Discussion of finding

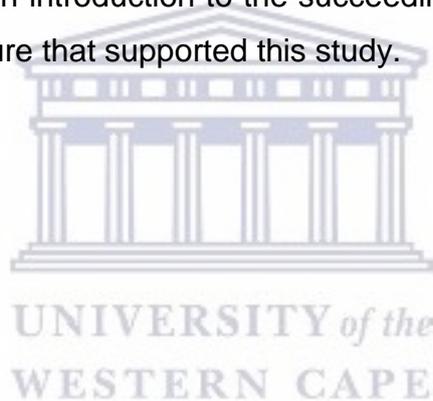
This chapter presents a discussion of the collected data.

Chapter 6: Conclusion and recommendations

Finally, this chapter concluded the study. It included a discussion of the main findings in terms of importance of mother-tongue instruction of static electricity in isiXhosa and English, a summary of the study, its conclusions, as well as the limitations of this study and recommendations for future research arising from the findings of the study.

1.10 Conclusion

This chapter provided the background to this research study. It clarified the research problem, the aims of the research, the research question, the rationale and the significance of the study. It further explained the facts that have limited the study. Importantly, it provided an introduction to the succeeding chapters. The next chapter have provided the literature that supported this study.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the previous chapter, the researcher looked at introduction of the study which encompassed research question, data collection, methodological framework and sampling. In this chapter the researcher will be looking at literature review and the theoretical framework that underpins this study.

Literature review refers to a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contribution to a particular topic. Literature review is an account of what has been published on a topic by accredited scholars and researchers.

The workplace of post-apartheid South Africa is transforming racially, culturally and linguistically to reflect our national diversity. Yet English remains the most used language for higher status occupations. This can be due to the fact that most African language speakers working as accountants, lawyers and scientists are, in fact, English mother-tongue speakers when it comes to debate on issues pertaining to their field of expertise (Mwepu 2005). It is curious that even a course like African Linguistics is taught through the medium of a foreign language i.e. English. This goes against the prediction of the 1996 National Commission on Higher Education (NCHE) which suggested that it was only a matter of time before [South Africans in general and] the speakers of African languages [in particular] realized that 'English only' or 'English mainly' options were not adequate in terms of redressing the imbalances of the past (NCHE 1996: - 381-385).

2.2 Theoretical framework

Theoretical framework is a collection of interrelated concepts, like a theory but not necessarily so well worked up. It gives guidance to your research, determining what things you will measure and what statistical relationships you will look for. The theoretical framework that this study is grounded on is called constructivism, in particular social constructivism.

2.2.1 Constructivism

Constructivism encompasses a number of related perspectives. Basically, a constructivist stance maintains that learning is a process of constructing meaning; it is how people make sense of their experience. Beyond that basic assumption, constructivists differ as to the nature of reality, the role of experience, what knowledge is of interest and whether the process of meaning-making is primarily individual or social (Steffe & Cole, 1995). In a constructivist classroom, the researcher is no longer responsible for transmitting knowledge, but acts as a facilitator with numerous roles: a presenter (of learner activities), an observer, a question and problem poser, an environmental organizer, a public relations manager (understanding and supportive), a documenter (of learners' learning), a contributor to the classroom culture and a theory builder (Chaille & Britain, 1997:54).

The researcher's role mentioned above are related to or compliment the roles of the researcher that are outlined in the Caps document, namely, mediators of learning, interpreters and designers of materials and learning programs, leaders, researchers and lifelong learners, community members, etc. Through mediation, the researchers must acknowledge the need for learners to play an active role in acquiring new knowledge. In other words, the learners should take control of their own learning in order to construct new knowledge. According to Martin, Jr, et al. (1994:46) a Constructivist Teaching and Learning Model is based on four key activities by the learner (i) exploration, (ii) explanation, (iii) expansion and (iv) evaluation. In each case, the researcher has a significant role to play as a facilitator of knowledge construction. In the process of knowledge construction, the researcher should create learning

circumstances which are meaningful to the learners. In order to deepen their understanding, learners should be encouraged to think and to exchange views with their peers. The Constructivist Teaching and Learning Model (or Learning Cycle) which suggests a learner-centred approach to science teaching and learning requires the learners to explore learning activities in order to discover new knowledge (Martin, Jr, et al.: 1994:46). Exploratory activities include science investigations and cooperative learning. They should be encouraged to explain the ideas they discovered in their exploration in meaningful ways. They should be encouraged to expand their knowledge through interactions and communication with peers, researchers, and parents and with other people in their communities.

Having explored and extended their understanding of static electricity in grade 10 Physical sciences, the learners should evaluate their knowledge. At this stage the researcher should assess them in order to see whether there is any change in learners' understanding and their mastery of science process skills. Learners cannot explore and explain concepts meaningfully if they are using a language in which they lack competence in. Likewise, the language used in evaluating knowledge is very important. If learners are evaluated in a language which they do not understand well, the evaluation results may be distorted. Constructivism is a heterogeneous movement. One recent review has identified at least the following varieties: contextual, dialectical, empirical, information-processing, methodological, pragmatic, radical, moderate, Piagetian, post epistemological, realist, social and socio-historical (Good *et al*, 1991). Piaget (1976) argues that small children start their mental activity or start to think before they have acquired a language. Piaget (1998) further argues that language helps to speed up and make learning processes more efficient.

2.2 Social Constructivism

Social constructivism is a sociological theory of knowledge that applies the general philosophical constructivism into social settings, wherein groups construct knowledge for one another, collaboratively creating a small culture of shared meanings. Social constructivist theory posits that learners learn concepts or construct meanings through their interactions with things around them. Therefore, teaching approaches that do not

give learners a platform to connect what they learn in the classroom to their prior knowledge result in learning by rote than with deeper understanding of what may be involved. It is therefore crucial to include in lessons; related events in their community, society, or the world around them via extended activities. When learners come into a science classroom, they have existing ideas about diverse natural phenomena. Learning involves construction of knowledge through experience. Science can therefore be taught more effectively if learners' prior knowledge is taken into consideration. According to Kilpatrick (cited by Rossow and Smith, 1999), learners acquire knowledge when they can incorporate new experiences into existing mental structures. When these structures are reorganized, they can be used by the learner to solve more problematic experiences.

The social constructivist theory is based on learners' real life experiences to construct meaning and understanding of, for example, Physical Sciences' concepts. The learners come with their home language and construct meaning based on their language and understanding. They become aware of their surroundings through their mother-tongue. For learners to develop cognitively, language plays a major role. They come to school being aware of lightning for example, that knowledge they are coming with, makes sense when, the static electricity, is taught at school. But now this knowledge they have about static electricity, has been constructed in isiXhosa and at school they are taught in English. If this knowledge they have was to be taught in the language in which they constructed meaning, they will understand the concept better.

Vygotsky (1978) believed that children learn by actively constructing their knowledge. Language plays a very important role in the learner's cognitive development. Language is used to plan, guide, and make decisions in what Vygotsky refers to as inner speech by children, which is an important tool of cognitive development during early childhood (Jones & Brader-Araje, 2002). The researchers in the above paragraph emphasize the importance of language. Learners who find them being subjected to learn Physical science in English will find it difficult to understand concepts at the same level as their peers who are doing it in their mother-tongue. For the learner to develop cognitively, he or she must learn in his or her own language.

Social constructivists emphasize the importance of culture and environment on the learning process. The basis of the theory of social constructivism assumes that reality is constructed through human activity, knowledge is created through interactions with others, and their environment and learning are more meaningful when the learner is socially engaged. Four perspectives of social constructivism include: cognitive tools perspective, idea-based social constructivism, pragmatic or emergent approach, and transactional or situated cognition.

Social constructivism is a sociological theory of knowledge that applies the general philosophical constructivism into social settings, wherein groups construct knowledge for one another, collaboratively creating a small culture of shared meanings. The constructivist theory is based on learners' real life experiences to construct meaning and understanding of Physical sciences' concepts. The learners come with their home language and construct meaning based on their language and understanding. They become aware of their surroundings through their mother-tongue. For learners to develop cognitively, language plays a major role. They come to school being aware of lightning for example, that knowledge they are coming with, will make sense when, for example, the static electricity, is taught at school. But now this knowledge they have about static electricity, has been constructed in isiXhosa and at school they are taught in English. If this knowledge they have was to be taught in the language in which they constructed meaning, they will understand the concept better.

One widely acknowledged division is between personal and social constructivists, the former deriving from Piaget, the latter deriving from Kelly and Vygotsky. This learning theory, which combines elements from both behaviourist and cognitivist orientations, posits that people learn from observing others. By definition, such observations take place in a social setting- hence the label observational or social learning (Lefrancois, 1999). Specifically, 'social cognitive learning theory highlights the idea that much human learning occurs in a social environment. By observing others, people acquire knowledge, rules, skills, strategies, beliefs and attitudes. Individuals also learn about the usefulness and appropriateness of behaviours by observing models and the consequences of modelled behaviour and they act in accordance with their beliefs concerning the expected outcomes of actions' (Schunk, 1996, p, 102). Just how the

learning occurs has been the subject of several investigations. In Vygotsky's theory (1997), development is limited by the size of the Zone of Proximal Development, which is Vygotsky's term for the range of tasks that are too difficult for the child to master alone, but that can be learned with the guidance and assistance of adults or more skilled children. It can prove to be difficult for children to master such tasks if learning takes place in a language that is not their mother tongue. The Zone of Proximal Development captures the child's cognitive skills that are in the process of maturing. Since language plays a central role in cognitive development, it can, therefore, be viewed as a tool for determining the ways in which a child learns how to think.

Complex concepts are conveyed to the child through words. As indicated by Vygotsky's theory (1997), learning always involves some type of external experience being transformed into internal processes through the use of language. Therefore, it is difficult for a child to transform cultural experiences into internal processes using a second language whose culture the child is not familiar with. Tudge (1990) defines the Zone of Proximal Development as the difference between the actual development level (what the child is capable of now) and the potential development level. This is the difference between what the child can do now and what the child can do with adult guidance or the guidance of more capable peers.

It is true that development occurs through social interaction with those who are more capable. Raggoff (1990) states that learning can be improved when more skilled peers provide guidance. Another crucial factor in learning is culture. Vygotsky (1997) suggests that mediators are culturally specific. A good example is that of formal logic and mathematics which are typical of Western culture. Cultural differences were also spotted in solving techniques among literate and illiterate Uzbeks. The Literate individuals approached problems as logical puzzles, whereas, the illiterate ones' concrete examples based on past experiences.

2.3 English as an “international” language

English is undeniably the dominant ‘international language’ at least at present. Indeed, Kumar (1996) pointed out that there are more non-native users of English in the world. According to Suzuki & Yoneda (2006:382), non-native speakers now outnumber native ones 3 to 1. Pennycook, et al. (1994) indicated that “English is an international language in that it is the most widespread medium of international communication, both because of the number and geographical spread of its speakers, and because of the large number of non-native speakers who use it for part at least of their international contact. The predominance of English speaking nations, British imperialism in the nineteenth century and the economic influence of the United States in the twentieth century.

Freire agrees that the form and context of knowledge, as well as the social practices through which it is appreciated, have to be seen as part of an on-going struggle over what counts as legitimate culture and forms empowerment (Aronowitz & Giroux 1986:156). Providing learners with good English knowledge is genuine and it equips them. Good command will assist in reducing socio-economic disadvantage, especially within the post-apartheid context of South Africa. Supporters of the use of English as a medium of instruction (Kachru 1986:1), agree that knowing English is like owning the fabled Aladdin’s lamp as it opens the linguistic gates of international business, technology, science, and travel as it has linguistic power. Although, this declaration was stated to emphasize the need to promote African languages and curtail the marginalization of the majority (75%) of the African population, one can also see through this declaration as somewhat covert call for better teaching of English so as to provide our schooling population with a chance to acquire standard English, especially because of the intricate relationships which exist between language, schooling and economic empowerment.

In academic settings, Bangeni (2001) found that, given a choice, bilingual students would still prefer to submit their written academic essays in English rather than writing them in their indigenous languages because arguably, writing in their mother-tongue would limit their ability to utilize all the educational resources available to them. Latu

(2004) in his study in Australia found that there is enough evidence to support the theory that students who use their mother-tongue while learning in English perform better than those who do not. He acknowledged that further study must be done into how learners can develop their mother-tongue to match the new concepts being taught in the classroom. In South Africa, the use of mother-tongue within the classroom is discouraged by the fact that the researchers do not understand the mother-tongue of the learners and also do not know how to facilitate this learning. This refers to researchers who do not speak the language of the learners.

Young (1979) has argued that for the use of English in the teaching of science, especially those learners from non-western societies do not have exact words or ideas as expressed by school science. In support of his claim he gave examples of words like 'same', 'similar' and 'identical' that are very important in science which some languages do not have separate terms for and hence argued that science requires linguistic accuracy. He further contends that, "languages develop words which are important to the people who use the languages" (p.56). Though Young's (1979) argument for English as the language of instruction in science may have some validity but this does not necessary hold when it is realized that there is hardly any English word that cannot be translated into these languages. For example, the equivalent word for 'fermentation' is translated as 'ukubila' in isiXhosa. The word 'ukusela' is used for drinking water while 'ukuphunga' is used for drinking tea. Terms like density in isiXhosa ubunzima bomthamo, cell is iseli in isiXhosa, soil is umhlaba in isiXhosa. This clearly indicates that Physical sciences can be taught in isiXhosa.

2.4 Mother-tongue Instruction

The views of the famous theoretical linguist, Chomsky (1957) on mother-tongue acquisition and his Language Acquisition Device (LAD), only made mention of the innate ability to acquire mother-tongue. Human beings are equipped, unlike animals, to acquire a rule-based language system simply by being exposed to the language spoken around infants. This kind of a language need not always be "correct" or "standard" or even intended for the infant. He called this kind of language the Primary Linguistic Data and the ability to acquire it via a high level of motivation as the

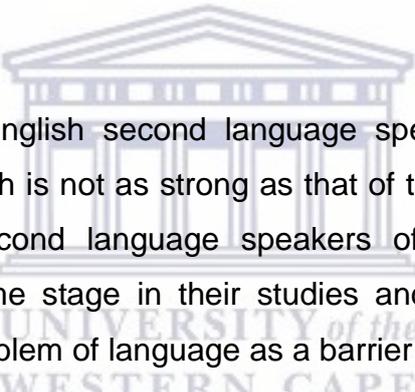
Language Acquisition Device (LAD). He clearly states that this specifically applies to acquisition of the mother- tongue. There is no mention of the LAD for a second, third or any language acquired after mother- tongue, and if there was, it is doubtful that its automaticity would be as the LAD meant for mother- tongue acquisition.

The LAD makes thinking as well as communication of ideas and views in mother tongue easier. Since the LAD is associated with mother tongue, it can, therefore, operate only where there is mother- tongue thinking and communication, be it verbal or written. The relationship between language and cognition is evident in Chomsky's views. The term cognition describes a mental activity of acquiring knowledge. The process of acquiring knowledge implies to thinking. Thinking is a crucial part in the learning and teaching process. It has been indicated that learning or acquiring a second or foreign language does not operate in exactly the same way as acquiring mother tongue. This means that thinking in one language and communicating in a different one is likely to create barriers. It is even worse in instances where English second language learners listen and hear the language of instruction, which is English, then interpretations and thinking have to be in mother-tongue and communicating both oral and written responses takes place in English. Barriers can lead to communication breakdown and a failure to interpret adequately and produce right responses. These learners will eventually fail to acquire knowledge in the same way as their counterparts; whose mother tongue is the same language used as a medium of instruction, in this case, English. Therefore, learning in English impacts negatively on the cognitive development of English second language learners.

All learners are equally capable of challenging achievements irrespective of their language status. It is, therefore, imperative that the language hindrances that deprive English second language speakers' equal chances to excel in challenging fields or careers must be identified and strategies to solve them must be devised. In his theory, Piaget (1957) states that what limits, what children can learn next is their level of cognitive development and biological maturity. A biologically mature learner can acquire knowledge and reason, but this is not the case with all second language speakers. The conclusion could, therefore, be that learning in a second language as it

happens for many in South Africa, might be negatively affecting the mental activity of acquiring knowledge.

The important part of this study was to clarify the role played by language in reasoning, whether language affects the reasoning pace or not, and how the two are related. An example is that of a learner who has to solve a Mathematical Literacy problem that is presented in the form of language and not numbers. That learner will struggle to solve that problem if he or she does not understand the language in which the problem is presented in. Language plays an important role here because the learner must understand the given scenario or case study before formulating the equation to be solved. A learner who fails to understand the instruction language will formulate an incorrect equation, thus resulting in the wrong answer. In this case, the instruction language can be viewed as a barrier to reasoning.



The mental activity of English second language speakers to acquire knowledge through learning in English is not as strong as that of their counterparts (English first language speakers). Second language speakers of English might not perform exceptionally well at some stage in their studies and chosen careers due to the language barrier. The problem of language as a barrier to learning has not been dealt with directly although some attempts have been made English is undeniably the dominant 'international language' at least at present. Indeed, Kumar (1996) pointed out that there are more non-native users of English in the world. According to Suzuki & Yoneda (2006:382), non-native speakers now out-number native ones 3 to 1. Pennycook, et al. (1994) "English is an international language in that it is the most widespread medium of international communication, both because of the number and geographical spread of its speakers, and because of the large number of non-native speakers who use it for part at least of their international contact. The predominance of English speaking nations, British imperialism in the nineteenth century and the economic influence of the United States in the twentieth century. This is a clear indication that English enjoys a lion's share among the other languages.

The question of language of instruction in Africa has received much attention in the past last two to three decades. There have been arguments for and against the use African languages as languages of instruction in schools. One part of the argument pertains to the low socio-economic status of African languages and the lack of adequate resources and scientific terminology which make them unsuitable as languages of teaching and learning (Bunyi 1997, Elugbe 1990, Hameso 1997).

According to Prah (2003) socio-economic factors affect our learners' performance in science. In South African context, this applies in particular to African language-speaking learners being taught new concepts in different learning areas through the medium of English, which is an additional or second language, from Grade 4, whilst still grappling with the challenges of learning new subjects and additional language (English) at the same time (Desai 2012; Nomlomo 2007; Banda 2006; Langehoven 2005; Heugh 2003; Desai 2001; McKay & De Klerk 1996 and Stentson 1994). This means that the learner will be tested twice, language first and then the new concept that the learner has to understand and master.

Some initiatives towards promoting African languages in education have been taken in some African countries. Nigeria was the first country to implement the Six Year Primary Project, they implemented this in the 1970s, and Mali also implemented its own programme in 1985. Similar quasi-experimental research studies were conducted in Tanzania where Kiswahili was used as a medium of instruction in science and geography in secondary education from 2004 – 2007 (Vuzo 2007, Mwinsheke 2008). Yohannes' 2009) study in Ethiopia focused on the use of African home languages in education. These initiatives spread further to South Africa. In Western Cape there has been a growing support on the use of isiXhosa as one of the languages of learning and teaching since 1990. Projects like the South African Threshold Project in 1990 and the Project for the Study of Alternative Education in South Africa (PRAESA) from 1992 focused on projects which promoted mother tongue based bilingual education which entailed the retention of learners' home language (Wababa 2009).

There is also the Language of Instruction in Tanzania and South Africa (LOITASA) research project which was a collaborative research project between Tanzania and South Africa. This project extended the use of isiXhosa in mathematics, geography and science teaching in the Intermediate Phase (Grade 4-6) in selected primary schools in the Western Cape. This is because African languages are not used as languages of learning and teaching after grade 3 in many South African schools (Nomlomo & Mbekwa 2013; Nomlomo 2007). LOITASA was divided into two phases called LOITASA1 and LOITASA 2 was conducted over a period of five years from 2003-2007), while LOITASA 2 continued from 2008 – 2012. The launch of the Western Cape Education Department's (WCED's) Language Transformation Plan (LTP) in 2007 and its implementation in 16 Western Cape schools in 2008 was also in support of mother tongue based bilingual education (Pluddemann, Nomlomo & Jabe 2010).

Given the myth that African languages are unsuitable as languages of learning and teaching in science (Heugh 2003) Prah (2003) reflected on the use of isiXhosa for science teaching and learning in the Intermediate phase in two primary schools in the Western Cape in order to highlight the success and challenges that were experienced. Guided by the notion of social constructivism and epistemological access to science knowledge, the article argues that while (isiXhosa) home language instruction is a priority with regard to learners' access to meaningful learning, there are constraints that have to be taken into consideration to ensure that learners' access to meaningful science knowledge is enhanced. It intends to inform future implementation of home language instruction in African languages, given the current national support of African languages in education through the Incremental Introduction of African Languages (IIAL) initiative (Department of Basic Education 2013). This is a clear indication that Africans now are beginning to be conscious of being who they are. If African learners can learn in their mother tongue, they will be proud of being themselves and this will lead to them being more open in their classrooms. The level of socialization in the classroom will increase.

2.5 English as the language of instruction in South Africa

Learning in a second language in South Africa is an extremely complex and sensitive issue. Language and thinking are tied together. If learners are abruptly cut off from their mother-tongue it can negatively affect their cognitive development. Teaching and learning often takes place through a language which is not the first language of our learners in my school. These learners are at a disadvantage in terms of understanding the content taught and this learning in a second language often leads to significant difficulties which contribute to learning breakdown. Within an additional language classroom there is a lot of code-switching, this code-switching influence understanding. Learning Physical Sciences in English language may lead to a high failure rate. English second language learners are particularly subject to low expectations and discrimination. The researcher may be forced to use code-switching, which is time consuming. Even in the smallest school districts, it is common for researchers to have one or more learners with limited or no command of the English language in their classrooms. To help close this gap, educators must have ways to help these learners to overcome the differences between their students' native language and the acquisition of spoken and written English.

This is a clear indication that English enjoys a lion's share among the other languages. South Africa is a linguistically diverse country. This is reflected in the origins of South Africans. Until 1991, South African law divided the country along racial lines according with Apartheid policies. Although these laws have been abolished in 1994, many South Africans still view themselves and others according to these categories (Schoeman, 2011:16). This contradicts its progressive constitution and language policy that boasts eleven official languages. Seeing that South African society is inherently diverse, it comes as no surprise that the use of English in South Africa also reflects such diversity. Alexander (2000) points out that unless a person has a command of standard English or of standard Afrikaans, he/she is simply eliminated from competition for jobs that are well remunerated or simply excluded from. This means that one's language determines whether one gets a decent job or not.

Studies reviewed by Flesich (2008), show that most South African Primary School children, black and white in the middle class, could read with degrees of proficiency and generally understood what they read. In contrast, only a few small numbers of children in former homeland schools and schools that fell under the former Department of Education and Training (DET) were at the same level of fluency. In those schools, even children who would read often did not comprehend the meaning of the text. (Fleisch, 2007:8).

Implementation of Bantu education by the apartheid government which aimed at providing low quality education to African people learners created an impression for many African people that learning through their languages was a means of blocking their access to socio-economic advancement (Cluver, 1992, Benjamin, 1994, Maake, 1994, Verhoef, 1998). As Bantu Education was associated poor or inferior education, the use of African languages in education is also perceived as providing low quality education. The backgrounds of learners also played a major role in the poor performance in Physical Sciences. The impact of violence and HIV/AIDS can also have adverse effects. Some learners are heading their families. Their parents have died due to HIV/AIDS. Inadequacies and inequalities in the education system are most evident in areas which have sustained poverty and high levels of unemployment. Lack of fluency in English is one of the factors that lead to poverty and under-achievement in many communities and is a huge barrier to employment and workplace opportunities and further and higher education. The majority of learners throughout the world find science to be a very daunting and intimidating school subject. The major reason for that is that, the majority of learners from non-western science backgrounds experience school science differently due to diverse and competing perspectives on which to interpret the world (Onwu & Mosimege, 2004).

A study conducted at University of Western Cape (Banda, 2007) involving isiXhosa speaking students found that the students had little or no English proficiency, as determined from the quality of their spoken and written English in the communication course. Banda became aware of a particular group of learners that had kept doing badly in the English communication course that he had been lecturing. This proves that the use of mother-tongue in our classes of science is important. In this group of

students, Banda discovered that three of the students had already failed the course and repeated twice. If learning at high school level was done in both English and isiXhosa as the language of teaching and learning, these learners might have performed better in Banda's classroom.

One of the remedial measures implemented in South Africa was the identification of poorly performing schools to be made Mathematics and Science focus schools. These schools receive additional support in order for them to produce quality results (Christie, 2008). Even though all these attempts have been made to improve the situation, nothing has changed; the examination results kept on dropping each year. Researchers tend to focus too much on the content prescribed by the Department of Education forgetting that science is a human explanation of nature (Ogunniyi, 2007). Nature is around us; therefore, science is everywhere and not just confined to textbooks or the classrooms. Learners are often regarded as "empty bowls" waiting to be filled up by researchers who are transmitters of knowledge (Lew, 2001). Learners come into science classrooms with prior knowledge upon which they will build new knowledge (Bybee and Fuchs, 2006).

Many remember Nelson Mandela's famous words, "that if you speak to a man in a language he understands, you speak to his brain. But if you speak to him in his own language, you speak to his heart". Perhaps it's time we put that into action. In South Africa we have imported professionals who don't speak any of our languages but are able to work here, like the Chinese for instance. Look at Afrikaans schools; they always get 100% matric pass rates because the learners are taught in their mother tongue. What is frustrating being the fact that it is not only white people alone who relegate our languages - our own black people have lingual self-hate. Even some black people look down their African languages.

Some years ago the then Limpopo MEC of education Dr Aaron Motsoaledi suggested a law that all schools in Limpopo have at least one Limpopo language (Venda, North Sotho and Tsonga) as either first or second language. White people were generally excited but black people who sent their kids to "town schools" threatened to protest

against such a law because they didn't want their kids to be taught "unimportant" languages. This fact is further strengthened by #the fees must fall# campaign, where some black students in the former white Afrikaans universities demanded that the universities must teach also their mother- tongue. Surprisingly the Afrikaaner students where happy and willing to learn in other languages, but the challenge was that there were no textbooks that were written in African languages. Who says English is the most widely spoken language in the world? While we brag about the need to use English and put it on a pedestal, I hope we are all aware that in Europe, it is only used in the UK.

If we are going to speak of a rainbow nation, then we need to embrace and ensure that our languages don't die down. A rainbow is a rainbow because of its seven colours. Language is an inseparable part of mathematics. Some of the first lessons parents teach their toddlers are the words to count the chubby little fingers on their hands. After learning to count their fingers, children progress to the basics of elementary school arithmetic - addition, subtraction, multiplication and division. On the other hand, we can't blame a language when kids fail. All you need to do is look around you in the malls. Black kids don't speak their mother tongues anymore. Taking a closer look at the matric results it is evident that the languages they fail are their own. The government should start taking this issue seriously. It will be a long process but it can be done. Language development does not have short cuts so we must not look for one.

2.6 Access to education

The notion of access to education has been a matter of concern in sub- Sahara Africa since the adoption of the Millennium Development Goals (MDG's) in 2000, and the commitment to Education for All by 2015 (Motala, Dieltiens, & Sayed 2009). Access to education is understood as both physical (formal) and epistemological access to knowledge. Physical access has to do with the numbers or enrolment rates, while epistemological access, a term coined by Morrow in 1994, entails access to meaningful learning (Motala *et al.* 2009; Jansen 2008; Morrow 2007). It is argued that language is one of the barriers (with poverty, gender inequality, social class, etc) to learners' equal

epistemological access to education, particularly in sub-Saharan Africa (Jansen 2008; Pendlebury 2008).many children in Africa access education or knowledge through the medium of a second or third language (eg English, French, Portuguese) in which they have limited competence(Bamgbose 2013; Brock-Utne 2010; Jansen 2008; Pendlebury 2008; Qorro 2004; Alidou 2004, Chisholm 2004,Gamede 2005). Consequently, there is a big gap in academic performance between children who are taught in their home language and those who are taught in a second language, most of them are from low socio-economic backgrounds (Pinnock 2009).

One argument I always hear (mostly from fellow blacks) is that a graduates who wrote engineering in IsiZulu, for example, would not be able to work anywhere else because IsiZulu is only spoken in South Africa. The influence of having a different home language from the Language of Instruction on the learning of abstract scientific concepts is particularly evident in African languages such as isiXhosa. The teaching of abstract concepts through the use of examples that learners are familiar with in particular poses challenges to researchers with isiXhosa speaking learners due to word ambiguity and the absence of terminology to describe the abstract concepts. The absence of isiXhosa terminology in textbooks to link the prior knowledge of the learners with abstract, scientific concepts is frequently cited by researchers at workshops as reasons for the poor performance in the Senior and Further Education and Training (FET) phases. Then there is the added complication of isiXhosa words with dual meanings when translated into English. An example is the term “umbane” in isiXhosa, which is used to both refer to the concept electricity and lightning. This may lead to learners getting confused with the difference between scientific concepts and the everyday use of the same concepts. The ambiguity may result in learners holding alternative conceptions about the nature of direct current (DC) electric circuit concepts and retard understanding of the concepts. But that does not make sense to me because Afrikaans is only spoken in South Africa and Namibia but graduates who wrote exams in Afrikaans are able to work all over the world.

Language is powerful. It forms part of our identity and is an emotional and somewhat touchy subject. This is why all languages need to be respected, be it in schools or in everyday interactions. With that said, teaching our children in their mother tongues,

although a noble concept is just impossible to implement practically. But making it compulsory for pupils to learn a different language is a step in the right direction. Racism and discrimination thrive in environments where there is a lack of understanding. This is what was said by an English speaking South African “I, for one, wish I could have learnt another African language; especially since I now work in the "language blend" that is Johannesburg”. This guy is sharing a feeling that is shared by many white South Africans.

In South Africa, access to education, particularly science and mathematics education, is receiving more attention, not only as a tool for transformation, equity and redress, but also for economic and technological development (Ogunniyi 2005). But the question of language of instruction and learners’ access to knowledge is still an educational challenge (Nomlomo 2007; Suhaimi 1981). Research shows a positive correlation between the languages of learning and teaching and learners’ academic achievement. All the above information concretises the fact the education in African countries is being hindered by the use of a second or third language rather than the first language or the mother-tongue. People who are for the use of English as a language of teaching and learning argue that the economy of the country is still in the hands of those people who speak English and Afrikaans. I agree with them but we cannot say that learners who are taught in second language are not disadvantaged in terms of learning and retention of the concepts learnt. Germany is one of the developed countries who use their mother-tongue in schools.

2.8 Current language policy in education

Present language in education policy privileges those whose home language is either Afrikaans or English by enabling them to be taught through the medium of their first language throughout their years at school and beyond. This is a right that, in practice, is denied speakers of the major African languages. As a general rule, African children begin their schooling in their home language, which remains the medium of instruction through the fourth year of schooling (grade 4). English is studied as a subject. Beginning of the fifth year of schooling, there is a shift in medium of instruction –in theory to either English or Afrikaans but in practice virtually always to English. There

are those who might argue that the June 1991 amendment to the 1979 Education and Training Act allows speakers of African languages the same choice enjoyed by English and Afrikaans speakers. The amendment transfers to parents the right to decide, in consultation with the Minister, which language should be used as a medium of instruction for their children and at what level. This choice also created problems as some former Model C schools used language as means keeping away black learners. Some former Mode C schools grew in terms of numbers of learners as they gave a choice to learners to learn in their language of choice.

Some schools used language to segregate other races, which led to serious fights and disruption of tuition time, while others benefitted in this language policy as their schools grew in numbers and really fulfilled the aspirations and dreams all South Africans. However, this choice is meaningless if there is no infrastructure to support it. If no resources are invested in developing materials / books on African languages, learners are unlikely to choose these languages as a medium of instruction. If such a choice is to have significance, it must be linked to affirmative action in terms of the active promotion of African languages. Key areas of education in which language has been a factor in helping to maintain current power relations have been, and still are:

1. Medium of instruction (always home language for the already powerful)
2. Promotion (or ignoring) of language (resulting in differential affirmation for speakers of different languages)
3. Parental and community participation in schools' policies, events, structures, language and dialect affect who feels free to participate and who is able to understand notices and so sent out by schools to parents.

Choice and affirmation action are key principled of the ANC's general language policy as outlined in the May 1992 Guidelines.

A new language in education policy should therefore contribute towards:

1. Redressing the inequalities and injustices of the past and present (in terms of access to education and all that may follow from that)
2. Shifting the balance of power from white/middle-class speakers of English and Afrikaans.

3. Preparing South Africans to be able and willing to speak and listen to one another in all areas of life, but particularly in domains of decision making.
4. Ensuring that all South Africans can gain access to necessary linguistic skills, such as fluent speaking, writing, reading and command of different discourses, in order to participate fully at all levels.

The main thing here is for the department of basic education to develop these African languages by making both material and human resource available for learners to learn in isiXhosa in this case.

2.9 A way forward

A principle of affirmative action has to be approved in relation to African languages in South Africa. As these languages are primary linguistic resource of most South Africans, the state will have to commit itself to promoting them, developing resources in them, and extending their use in public domain. Citizenship (in the fullest sense) should not be dependent on whether one can speak a particular language or not. In practical terms, this would mean that language services would have to be provided by the state to facilitate communication and understanding. However, the commitment of the state is not a sufficient condition for extending the use of African languages. Speakers of these languages will also have to promote them. The dominant view in the study is that science should not emphasise scientific formalisms at the expense of interesting learning experiences that are similar to the context of the learners at home and in the community at large (Sadler & Zeidler, 2009). Hence, the learners' familiar experiences from home, community and classroom and language will be considered when teaching and learning of static electricity.

2.10 Conclusion

This chapter provided an exposition of the theoretical frameworks that underpin this study and the relevant literature that impacts this study. The next chapter will highlight the methodology used to collect the data to answer the research question.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter the researcher looked at research design, case study sampling, methodological framework, reliability, validity and ethics in detail. The researcher described the procedures that were to be followed in order to generate and collect the necessary data to answer the research questions. All the methods of collecting data, methodology adopted and the analysis used were discussed in the chapter sections.

3.2 Research design

This research was a case study using qualitative research method to compare learners' achievement when English and isiXhosa were used as a medium of instruction in the science class. Qualitative research method is a way of collecting data through the use of interviews, observations and reflective journal. Borg and Gall (1987) explain this research method as a way of solving a research problem in a logical manner. Classroom intervention, a written test and focus group interviews were used in this investigation. Henning, van Rensberg and Smit (2004) points out that qualitative research examines the qualities, characteristics or properties of a phenomenon for better understanding and explanation. This meant that this study looked into the quality of the teaching and learning and also compared the grasping of concepts by learners through the use of a controlled test. These scientific concepts were taught in isiXhosa as a medium of instruction and English as a medium of instruction. Retention of the knowledge which is an indication of better understanding of concepts, was evaluated through the controlled test that was given after the lesson has been completed.

3.3 Case study

Creswell (1998) defines a case study as a single person, organization, institution or phenomenon that is investigated within a specific time frame using various data

collection devices. Zainal (2003) points out that that a case study selects a small geographical area or limited number of individuals as subjects of study. I agreed with the above authors in that this study was based in one school and one class whereas there are many schools in the same district. The case study was used in this research as a tool. A case study is not like other research studies in that it puts its main focus of attention on the individual case and not the whole population (Stake:1998). According to Diana Burton and Steve Bartlett (2005), a case study is an empirical inquiry that investigates contemporary phenomena within its real life context, especially when boundaries between phenomena and contexts are not clearly evident. This research was conducted in one Grade 10 Physical Sciences class in a school in an under privileged community in Queenstown. The school was situated in a low socio-economic, rural where unemployment was rife. Unemployment always brings crime and poverty. The teachers and the learners are home language speakers of isiXhosa. English was taught as an additional language and was used as a medium of instruction.

3.4 Sampling

This study employed a purposive sample which comprised a group of 30 grade 10 science learners in one school. Sampling is a process whereby units are chosen from a large group of interest. The results obtained from this study lead to the generalization about the school population from which they were selected. In statistics, quality assurance and survey methodology, sampling is concerned with the selection of a subset of individuals from within a statistical population to estimate characteristics of the whole population. In this research a purposive sampling was used as one class was chosen. The criterion was a grade 10 Physical sciences class that the researcher was not teaching. A random process of selecting learners for each group was used. A box with papers with numbers from 1 to 30 was put in front of the class; each learner was to pick a paper with a number. The first 15 names of learners were put in group A and the last 15 in group B. Interviews were conducted with the two focus groups. The table below gives a summary of the sample to be used:

Table 1. Research sample

Participants	Sample	Technique	Criteria
Learners	Group A Group B	Purposive	Grade 10 learners who doing Physical sciences

3.5 Methodological framework

The data collection process followed four steps outlined below. Table 2 represents a summary of the data collection process.

Step1

Learners were divided into two groups of equal numbers, that is, 15 learners in each group. A pre-test was administered to both groups of learners to establish their prior knowledge on the topic of statistics in Physical Science.

Step 2

The first group (group A) was taught in isiXhosa as a medium of instruction. Group B was also to be taught the same lesson as group A, but English was used as a medium of instruction. The same lesson plan was used to guide to ensure that the same lesson was implemented to both groups. The implementation of the lesson was observed and videotaped by the researcher and an observation schedule was used for the analysis of the data.

Step 3

A controlled test in isiXhosa was administered for Group A. Group B answered the same controlled test in English

Step 4

Two focus group interviews were conducted.

Table 2: Summary of data collection process

Step	Method	Instrument	Respondents	Analysis
How does the learning of Grade 10 learners compare when static electricity in Physical Sciences is taught in isiXhosa and English?				
1. What was learners' initial understanding of static electricity?	Pre-test	Test	Learners	Memorandum of marking
2 How were the lessons implemented in isiXhosa and English respectively?	Observation of <ul style="list-style-type: none"> • Teaching group A in isiXhosa • Teaching group B in English 	Observation schedule	Learners	Check list and thick descriptions
3 What was learners' achievement after the lessons in isiXhosa and English respectively?	Post-test-	Test	Learners	Excel
4 What were learners' perceptions of the lessons conducted in isiXhosa and English?	Focus group interviews	Interview schedule	Learners	Thematic analysis

3.6 Research Instruments

The following instruments were used to collect the research data:

3.6.1 Focus group interviews

A focus group interview is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea, or packages. In this study, the researcher focused mainly science (static electricity) understanding through the use of isiXhosa and English as a medium of instruction. A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept, advertisement, idea or a package.

According to (Blumenthal, 2005) the following can be considered as an overview of the focus group design

- Carefully plan the focus group
- Write the script and practice
- Identify and recruit the participants
- Conduct the focus group sessions
- Develop the coding scheme
- Segment and code the data
- Interpret and publish the results

Focus group method should be used (Blumenthal, 2005):

- when insights are needed into a new area of research. The researcher needed to understand what other people thought about the teaching of science in the mother-tongue, instead of English
- when the purpose was to investigate topics where opinions or attitudes were conditional. Language of teaching and learning was always taken for granted. It was just accepted without questioning it. So as a researcher, I needed to find out the opinions or opinion of this focus group.

- when the researcher needed additional information to prepare for a larger scale. The information that was gathered there, was used to generalize or to form a general inference.

When not to use the focus group method (Blumenthal, 2005):

- When discussions could become emotionally charged. This can turn ugly when participants have emotional connection to the topic of discussions.
- When the researcher loses control over the project and relinquishes control to a biased third party. As the researcher make sure you that keep the discussion on track as this may lead to chaos and time wasting.
- Statistical projections are needed. Provide statics so as to make sure that everybody understands exactly the point and aim of discussion.
- Other methods would produce better quality information. Use the focus group discussion only when it can produce better results than other methods.
- Confidentiality is compromised. Make sure that confidentiality is maintained

A focus group interview presents a more natural environment than that of one-on-one interview. The participants in the focus groups were influenced and were also influenced by other participants in the group through minor debates that were taking place; other participants were dominating the debate, and were more vocal. The responses here were more realistic because the participants relaxed and felt safe and comfortable amongst their peers and friends. The participants in a focus group discussion were on average, 6 – 10 people. The group was small enough to give everyone in the group the opportunity to express opinion. It was also large enough to provide diversity of opinions.

Advantages of focus group interview

- It is a socially orientated research procedure
- It allows the researcher to probe, it gives the researcher flexibility to explore unanticipated issues
- Focus group interview has got high face validity.
- It is relatively cheaper to organize
- Unlike structured interviews, increasing the sample size requires minimal time and resource investment.

Disadvantages of the focus group interview

- There is a lack of control from the researcher, e.g. less experimental control
- Data was difficult to analyse
- It required a carefully trained interviewer
- Groups may have changed considerably
- Groups may be difficult to assemble
- Discussions must be conducted in an environment that is conducive to conversation.

3.7 Reliability and Validity

3.7.1 Reliability

Reliability is the degree to which an instrument produces stable and consistent results. Babbie (1983) is of the opinion that as tools of social research, the questionnaire and interviews are strong on reliability. The interview's reliability rested on the fact that it has the space to ask supplementary questions that would provide additional information to explain answers and to check that the respondent is not 'making it up' (Peil, Mitchell and Rimmer, 1982). To ensure reliability, a colleague of mine, who is also a science researcher, administered the interviews using the focus group interview schedule. Respondents were not required to give their names.

3.7.2 Validity

Validity refers to how well a test measures what it is supposed to measure. Validity is seen as a relation between an indicator and a concept. It is argued that to declare something as valid or invalid measure assumes the existence of a 'real' definition of what is being measured. The researcher video-taped the lessons and the focus group interview, to make sure that the results were valid. Whereas the issue of reliability is simple and more straightforward, the question of validity of a method of research has been a subject of debate (Babbie, 1983; Bulmer and Warwick, 1993). Validity is the extent to which the inferences and actions made on the bases of test scores are appropriate and backed by evidence (Messick, 1989). To further validate my study, as I said before, the focus group interview was taken to the neighbouring school for grade learners to answer the questions. To ensure that the results were valid the researcher made sure that the interview schedule had clear and unambiguous questions. More

than one instrument was used to triangulate the results. Triangulation is a good strategy to ensure validity.

3.8 Piloting

In a quantitative study, a survey instrument that a researcher designs needs a pilot study to validate the effectiveness of the instrument and the value of the questions to bring about the right information to answer the primary research questions. The focus group interview schedule was taken to the neighbouring schools for validation. The permission from the school principal of the neighbouring school, the physical science teacher and also permission from the parents of those learners, who were the respondents in this pilot program of mine, was asked for. Permission from the department of education e.g. the circuit manager and the district office official, were obtained. The focus group interview schedule was given to grade 10 learners who were also doing science to answer it. This helped the researcher to see whether there were flaws in the focus group interview schedule, to remove any ambiguity that were found in the schedule and corrected any problems with the instrumentation or other elements in the data collection technique.



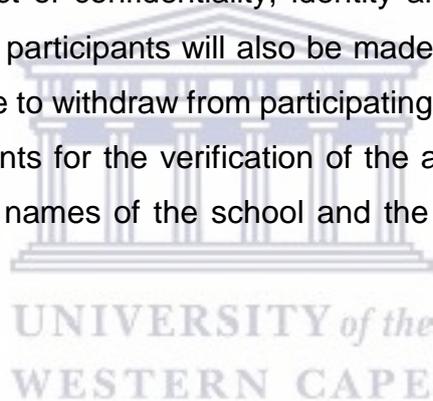
3.9 Data Analysis

Data analysis is defined as the interpretation and the understanding of the data that is raw so as to address the aims and provide relevant answers to the research question (Henning, van Rensberg&Smit, 2004). Stake (1995:71) states that “there is no particular moment when data analysis begins. Analysis is a matter of giving meaning to first impressions as well as to final compilations”. Gardner (2009) further explained that data analysis refers to the process of inspecting, cleaning, transferring and modelling data with a goal of highlighting useful information, suggesting conclusions and supporting decision making. Lebotse (2014) revealed that the purpose of data analysis is to explain concepts in a simplified manner and to indicate clearly the relationship between variables. Qualitative research generates a huge amount of data that needs to be summarized, described and analyzed.

In this study the learners' scores were analyzed and categorized. The interview data were colour coded in themes that identified particular aspects of the research that recurred in the form of triangulation. The responses during the focus group interviews were also coded and analysed.

3.10 Ethics

The public has a right to know and the participants have the right to privacy and protection of their identity. In this particular study, the researcher first asked the Eastern Cape Department of Education for permission to carry out the research in their schools. The researcher also asked the University of Western Cape to grant him permission to conduct this research under their name. The researcher also asked permission from all the relevant people including the department of education, the school principal, parents of learners, learners and teachers (see Appendices E to I). The learners were clearly told of the respect of confidentiality, identity and professionalism during the course of the study. The participants will also be made aware that if they do not feel comfortable, they are free to withdraw from participating. All data collected were made available to the participants for the verification of the authenticity of the information. For ethical reasons, the names of the school and the learners were translated into codes.



3.11 Conclusion

This chapter presented the methodology and research instruments used for data collection. The following chapter discussed the findings of the research corresponding to the research questions.

CHAPTER 4

FINDINGS AND DISCUSSION

4.1 Introduction

In the previous chapter, the researcher looked into the methodology and all the steps that will be followed in conducting the research. All the approaches and steps that will be followed in conducting the research, research design, case study, sampling, focus group interviews, reliability and validity, piloting and ethics. In this chapter, the researcher will be looking at the results responding to the research sub-questions.

4.2 How were the lessons on static electricity in IsiXhosa and English implemented?

4.2.1 Example of one lesson using isiXhosa as the medium to teach static electricity.

Introduction of lesson

The lesson was introduced to the learners by a question and answer method. The educator asked whether they know the sources of lightning. From the learners' responses, the researcher could see that they knew what lightning was, but the sources of it were more interesting. They expressed that witchcraft was one of the sources of lightning strikes and others associated lightning to the ancestors being angry. The researcher had to control the lesson because it was losing trend as this topic was a very thorny issue in this area and everybody got excited and wanted to contribute. In one of the learners' responses witchcraft came out, so the researcher had to explain what witchcraft is. Some of the learners you could see from their faces that they were afraid of witches. This might be coming from the bad stories they heard about witches. The researcher explained that witchcraft is an act of ugly socially improper traditional practices in the Xhosa society. It is commonly practised by people called amagqwirha (the witches) who are believed to have contact with nasty powers and can take the form of causing misfortune and death through poisoning, directing lightning and the use of mythology such as the belief about the lightning bird

'impundulu'. According to the Xhosa people, the lightning bird known as impundulu is about the size of a man, white or black in colour with a large hooked beak, long legs and red feet. Impundulu is frequently employed by witches as it cannot resist a woman and is easily influenced by their cunning tricks. The power of the impundulu is immense. It flaps its wings and thunder roars, it spits and forked lightning flashes. When impundulu strikes, the ground is burnt and here it lays its eggs. These eggs are about the size of a hen's eggs. The egg sets about tunnelling through the ground to the nearest stream or river where it lies in the water. There it swells until it bursts and releases a new, full-grown impundulu. Sometimes the bird likes to show off to the ladies and it dresses in a red and black suit and mingles with beer drinkers. But it is soon discovered as it cannot drink beer. Then it quickly vanishes. A female witch (igqwirha), reputedly inherits this dreaded familiar? such as lightning bird from her mother I got all sorts of responses from learners.

These were few responses learners gave to the question, "What are the causes of lightning?".

For example

Learner 1: '*Wenziwa ngu Thixo kunye neenzululwazi*', directly interpreted into English as '*It is caused by God and scientists*'.

This learner was one of those who were shy in the 'normal science classes' he would sit at back of the classroom and show very little interest in activities in the classroom. But to researcher's surprise, the boy was the first one to even hand in his homework that the researcher gave them a day before.

Learner 2: '*Idaliwe tishala, akukho mntu okwaziyo ukuwenza umbane*', directly interpreted as '*That's impossible to happen, lightning is natural. No one can cause it.*' When the researcher probed further, the learner said that she discussed this topic with her grandmother at home. The granny said that lightning is a natural phenomenon.

Learner 3: '*Umbane ezilalini wenziwa ngamagqwirha kunye namagqirha xa efuna ukubulala omnye umntu olutshaba nabo nee charges in the sky*'. Interpretation into English '*Lightning is caused by charges in the sky but in rural areas lightning is triggered by witches when they want to kill someone who is an enemy to them.*

Learner 4: *'Umbane wenziwa ngu Thixo xa enomsindo.'* Lightning is caused by God when He is angry.

Learner 5: *True lightning is different from witchcraft lightning. True lightning can last up to hours but witchcraft lightning last up to a few minutes.*

Learner 6: *There is no such thing, there is only one person that can cause the lightning is God. Traditional doctors and also human being how can they do such a thing?*

Learner 7: This learner said that one of their neighbours is a witch. When she asks you to do something for her and you refuse, she will 'send lightning to strike you'. The class laughed but you can see that they are a bit afraid of this woman. She described her as an old woman who is 'ugly' and dark in colour. Her eyes are red and she uses a long walking stick to move around as she cannot walk on her own due to age.

Learner 8: said that when it starts to rain, they must cover everything in the house. He believes that when there is any shiny item in the house that is not covered or hid in the cupboard, that object will be hit by lightning. This learner believed that when objects are kept in the dark during a thunderstorm, then they will be safe from lightning strikes. Of course, this lightning is sent by a witch (igqwirha).

The researcher explained that generally, there are few myths associated with lightning. For example,

Myth 1: People believe that rubber tyres or rubber soled shoes protect you from lightning by insulating you from the ground. The researcher explained that this can mislead people to not seek a safe place, or think that some unsafe locations are safe, e.g. convertibles, motorcycles, bicycles, etc.

Myth 2: Metal attracts lightning (cell phones, i-pods, under wire bras, etc.) This is misleading people into thinking wrongly that they are safe outside and thus avoid a safe place, or waste time shedding metal rather than rushing to safety.

Myth 3: Cell phones attract lightning because they are metal; attract lightning because the radio waves ionize the air and create a conducting path; This increases injuries because they are metal touching the skin, which channels more of the lightning current inside the body. The researcher explained that all this can mislead people to think that they are safe outside near thunderstorms if they do not have a cell phone. This can also mislead people that are outside not to use their cell phones to call for a ride when thunderstorms are threatening.

Myth 4: Lightning would not strike if it is not raining or cloudy, this can mislead people to think that they are safe outside when thunderstorms are in the area. About 1/3 of lightning strikes occur outside in the rain. Lightning never strikes the same place twice. This sometimes leads to flawed advice to run to where lightning has just struck, rather than an appropriate safe place;

Myth 5: A person who was just struck by lightning can electrocute you if touched. The researcher explained that this can mislead people to delay or not provide lifesaving first aid.

Myth 6: Lay flat on the ground if lightning is about to happen. This is misleading people to stay outside longer than they should when thunderstorms are in the area.

The researcher further explained that the National Lightning Safety Institute suggests that even though 100% protection against lightning is impossible,

Protective measures that can be followed during a lightning storm

1. Do not go out-of-doors; seek shelters in buildings that are protected against lightning, enclosed metal trains/cars/boats/ships;
2. Avoid places with little or no protection like barns, sheds, tents;
3. Avoid: hilltops, top of buildings, open sports fields, parking lots, swimming pools, wires (fence, electrical appliances, telephone);
4. Do not ride in open boats tractors, bicycles, scooters, etc.

Lightning is a risk and some people still do not take safety measures to alleviate that risk. Previous researches stated that 42% of deaths from lightning are caused by a lack in lightning safety knowledge.

This was a very interesting debate as most of my learners were willing to contribute as they were allowed to speak in isiXhosa. But the majority of them did not associate lightning with charges or friction or attraction. One could sense that these learners really believed the idea of lightning being sent by witches to harm or even kill people. The researcher made sure that the researcher was laughing so as to lessen the tension amongst the learners, because some of them were still afraid. The researcher made sure that he was going to remove this myth of lightning being created and sent to other people by witches in the implementation stage of the lesson.

Implementation of the lesson.

The teacher explained what lightning is. Lightning is defined as a flash of electrical discharge often accompanied by thunder and rain. When storm clouds gather, the wild air turbulence inside them causes a separation of electrical charges. Usually negative charges accumulate in the lower part of the cloud, while positive charges build up in the earth and in the upper part of the cloud. As air is a poor conductor of electricity, the resistance in the air is often overtaken by the attraction of charges resulting in lightning. It happens when these opposite charges become strong enough to bridge the gap separating them. The most frequent lightning flashes occur within the atmosphere in the form of cloud-to-cloud flashes but the most destructive are the cloud-to-ground flashes. That is why when our houses are insulated, the insulators are directed towards the ground or dug into the ground. It has been said that the average flash has enough energy to keep a 100 Watts light bulb lit for three months. The flash of light heats the air around it to nearly 28 000°C, which is hotter than the surface of the sun. This scorching heat forces the air to expand in an explosion of thunder (Blumenthal, 2005). By this explanation the researcher was trying to show them that lightning is another form of electrostatics. The charges there are static, they are not moving. This is the reason why this type of electricity cannot be used in the households.

The researcher started by taking out a 30 cm ruler and some pieces of papers. A piece of paper was cut into very small pieces so for the ruler to be able to attract them. The researcher brought the ruler to the pieces of paper but nothing happened. The researcher rubbed one side of the ruler with a piece of cloth and it started to pick up the pieces of paper. Some learners were told to rub the ruler on their hair. The researcher wanted them to observe and give an explanation of what is happening and why. The general answer the researcher got was that the pieces of paper are being attracted to the ruler. This was the response of the learners, 'Sir, the pieces of paper are being attracted to the ruler'.

They struggled but the researcher ended up explaining what was happening. The researcher further opened a lab tap, as the water was oozing lightly from the tap, I brought closer a charged ruler. The water started to bend towards the ruler. This was a fascinating experiment. My learners were so excited and they all looked so amazed. The researcher allowed them an opportunity to try it on their own. This meant that the

charged ruler attracted the water molecules also. When the ruler was rubbed it gained some charge. This made the ruler to attract the neutral and oppositely charged pieces of paper. When the ruler gained some charges it became electrically charged. This led to the definition of electrostatics. Electrostatics is the study of stationary charges or fields as opposed to electric current. It is sometimes referred to as the study of forces between charges. The researcher then introduced the term 'charges'. Positive charges always attract negative charges. Simplified as 'opposites attract'. This was further explained by the researcher that one lost an electron and the other one gained an electron. This brought the negative and positive charges attracting each other.

Conclusion of the lesson

In conclusion the learners were given the difference between a charged object and a neutral object. The definition of electrostatics was given.

The Researcher's perception of the lesson

As the researcher was introducing the lesson, he felt like starting with asking the learners whether they know anything about lightning and lightning strikes. The reason for asking this question was to drive the lesson towards establishing whether the learners still remember the terms, like charges, unlike charges, attraction and repulsion, as these were taught in the GET band. But to the researcher's surprise the lesson ended up discussing witchcraft and lightning bird and how it attacks people and kill them. When the researcher looked deeper into details of the lightning strikes he was shocked to find out that learners associated lightning strikes with witchcraft. This almost derailed the researcher's lesson, as this was a thorny issue in the villages where these learners stay. The researcher allowed this discussion to go on so as to remove myths that were associated with lightning strikes and witchcraft. This part of the lesson took more than 20 minutes even though the researcher planned it to take plus minus 5 minutes. This discussion was to an extent fruitful as the researcher noticed that even the shy and the reserved learners were happily and confidently participating in the discussion as we were using the mother-tongue. The researcher was somehow forced to go deeper into explaining the lightning bird in detail. Out of the discussion the researcher noticed that learners possessed a lot of prior everyday scientific and non-

scientific knowledge and the experience about lightning that they acquired outside the school. The researcher also noticed that engaging learners in their cultural beliefs and experiences enhances participation and facilitating learner's understanding of the natural phenomenon of lightning.

4.4.2 Example of one lesson using English as the medium of instruction

Introduction of the lesson

The researcher asked the same questions that were asked in the class that was learning in isiXhosa. The first question was whether they know anything about lightning. The learners were asked questions relating to the lightning strikes that are frequent in their area. This group also knew about lightning but when the researcher asked about sources of lightning, nobody actually knew. The researcher didn't know whether it was the language or they really did not know. The lesson was interesting but the researcher did not get the enthusiasm that the researcher got from that group that was taught in isiXhosa. None of the learners associated lightning with charges or friction or attraction. The ability of the learners in this group to speak English might be a factor that made them not to participate enthusiastically and actively in this lesson. They might know 'impundulu' in their language, but they do not know the English term for it. They could not ask questions and argue. They just took what they got from me as an educator without questioning it. This limitation made them not to put forward their cultural views in a comprehensive manner. This could mean that the learners' poor English proficiency lowers their level of understanding and knowledge construction.

Implementation of the lesson

The teacher explained what lightning is. Lightning is defined as a flash of electrical discharge often accompanied by thunder and rain. When storm clouds gather, the wild air turbulence inside them causes a separation of electrical charges. Usually negative charges accumulate in the lower part of the cloud, while positive charges build up in the earth and in the upper part of the cloud. As air is a poor conductor of electricity, the resistance in the air is often overtaken by the attraction of charges resulting in lightning. It happens when these opposite charges become strong enough to bridge the gap

separating them. The most frequent lightning flashes occur within the atmosphere in the form of cloud-to-cloud flashes but the most destructive are the cloud-to-ground flashes. That is why when our houses are insulated, the insulators are directed towards the ground or dug into the ground. It has been said that the average flash has enough energy to keep a 100 Watts light bulb lit for three months. The flash of light heats the air around it to nearly 28 000°C, which is hotter than the surface of the sun. This scorching heat forces the air to expand in an explosion of thunder (Blumenthal, 2005). By this explanation the researcher was trying to show them that lightning is another form of electrostatics. The charges there are static, they are not moving. This is the reason why this type of electricity cannot be used in the households.

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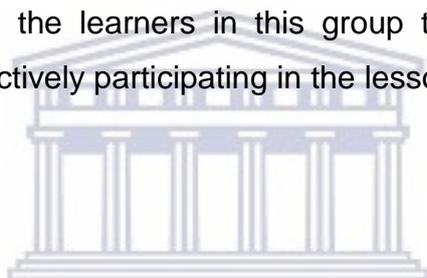
explained by the researcher that one lost an electron and the other one gained an electron. This brought the negative and positive charges attracting each other.

Conclusion of the lesson

In conclusion the learners were given the difference between a charged object and a neutral object. The definition of electrostatics was given.

The Researcher's perception of the lesson

The lesson introduction followed the same trend as those who were taught in isiXhosa, but the discussions were short and not much questions were posed to the researcher by the learners. But they had the same understanding of the lightning bird and witchcraft. The ability of the learners in this group to speak English might have contributed to them not actively participating in the lesson.



4.3 What were learners' understanding of static electricity after the lessons in English and IsiXhosa respectively?

After the series of four lessons for the topic on electrostatics were completed learners were given a standardised test to determine their understanding of the content. The test was formalized as the question paper was moderated by the Head of Science department in my school. Learners were given an hour to write the test being supervised by an invigilator. The scripts were moderated after they marked. The standards were not dropped in terms of the credibility of the examinations and the scores after the test was written.

In the previous grade the achievement of these learners all ranged between 10 and 30% in a control test that dealt with this particular topic. The teacher in Grade 9 indicated that she had great difficulty getting learners to understand what static electricity was and indicated that these learners were not interested in this topic.

4.3.1 Learners achievement in the standardized test after the implementation of the lessons in IsiXhosa.

The learners all wrote the standardized test (see Appendix C) set for this topic. The test was conducted in IsiXhosa. Table 3 and Figure 1 represent the achievement of the learners in the test.

Table 3. Learners' achievement taught in IsiXhosa

Learner	Score
1.	48
2.	70
3.	38
4.	52
5.	74
6.	10
7.	10
8.	50
9.	34
10.	34
11.	32
12.	74
13.	46
14.	74
15.	42

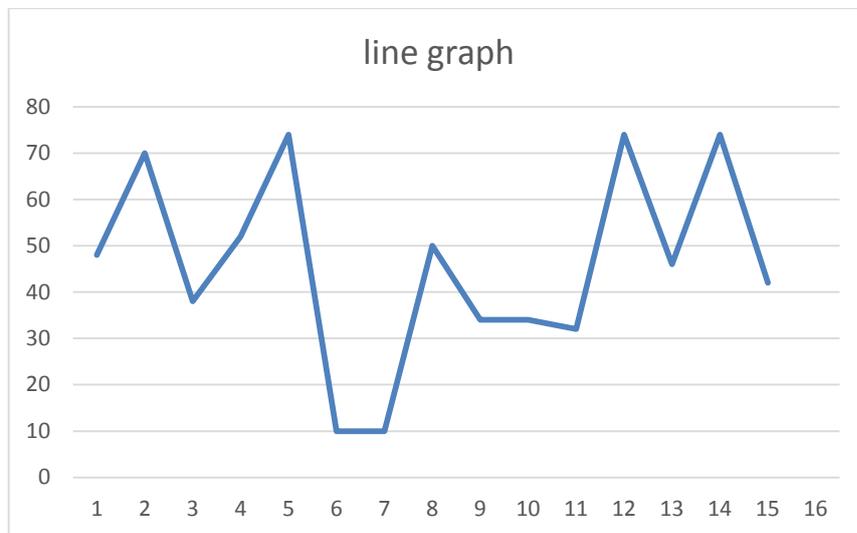


Figure 1. Line graph for learners' achievement taught in IsiXhosa

Learner 5, 12 and 14 scored level 6 (74% each). They were seated in different corners in the classroom, hence it was not possible that they could have copied. The invigilator was also there, to prevent copying. They usually scored around 30% in the other tests during the course of the year. They showed a tremendous improvement in their scores. These are the learners who were very vocal and participated a lot in my lesson in the classroom. They are shy learners by nature but on that day they were very vocal and they were very active. These scripts were marked and presented to the head of science department at my school for moderation. Figure 1 is a line graph that shows the performance of the learners who were taught static electricity in isiXhosa. It shows that learner number 2 got 70%. In terms of levels, this learner obtained level 6. This is one of the top learners in the school. She always gets level 7. Level 7 is 80% and above. Learner 5, 12 and 14 got 74%. These are the learners who were getting around 30%, but their performance has improved greatly. The majority of learners scored around 43%. Meaning that the average mark the learners got (43%) is well above the passing mark, which is 30%.

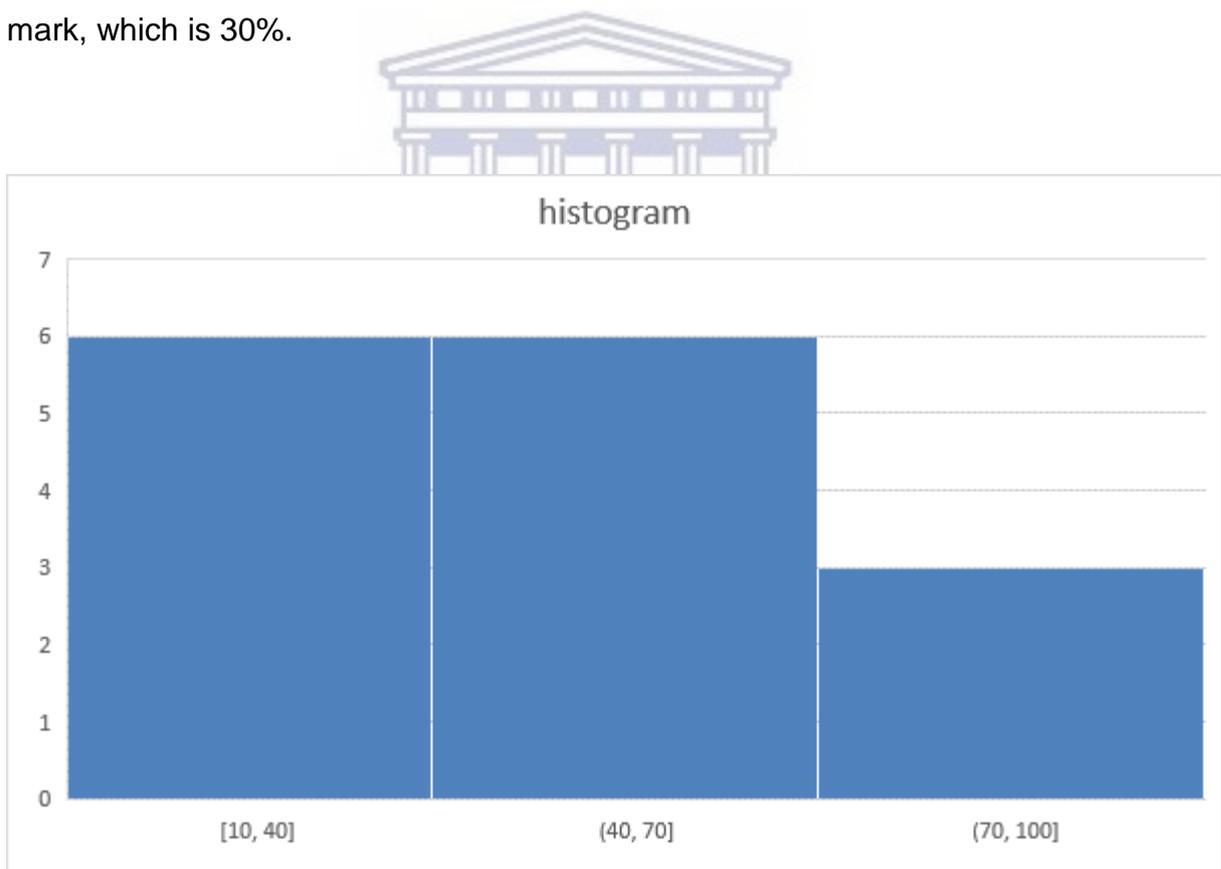


Figure 2. Histogram of achievement of learners taught in isiXhosa

The histogram shows the distribution of marks in ranges between [10, 40], [40-70] and [70-100]. The graph is skewed towards the left, meaning that the majority of learners got less than 70%. There were 5 learners who scored in the range of [10, 40], 6

learners who scored in the range [40, 70] and 4 learners in the range [70, 100]. This illustrates that the learners have understood the lesson. Even though there were no learners who scored 80% and above.

4.3.2 Learners achievement in the standardized test after the implementation of the lessons in English.

The learners all wrote the standardized test (see Appendix C) set for this topic. The test was conducted in English. Table 4 and Figure 3 represent the achievement of the learners in the test.

Table 4. Learners' achievement taught in English

Learners	Scores
1.	24
2.	10
3.	10
4.	6
5.	4
6.	18
7.	20
8.	20
9.	26
10.	26
11.	40
12.	30
13.	24
14.	28
15.	24

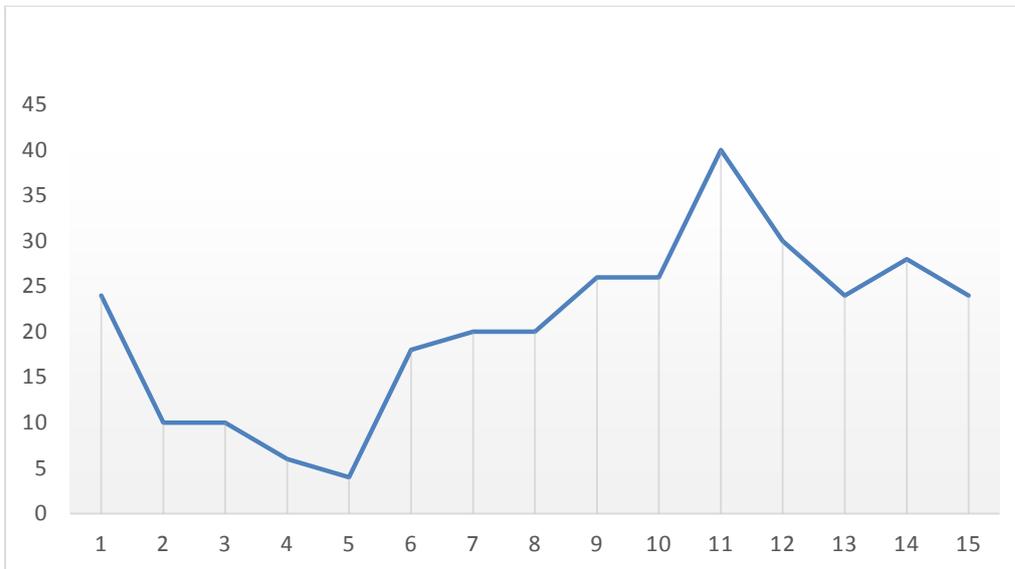


Figure 3. Line graph for learners' achievement taught in English

Figure 3 line is a graph of learners marks versus the learner numbers. Learner number 1 scored 24% in the test. The learner who scored the highest mark is learner number 11. The highest mark is 40%. This group's average percent was 21%. The average mark was pulled down by learner number 4 and 6 who got less than 10% in the test. Learner number 11 and learner 12 managed to get a pass. Their performance was not wonderful or impressive as no learner in this group got level 6 or higher. These marks the learners got are the true reflection of the performance. Learner number 5 scored less than 4%. The learner attended all my classes for this research. As I was teaching, I kept on asking whether they understand or not. All of them will always say 'yes Sir, we do understand'. The results the learner got really surprised me. Learner 4 scored 6%.

Table 5 and Figure 4 shows the frequency of learners' achievements in the test. It looked how learners fared within certain ranges. The class that was taught in isiXhosa had a fair distribution of scores in all the class levels. There were two learners who had marks below 10%. The majority of the learners achieved between 30% and 50% while 5 learners achieved in the higher ranges. This demonstrated a good achievement for learners from this school that generally achieve in the lower ranges for this topic. This showed that they had a slightly better understanding of the content compared to their previous year's achievement. This is demonstrated by the fact that; they were arguing

in corridors after the lesson. They understood the lesson even though there was a lot of activity that was happening in the classroom as the researcher was teaching. Learners were so excited by the experience of being taught in their own language.

Table 5: Frequency table learners' achievements

CLASS IN %	isiXhosa	ENGLISH
0 – 10	2	5
11 – 20	0	3
21 – 30	0	7
31 – 40	4	0
41 – 50	4	0
51 – 60	1	0
61 – 70	1	0
71 - 80	3	0
81 – 100	0	0

The achievement of learners taught in English remained in the 10-30 % range as demonstrated by their Grade 9 results for this topic. This is also in keeping with the understanding of the Grade 9 teacher who indicated that learners from this class never wanted to participate in the science lessons and refused to deviate from their own understanding when dealing with the topic of electrostatics.

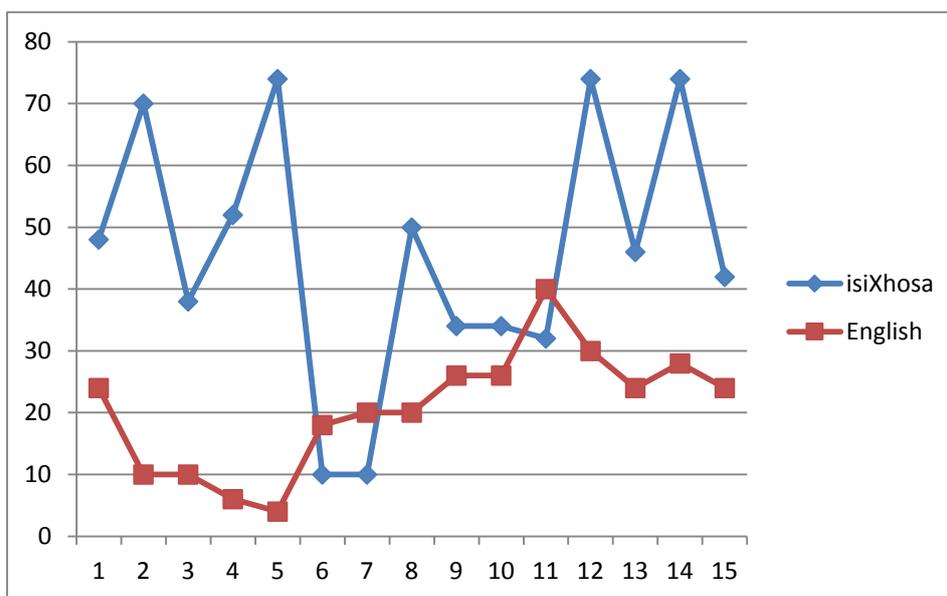


Figure 4: Trend line graph of isiXhosa versus English

Figure 4 clearly shows the difference in achievement of learners. The red line represents the learners' scores who were taught in English. This line is generally below the blue line which represents the learners' scores who were taught in isiXhosa. Reading from the graph, there were only 5 learners who were taught in isiXhosa who achieved less than those who were taught in English. On average the learners who were taught in English achieved almost exactly what they used to get when they were taught in English which means there was no change in their performance. The reason for them to perform poorly might be the fact that they are used to be taught in English, so there was nothing special for them. As the researcher who was teaching the learners, he taught them in the same way he used to teach them, he did not change his teaching style.

Figure 4 made it clear that the level of achievement of learners being taught in their mother-tongue was higher than the achievement of learners who were taught in English.

4.4 What were learners' perceptions of the lessons in English and isiXhosa?

4.4.1 Focus group interviews

Learners were interviewed as the two focus groups to obtain their perceptions of the lesson implementation. The interview schedule used is found in Appendix B.

'Why did you chose physical sciences as a subject. 'In response to this question, many learners pointed out that they chose Physical Sciences because they wanted to be doctors, technicians, engineers, pilots and a small group wanted to be nurses and researchers. This choice of subjects (Physical Sciences and Mathematics) was associated with their dream careers.

'I chose Physical Sciences as a subject, Sir, because I wanted to be a doctor'. [Learner 1, Group 1]

This really shows that these learners are career oriented in whatever they do, irrespective of their ability and capability in the subject. The researcher was surprised by this answer because in community where they come from, there are no doctors who are from that community. This might have motivated this learner to want to be the first doctor from this area. One boy from this group said that the science subjects are key in solving the skills shortage in South Africa. The researcher was a bit surprised by the maturity the learner displayed in the current events that are taking place in South Africa. When the researcher probed further and said he must explain what he meant by that, he responded by saying that from the aviation program he attended in Pretoria a month ago, one of the facilitators mentioned the skills shortage in the following sections, aviation, the army and the navy.

In response to question of their perceptions of lessons on electrostatics, the response to the classes taught in English were that previously the teachers mainly took the meaning or definition of terms straight from the textbook and explain them as they are, without making learners to understand them in their mother-tongue. This made them to be less interested in Physical sciences. That is why they were bunking some science periods.

Teachers just read the terms and stuff from the textbook. No explanations.
[Learner 2, Group 2]

Physics is not interesting because I don't understand what these things are.
It's like it is deliberately not for us [Learner 3, Group 2]

These concepts are strange to me that's why I don't attend some classes.
[Learner 4, Group 2]

The group that was taught in English complained about the understanding of the terms first, let alone writing what they've learnt. They had to understand the language first before understanding the content. They were struggling with writing what they have learnt.

The terms are really difficult to get to know about. Then we have to write it but I don't know what it means. [Learner 2, Group 2]

Yes the things about writing it is that you are writing something that you don't understand. How are we supposed to study something that we don't understand? [Learner 7, Group 2]

One boy said that if he has a problem with understanding the language, then he should take more time to understand what is being taught.

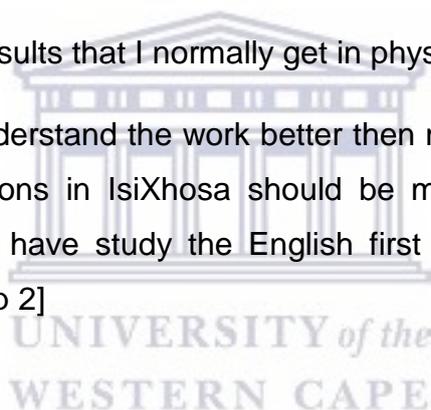
I have look up what it means first in a dictionary or in the textbook. Then I try to write about it what I understand from there. [Learner 19, Group 2].

The teacher reads the definition of a term straight from the textbook, really science is boring. [Learner 1, Group 2]

Many of the students in this group indicated that the marks that they achieved were what they normally get in the tests and that is what they expect to get in the examination as well.

I got the same results that I normally get in physics. [Learner 11, Group 2]

If I can get to understand the work better then maybe I can get better marks. Maybe explanations in IsiXhosa should be more used instead of English because we not have study the English first and then study the Physics. [Learner 5, Group 2]



The group that was taught in isiXhosa were upfront when it came to the question of understanding electrostatics, they said that they were able to relate to static electricity, like witchcraft and the myths that were associated with lightning. They did not struggle with understanding the content.

When the static electricity is taught in isiXhosa, I am able to understand the lesson quicker and when I don't understand, I am able to ask the question confidently, without the fear of 'breaking' English. [Learner 1, Group 1]

Because the lesson was given in IsiXhosa and I could connect it to my own understanding as we know it in the village, and electrostatics as we understand it. [Learner 2, Group 1]

This was really good to have these lessons so that we can talk and ask questions in IsiXhosa. [Learner 3, Group 1]

The group that was taught in isiXhosa responded by indicating that if it can be taught in their mother-tongue, then it was a little bit interesting and therefore they would like static electricity to be taught in isiXhosa.

I get more interested because I can talk about it clearly. I got to know that I know about static electricity outside of the science classroom and the school. [Learner 5, Group 1]

As the researcher probed further, they showed quite an interest in static electricity because now they were free to ask questions and discuss those questions amongst themselves. The class became vibrant and to a lesser extent chaotic.

Static electricity is part of lightning which we experienced almost every day. [Learner 12, Group 1]

They also showed interest now on the precautions that were needed to be taken when there is lightning. On the roofs of the huts in the villages, they will put an old car tyre to protect the hut against lightning. When the researcher further probed about the tyres on the roof of the huts, learners did not know the reasoning behind it.

Yes we have a car tyre on our roofs. I don't know why that is there but almost all the huts in the village has this. [Learner 7, Group 1]

The tyre is rubber and so I always thought the lightning bounces off it. At least that's the explanation I came up with. [Learner 9, Group 1]

We were always told not to be under a tree or to cover the mirror. I never knew why but I always thought it was about witchcraft. [Learner 8, Group 1]

This probing made them to understand that rubber is a good insulator. Most of the respondents were keen to be taught static electricity in isiXhosa.

I enjoyed the lesson where I could speak my mind in IsiXhosa and not have to search for the words in English. [Learner 13, Group 1]

Learning in IsiXhosa improved my understanding of the topic. I could relate to it and understand it and talk about it. [Learner 14, Group 1]

If we can get all our lessons in IsiXhosa and write our tests in IsiXhosa this would help me and I can get better marks. [Learner 7, Group 1]

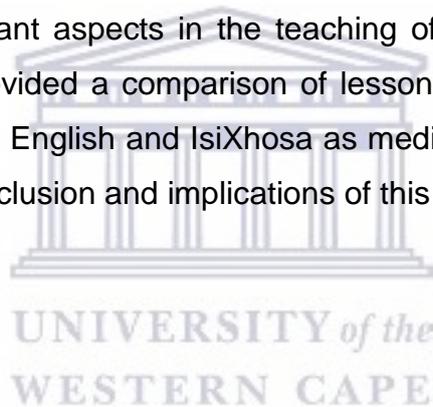
However, one girl who indicated that she wanted to be studying through English.

I don't see myself as a doctor who will be labelled as a doctor who studied in isiXhosa. [Learner 4, Group 1]

The whole group burst into laughter, but the researcher reminded them that in most European countries learning takes place in their mother-tongue and these countries are well ahead of South Africa when it comes to technology.

4.5 Conclusion

This chapter provided the findings in response to the research questions and highlighted some important aspects in the teaching of a contentious topic such as electrostatics. It also provided a comparison of lessons implementation and learner achievement when using English and IsiXhosa as media of instruction. The following chapter provides the conclusion and implications of this study.



Chapter 5

Conclusion

5.1 Introduction

In the previous chapter the findings were discussed in detail. The participation and contribution of learners in the lesson was observed, as those who were taught in isiXhosa were most active as compared to those who were taught in English. In this chapter the researcher will be looking at the overview of the scope of the study, literature review, findings, discussions major findings of the study, implications of the study and the limitations of the study.

5.2 Overview of the scope of the study

5.2.1 Introduction

Chapter One provided the background and context of the study. It highlighted the research problem, the research questions to be answered, significance and the limitations of the study. This study focusses on the use of isiXhosa and English in the teaching of static electricity in a grade 10 sciences class. The research is concentrated in a rural school in Queenstown district.

5.2.2 Literature review

Chapter 2 presented social constructivism as the theoretical framework that this study is grounded on. (Vygotsky, 1978). This theoretical framework emphasizes the importance of culture and environment in the process of learning. This is evident as the learners understood static electricity in context of lightning strikes being associated with witchcraft. In this group of participants, witchcraft is rife in their communities. The basis of social constructivism assumes that reality is constructed through interactions with others and with the environment. Learning is more meaningful when the learner is socially engaged.

5.2.3 Methodology

In this chapter the researcher looked at research design, case study sampling, methodological framework, reliability, validity and ethics in detail. The researcher also looked at the approach that underpins this study. In methodology, the researcher described the procedures that were to be followed in order to generate and collect the necessary data to answer the research questions. All the methods of collecting data, methodology adopted and the analysis used were discussed in the chapter sections.

5.2.4. Findings and Discussion

Chapter 4 presented the findings of the research and provided a discussion of the data collected.

5.2.5 Conclusion

This chapter provides a summary of the research and draws conclusion and implications of the study.



5.3. Major findings of the study

Learners who were taught in isiXhosa performed better than the learners who were taught in English. Even those learners who were shy and did not contribute in classroom, were participating and were very active in class. The learners who were taught in isiXhosa performed better in the study of static electricity. The researcher found out that engaging learners in their cultural beliefs and experiences enhances participation and facilitating learners' understanding of the natural phenomenon of lightning. They were contributing actively in lesson as they were allowed to interact in their mother- tongue. These learners were able to bring forth their background and myths. This was shown by the participants' responses when they were asked about lightning strikes. They also projected their enthusiasm in their results, as they performed better than those learners who were taught in English.

The researcher introduced the lesson in isiXhosa by asking whether learners know anything about lightning and lightning strikes. The aim of this question was to establish whether the learners know anything about the terms: charges, like charges, unlike charges, attraction and repulsion as these terms were taught in the GET band. This ended up being a discussion about lightning bird and witchcraft. The researchers ended up removing all the myths they had about lightning and lightning bird.

The introduction of the lesson in English was done in the same as in isiXhosa, but everything was done in English. The discussion was short and not many questions were asked to the researcher by the learners. They had the same understanding of the lightning bird and witchcraft.

5.4. Implications of the study.

This study could open doors for learners who want to learn sciences in their mother-tongue. Creativity of the learners is enhanced and the learners are motivated to explore. This curiosity will help them to venture into the habit of creating and discovering of things. Science should be more about discovery.

The study has implications for the department of education. The department should take note of this study, by making sure that space is created for learners who want to study in their mother-tongue, which is, isiXhosa, in this instance. Textbooks should be written in isiXhosa and distributed to schools. The fact that all the sciences textbooks are written in English. It is not easy to translate English to isiXhosa. One word in isiXhosa can mean more than thing at a time. For example, `umbane` means electricity at the same time it means lightning. The learners were never taught and assessed in isiXhosa before.

This study also has implications for fellow science teachers who are struggling with teaching science in the English medium only as many learners fail not due to their limited knowledge but that they are unable to explain fully what they mean in the English language.

The researcher found out that engaging learners in their cultural beliefs and experiences enhances participation and facilitating learners' understanding of the

natural phenomenon of lightning. This one of the major themes that the researcher identified.

The study also provides baseline data for future research that investigates the use of mother tongue in science classrooms.

5.5. Limitations of the study

The study was conducted in one school and the research data obtained in this case study cannot be generalised.

5.6. Recommendations

I strongly recommend that future researchers should explore more research on the influence of language on learning and teaching and especially on the application of mother-tongue instruction to understand very challenging subjects like Physical science.

Future studies should take larger samples and do a longitudinal study on the impact of mother-tongue instruction from the lower to the higher grades.

5.7 Conclusion

This study compared the teaching and learning of static electricity when taught in English and IsiXhosa respectively. The results show that learners do much better in standardised tests when taught in their mother-tongue.

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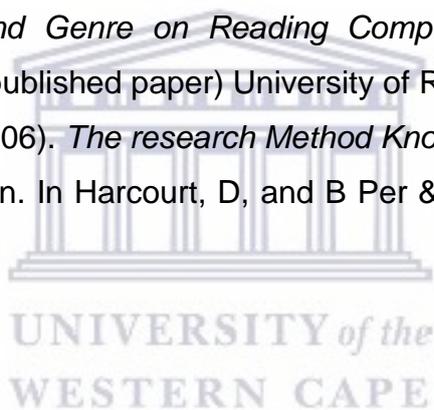
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APPENDIX A

LESSON PLAN 1

Subject: Physical sciences Level 3 Lesson Plan: Electrostatics Number of activities 2 Duration: 55 min			
Context: LIGHTNING			
Prior knowledge: MAGNETISM AND MAGNETIC FIELDS			
Aim: learners must be able to define electrostatics, be able to differentiate between positive and negative charge, polarization.			
LTSM: Magazine picture, Worksheet, Textbook.			
Activity content	Activity 1	Activity 2	Activity 3
Detail of activity	<p>I will start by trying to find out their previous knowledge. A few questions will be asked on Magnetism and magnetic fields. If there some gaps in their knowledge of magnetism and magnetic fields, they will be dealt with before the term electrostatics</p> <p>Educator will explain the meaning of electrostatics</p>	<p>Demonstration Charging by contact</p>	
Teaching method		<p>Demonstration, Q+A Discussion</p>	
Assessment strategies		<p>Worksheet, classwork, memo</p>	

Expanded opportunities		Homework	
Misconceptions			
Researcher reflection	(Researcher will reflect after the lesson has been completed.)	(Researcher will reflect after the lesson has been completed.)	



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APPENDIX B

Focus group interview schedule

Name of school.....

Interviewer.....

Date.....

1. Why did you choose Physical Sciences as a subject?

.....
.....

2. What skills do you need to have to learn static electricity through English? Give reasons for your answer

.....
.....

3. What do you like about learning Static electricity through the medium of English/isiXhosa?

.....
.....

4. As you are taught static electricity through the medium of English/ isiXhosa, what did you like about that?

.....

5. Would you prefer to write your static electricity examination or tests in isiXhosa or English? Explain.

.....
.....

6. In what ways would your performance improve if you were taught in your home language?

.....
.....

.....
.....

7. What do you find challenging in the Physical science class when taught static electricity in isiXhosa / English?

.....
.....

8. What support did you get in solving those problems in the classroom?

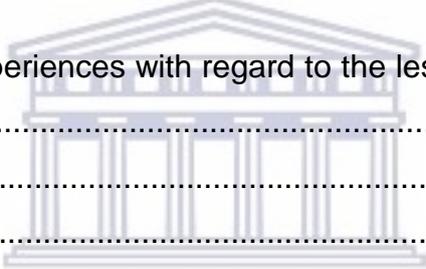
.....
.....
.....

9. What support did you receive in your static electricity class?

.....
.....
.....

10. What are your experiences with regard to the lesson that is taught in English / isiXhosa?.....

.....
.....



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THANK YOU FOR YOUR TIME AND CO-OPERATION

APPENDIX C

1. Controlled test

Question 1

Explain what is meant by:

- 1.1. Electric field
- 1.2. Electric field line
- 1.3. Test charge

Question 2

Draw the following electric field diagrams:

- 2.1 surrounding a negative point
- 2.2 surrounding two negative point charges
- 2.3 surrounding two unlike point charges (negative charge on the left)
- 2.4 Between two oppositely charged plates with upper plate being negatively charged.

Question 3

How do you decide the direction of the electrostatic force on a negative charge placed?

- 3.1. on the field line?
- 3.2. Between two field lines?

Question 4

- 4.1. Name a disadvantage of an electric field diagram drawn on a piece of paper compared with an actual field.
- 4.2. How can you immediately see on an electric field diagram where the electric field is weakest?

Question 5

- 5.1. What is meant by the description *uniform field*?

5.2. Describe how to set up a uniform electric field.

5.3. Explain whether the acceleration of a charged object in a uniform field will also be uniform.



APPENDIX D

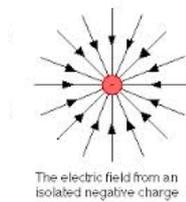
Memorandum

Question 1

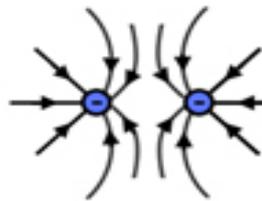
- 1.1. An electric field is a region of space in which an electric charge experiences a force
- 1.2. Electric field lines are a way of representing an electric field.
- 1.3. A test charge is a small charge that is used to test or measure the magnitude and direction of the force in an electric field.

Question 2

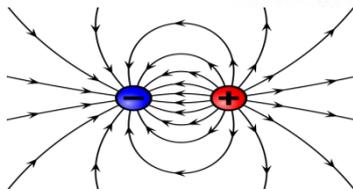
2.1.



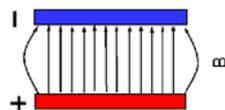
2.2



2.3



2.4.



Question 3

3.1. The direction of the force is opposite to the direction of the field line (or the tangent to the field line)

3.2. You decide on the direction by comparing the directions of the two nearby field lines

Question 4

4.1. An electric field diagram on a piece of paper in two dimensions whereas in reality it is in three dimensions.

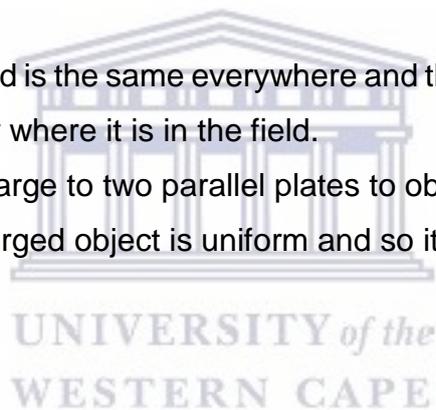
4.2. The electric field is weakest where the field lines are further apart.

Question 5

5.1. A uniform electric field is the same everywhere and the force on a particular charge is the same no matter where it is in the field.

5.2. Give an opposite charge to two parallel plates to obtain a uniform field.

5.3. The force on the charged object is uniform and so its acceleration is $a = F/m$



50 Marks

APPENDIX E

1. Letter to the university

P.O. Box 835

Queenstown

5319

10 April 2015

The Chairperson-Ethics committee

University of Western Cape

Bellville

7493

Dear Sir /Madam

Re: Permission to conduct research



I, Monwabisi Diko, a post graduate student at the University of the Western Cape, hereby request permission to interview and conduct a research to grade 10 learners in one school in the Queenstown district on the comparative use of isiXhosa and English as the medium of instruction.

The identities of the participating school and the learners will remain private while the findings of the study will be disseminated to the management of the school in the Eastern Cape. In no way will the Eastern Cape department or its institutions be prejudiced or slandered.

I hope that my request meets with approval your and that I will receive the necessary approval to conduct my research.

Yours in Education

M, Diko.....

APPENDIX F

Letter to the department of education (Eastern Cape)

P.O Box 835

Queenstown

5319

10 April 2015

Department of Education Eastern Cape

Queenstown

5320

Dear Sir/Madam

Re: Permission to carry out a research project at your school

As the above matter refers, I do hereby seek your permission to carry out a research at Kwa-Komani Comprehensive School. I am a student at the University of Western Cape studying MEd in science education. The research I intend to carry out is one of the partial requirements to fulfil the degree. The study seeks to investigate a comparative study of the use of isiXhosa and English as a medium of instruction in a science class

I do, hereby, guarantee that discreet of names and confidentiality will be adhered to. In the event that you approve my application, I will also apply to the principal of the school, the School Governing Body and the learners of my intentions.

I am looking forward to your considerable response.

Yours Sincerely

Diko, M

073 194 5386

monwabisidiko@gmail.com

APPENDIX G

3. Permission Letter to Principal

P.O. Box 835

Queenstown

5319

10 April 2015

Principal of Kwa-Komani Comprehensive School

Private bag x 303

Queenstown

5319

Dear Sir

Re: Permission to conduct research

I, Monwabisi Diko, hereby request permission to conduct a research in your school.

I am a student at the University of Western Cape studying M.Ed in science education. The research I wish to carry out is a requirement to fulfil the degree. The objective of the study is to compare the achievement of science learners who are taught science in isiXhosa and English as the medium of instruction

I pledge and promise not to disrupt any programs of the department and the school. I will use the time I get with the learners, while I conduct the study, to benefit the learners and the school. I will work within the framework of the school' and department's disciplinary arrangements.

I have also written a letter to the Education Head Office in this regard.

Yours in Education

M. Diko

073 194 5386

monwabisidiko@gmail.com

3081391@uwc.ac.z

APPENDIX H

1. Learner's parent

P.O BOX 835
QUEENSTOWN
5319
10 April 2015

Dear Sir/Madam

Re: Permission to conduct research

I, Monwabisi Diko, hereby request permission to involve your child in a research I am conducting in his/her class.

I am a student at the University of Western Cape studying M.Ed in science education. The research I wish to carry out is a requirement to fulfil the degree. The objective of the study is to compare the achievement of learners in science when taught in isiXhosa and English as the medium of instruction.

I pledge and promise not to disrupt any learning time of your child. I will use the time I get with the learners, while I conduct the study, to benefit the learners and the school. I will work within the framework of the school' and department's disciplinary arrangements.

I have also written a letter to the Education Head Office in this regard.

Yours in Education

M. Diko

073 194 5386

monwabisidiko@gmail.com

3081391@uwc.ac.za

APPENDIX I

2. University consent form

UNIVERSITY OF WESTERN CAPE

FACULTY OF EDUCATION

CONSENT FORM

NOTE: This consent form is to be retained by the parent of the learner and the school principal and kept in a secure location. The student may be required to present the original copy to the University of the Western Cape Ethics Committee as evidence that consent has been granted to conduct research at your school.

I, _____, hereby give permission for Monwabisi Diko (studying M.Ed in science education) who is a student of the University of the Western Cape and is involved in the planning and implementation of this research project permission to use the material which has been obtained during the course of the research.

I understand that the above research project has been explained and specified and those involved intend to share the research in the form of publications.

I also understand that:

- My participation is a personal decision and entirely voluntary.
- There are no rewards for granting permission.
- I will not be penalised for granting permission.
- I have the right to withdraw my permission at a later stage.
- The content obtained through the interview and questionnaire will only be used for the purpose of this research project.
- My own identity shall remain anonymous.

My signature below indicates my permission to use the material for research.

Signature _____

Date _____