

**AN INVESTIGATION INTO THE FACTORS ASSOCIATED WITH HIGH  
SCHOOL LEARNERS' POOR PERFORMANCE IN PHYSICAL SCIENCE IN  
THE LIBODE DISTRICT IN THE EASTERN CAPE**

by

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Submitted in accordance with the requirements for  
the degree of

**MASTER OF EDUCATION – WITH SPECIALISATION IN NATURAL SCIENCE  
EDUCATION**

at the

UNIVERSITY OF SOUTH AFRICA

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November 2016

## Declaration

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I, SIBANDA ISHMAEL, solemnly declare that this dissertation is entitled: **An investigation into the factors associated with high school learners' poor performance in physical science in the Libode District in the Eastern Cape** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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Signature

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Date

## **Abstract**

The aim of the study was to investigate the factors associated with high school learners' poor performance in physical science in the Libode District in the Eastern Cape. The research also meant to answer the following research objectives on factors associated with high school learners' poor performance in physical science. The first research objective was based on determining the school related factors that cause poor performance in physical science in the Libode District, while the second research objective was based on determining the home related factors that caused poor performance in physical science in the Libode district. The third research objective was based on ascertaining the skills and competencies of both physical science educators and physical science learners to improve performance while the fourth objective was based on suggesting strategies that could improve performance of both the physical science learners and educators. Research objectives three and four were addressed as recommendation.

The study employed a qualitative as well as a quantitative approach. Six public high schools in the Libode District participated in this study. The identities of all the respondents were protected accordingly. Upon analysis of the results, several school related and home related factors respectively were identified as causing poor performance in physical science. No single factor was accountable for the poor performance in physical science. Recommendations for improvement in the areas identified were provided as well as areas for further research.

**Key Words:** Physical science, curriculum, performance, learning, curriculum change.

## **Dedication**

This study is dedicated to my wife, Prudence Sibanda and my three sons Sijabuliso Hilton, Siyabonga and Sibusiso Andile. I also dedicate this study to my late parents Bebi Gibson Sibanda and Idah Sibanda.

## **Acknowledgements**

It is with sincere gratitude that I acknowledge the following:

- Prof CP Loubser who helped me throughout the study. He instilled a sense of purpose in me and motivated me to work hard during the course of the study. Without his support, this dissertation would not have succeeded.
- Mrs Carol Jansen for editing my dissertation. I say thank you very much.
- My brother Bhekimpilo Sibanda for his parental involvement with me.
- My wife Prudence Sibanda, who managed to take great care of our children when I was busy with my studies
- The principals of the schools, physical science educators, learners and parents who took part in the study. Without them, the research was not going to be a success
- The University of South Africa for its financial support
- The Eastern Cape Department of Education for allowing me to conduct my research in their schools.

## **Abbreviations**

CAPS      The Curriculum and Assessment Policy statement

DST        The Department of Science and Technology

FET        Further Education and Training

NCS        The revised National Curriculum Statement

TIMMS     Trends in Mathematics and Science Study

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## **CHAPTER 1: INTRODUCTION AND BACKGROUND**

### **1.1 INTRODUCTION**

Poor performance in science at high school is a cause of great concern both in South Africa and other countries (Fonseca & Conboy 2006:82). Importantly, Mji and Makgato (2006: 254) assert that we live in a world where science and technology have become an integral part of the world's culture, therefore, for any nation to be relevant, it must not overlook the importance of science in its education system. The third International Mathematics and science Study (TIMSS) confirmed that mathematics and science learners' performance in South Africa was poor compared to other countries that participated (Howie 2003:18; Makgato 2007:90-94). This poor performance will affect the country's wealth and development. Muwanga-Zake (2008:56-60) asserts that it is important to address the issue of underperformance in science as the country's wealth and development are dependent on the capacity of the scientific workforce.

The failure rate in science in schools remains extremely high (Modisaotsile 2012:1-3). As a result, the science education systems deliver fewer science graduates at all levels than the global economy requires. This is also in line with the report from the National Academy of science which avers that the fields of science, technology and education hold a paramount place in the world but there are not enough workers in the United States entering science, engineering and mathematics professions.

Ruby (2006:1008) claims that the most common problem linked with learners' poor performance in most undeveloped countries is the shortage of qualified science teachers. This shortage of qualified science teachers led to the lack of thorough preparation for lessons and reduced content coverage (Howie 2003:4-5). In developing countries, such as South Africa, learners do not master the knowledge and skills underlying learning and problem solving (Maree & De Boer, 2003:451-456). Furthermore, disadvantaged learners from seriously disadvantaged learning environments lack informal scientific knowledge (Teese & Lamb 2007:297-299).

Dugmore (2009:16) asserts that most of these learners who perform badly come from historically disadvantaged townships and rural public high schools. This, therefore implies that even though a lot of research has been conducted in South Africa on poor performance of learners in science and mathematics, the underlying reasons for poor performance in science in these historically disadvantaged townships and rural public high schools has not been fully researched. This study is therefore designed to identify and analyse not only the school related factors but also the home related factors that cause poor performance in physical science amongst high school learners in historically disadvantaged public high schools of South Africa with specific reference to the Libode District, Eastern Cape by obtaining information directly from high school physical science educators, parents and learners themselves since they are involved in the teaching and learning of science. It is also intended to suggest ways of improving performance in science and also to inform policymakers and to drive transformation to a scientifically literate society.

## **1.2 BACKGROUND**

Statistics obtained by the Human Research Council indicate that the number of engineers per million of the population in South Africa, which hosted the 2010 World Cup was approximately four hundred and seventy three (473) in comparison with three thousand three hundred and six (3 306) per million of population in Japan when Japan was hosting the cup (Antonia, Charles & Iwu 2014). An analysis of the data shows that the number of scientists and engineers in South Africa is far lower than the number in Japan. This can be attributed to the following reasons:

- The poor performance of learners in physical science at Grade 12 level
- Of the small number of learners that pass physical science, only a few of them will enrol in science related careers

This poor performance in physical science hinders development in South Africa and presents a considerable challenge for South Africa with reference to improving and increasing the number of professionals in science related fields.

Various intervention programmes have been set up to attempt to improve the performance of learners in physical science. These include the Dinaledi programme by the South African national Department of Education and the Bokamoso science Centre in the Eastern Cape. The table below shows the analysis of the physical science results in the Libode District for the year 2011-2014. The number of schools that offer physical sciences is 42.

**Table 1.1: Analysis of physical science results in the Libode District for the year 2011-2014**

Year	Number of learners who wrote	Percentage pass
2011	2561	33,9
2012	2137	42
2013	2270	52
2014	1699	49,8

**Source : Republic of South Africa (Department of Education 2015)**

The above table shows that the percentage pass rate for Libode District was below the national average pass rate for four consecutive years (2011- 2014) Mayatula (2009:1) asserts that any school that has a pass rate below the national average pass rate is called an underperforming school. This is enough evidence to assert that there are some gaps in the teaching and learning of physical science in the Libode District, hence, the need to carry out this study to find a solution for the underperformance in physical science.

### **1.3 THE LIBODE DISTRICT PROFILE**

This section is aimed at establishing basic facts about the Libode District. In order to fully establish these facts, the following was discussed: geographic location, demographic profile, infrastructure and the socio economic status of the District.

### **1.3.1 Geographical location**

The Libode District is located 15 kilometres East of Umtata Town, situated in the Eastern Cape in South Africa. The entire district falls within the former Transkei homeland. The urban population is mainly located in the Libode Township and Ngqeleni. Scattered low-density rural settlements dominate the district and it covers an area of 2,474 square kilometres. Seventy nine percent of the households reside in village settlements and are surrounded by communal grazing and arable lands (Republic of South Africa 2011).

### **1.3.2 Demographic profile**

According to the official statistics documented in the 2011 in the national census, the Libode District is one of the most densely populated rural districts in the Eastern Cape Province with a population of 290 390 people (Republic of South Africa, 2012). About 77 percent of the households can be regarded as indigents with an access to an income of less than eight hundred rands per month. Most of the educational institutions in the Libode District cater for lower level schooling. Out of the four hundred- and- twenty six (426) schools in the Libode District, 64 percent are overcrowded (Republic of South Africa 2012). The spread of HIV/AIDS is an extremely urgent problem in the Libode District. In 2009, the HIV/AIDS prevalence rate was as high as 50 to 60 percent among those tested (Republic of South Africa, 2012).

### **1.3.3 Infrastructure**

Although the population of the Libode District is 290 390, the urban population is mainly located in Libode Town and the Ngqeleni Township. The population of Libode and Ngqeleni is 3 835 and 2 062 respectively. Scattered low density settlements dominate the district with 79 percent of households residing in village type settlements. The majority of the residential structures are self-built and there are a few trading stores. Importantly, there are 426 schools in the Libode District with only 42 high schools.

### **1.3.4 Socio- economic status**

Lauer and Lauer (2006:22) define social status as “the position in the social system based on economic resources, power, education, prestige and life style.” In the Eastern Cape Province, the Libode District is considered to be one of the districts with the lowest socio-economic status because of a number of problems. These range from a lack of educational facilities, the high levels of illiteracy, unemployment, violence and crime and the lack of investment. Furthermore, single parents and orphans have been reported as care givers. It is possible to suggest that these factors make living conditions extremely difficult in the Libode District for both learners and parents.

### **1.4 PURPOSE OF THE STUDY**

The purpose of this study is to understand how school related factors and home related factors are associated with poor performance in physical science in public high schools in the Libode District in the Eastern Cape with the aim of devising recommendations for solutions to underperformance in physical science.

### **1.5 RESEARCH PROBLEM**

To investigate the factors associated with poor performance in physical science amongst high school learners.

### **1.6 RESEARCH QUESTIONS**

- What are the school related factors that cause learners to fail physical science at high school level in public schools in the Libode District?
- What are the home related factors that cause learners to fail physical science at high school level in public schools in the Libode District?
- Which strategies for example, could be suggested as solutions to underperformance in physical science in the Libode District?

### **1.7 RESEARCH AIMS AND OBJECTIVES**

In this section, the aims and specific objectives of this study are discussed.

### **1.7.1 Aims**

This research will attempt to:

- Investigate the factors associated with high school learners' poor performance in physical science in the Libode District
- Provide recommendations for solutions to underperformance in physical science.

### **1.7.2 Specific objectives**

In this study, it will be attempted to:

- Determine the school related factors that cause poor performance in physical science in the Libode District
- Determine the home related factors that cause poor performance in physical science in the Libode District
- Ascertain the skills and competences of both physical science educators and physical science learners to improve performance
- Suggest strategies that could improve performance of both physical science educators and physical science learners

## **1.8 SIGNIFICANCE OF THE STUDY**

The Department of Science and Technology (DST) (Republic of South Africa 2008:12-13) asserts that the economic survival of South Africa depends on the education and training of enough science learners at both secondary and post-secondary levels. This means that the science curriculum should prepare the high school learner for holistic development, socio economic development and environmental management (Republic of South Africa 2011:3-5). The significance of this study lies in identifying both school related factors and home related factors that affect the high school science learner's performance in physical science negatively in historically disadvantaged districts of South Africa such as the Libode District.

The results obtained could be used to rekindle the learner's interests in physical science as well as improve and increase their pass rates by addressing the need for resources in schools which in turn will result in effective lesson delivery. This should increase the potential number of science related professionals. This study will also help to develop strategies aimed at producing quality science educators who have exposure to new methods of teaching science and who stimulate scientific curiosity in learners if the department continuously engage teachers in teacher development workshops so that they (teachers) are always informed of the changes in the science curriculum. This should elevate the levels of teaching and learning science in rural district high schools. The results obtained should also encourage and motivate policymakers and curriculum developers to improve the quality, relevance and attractiveness of their science education so that it is adapted to the needs of the learners.

## **1.9 RESEARCH METHODOLOGY**

A mixed methods research approach was used. According to Johnson, Onwuegbuzie and Turner (2007:116), a mixed methods research approach involves employing rigorous quantitative research methods that assess the magnitude and frequency of the constructs under study as well as rigorous qualitative research methods that explore the meaning and understanding of the constructs under study

### **1.9.1 Research design**

A research design refers to the plan and structure of the investigation used to obtain evidence to answer the research question (White 2002: 42). The qualitative and quantitative approaches were used to establish both the school related factors as well as the home related factors that caused poor performance amongst high school learners in physical sciences in the Libode District, Eastern Cape. The research approach necessitated the gathering of data from science learners, science educators and parents so that insight could be obtained into the causes of poor performance amongst high school learners.

## **1.9.2 Population and sampling**

A population is a group of elements or causes, whether individuals, objects or events that conform to specific criteria to which we intend to generalise the results of the research (McMillan & Schumacher 2001: 169). For this study, the target population comprised of high school science learners, high school teachers and parents from a sample of four public high schools in the Libode District in the Eastern Cape.

## **1.9.3 Data collection techniques**

Data were collected by means of

- Questionnaires
- Interviews
- Learner non - standardised tests
- Observations

### **1.9.3.1 Questionnaires**

According to Johnson & Christensen (2008: 170) a questionnaire may be described as a self-reporting data collection instrument that each respondent completes as part of a research study. A questionnaire is considered to be the best tool because of the following reasons:

- It is normally treated confidentially and safeguards anonymity and can therefore result in more honest responses.
- The absence of face- to- face contact between the researcher and the respondents is assumed to reduce the effect of the researcher on the respondents.

### **1.9.3.2 Interviews**

According to Dick (2000:12) interviews are particularly useful for getting the story behind a participant's experiences. The interviewer can pursue in depth information around a topic and they may be useful as a follow up to certain respondents to questionnaires, for example to further investigate their responses (Dick 2000:14)

Marshall & Rossman (1989) in Kawulich (2005:78) define observation as a systematic description of events, behaviours and artefacts in social setting chosen for study, they enable the researcher to describe the existing situations using five senses providing a written paragraph of the situation under study.

### **1.9.3.3 Observations**

Observations according to Kawulich (2005)

- Provide researchers with ways to check for non-verbal expressions of feelings.
- Determine who interacts with whom.
- Grasp how participants communicate with each other.
- Check for how much time is spent on various activities.

Taylor and Bogdan (1984) in Kawulich (2005:82) suggest the following guidelines for collecting useful observational data. They suggest that researchers should be unobtrusive in their dress and actions, become familiar with the setting before beginning to collect data, keep the observations short at first to keep from becoming overwhelmed and still be honest, but not too detailed in explaining to the participants what he or she is doing.

### **1.9.3.4 Non-standardised tests**

Shiel, Kellaghan & Moran (2010) describe a non-standardised test as a test that looks at an individual's performance that allows us to obtain specific information about the student. In the next section the data analysis methods are discussed.

### **1.9.4 Data analysis**

The main methods of data analysis used were descriptive statistics and inferential statistics for quantitative research. White (2002:85) lists the following advantages of descriptive statistics and inferential statistics. Descriptive statistics are essential for arranging and displaying data and form the basis of rigorous data analysis as this is much easier to use, interpret and discuss than raw data. It also examines the tendencies, spread, normality and reliability of the data. Inferential statistics provide more detailed information than descriptive statistics and also give insight into relationships between variables and generate convincing support for a given

theory. In qualitative research, “quote research” is used to analyse the data. White (2002:95) asserts that we use quote research from the interviews as illustrations or confirming examples. Interviews can also be analysed by taking constructions gathered from the context and reconstructing them into meaningful whole (Johnson & Christensen 2008:210)

## **1.10 LIMITATIONS OF THE STUDY**

This research is limited to public high schools in the Libode District because learners come from similar socio - economic backgrounds and attend public high schools with almost similar resources and infrastructure, therefore it cannot be generalised to all rural areas in South Africa.

## **1.11 DEFINITION OF TERMS**

In this study, a variety of terms were used, therefore they needed to be defined in order to clarify their use in the study

### **1.11.1 Physical science**

The Republic of South Africa (2011:8) defines Physical science as a subject that focusses on investigating physical and chemical phenomena through scientific enquiry by applying scientific models, theories and laws in order to explain and predict events in the physical environment.

### **1.11.2 Curriculum**

A curriculum is defined as an official written document from a higher authority that is seen as a mandated template that must be followed by all teachers (Bloom 2004:7)

### **1.11.3 Curriculum change**

Curriculum change means making the curriculum different in some way to give it a new position or direction. This often means alteration to its philosophy by way of its aims, reviewing the content included, revising its methods and rethinking its evaluator procedures (Bloom 2004:9).

#### **1.11.4 Learning**

Learning is the change in behaviour that results from experience or change in the organism that results from experience (De Houwer, Barnes-Holmes & Moors 2013:1).

#### **1.11.5 Performance**

Singh, Granville and Dika (2002:325) define performance as that which includes multiple and interrelated variables which include school related factors as well as home related factors

### **1.12 CHAPTER DIVISION**

The research project consists of five chapters which are structured as follows:

#### **Chapter 1: Introduction and background:**

The general performance of physical science learners worldwide is discussed in this chapter. The performance in South Africa is discussed and it further focusses on the historically disadvantaged rural districts of South Africa with specific reference to the Libode District which will be the area of focus in this study. Background to the study, research aims and objectives, relevance to the study, and definition of key concepts will also be discussed.

#### **Chapter 2: Literature review**

This chapter demonstrates how the research questions fit into a larger field of study. It consists of a literature review about the theories and models of science and a literature review on previous research; which analyses previous research critically with regard to the causes of the high failure rate in science in South Africa and other countries. The relevant books, journals, newspapers, magazines, websites and other information were consulted to support and explain the research question, the design and the data collection procedures.

### **Chapter 3: Research methodology**

The research design and techniques explain the data collection methods, measuring instruments, the population, sample, participants, statistical tools, and analysis are presented.

### **Chapter 4: Data analysis and presentation of findings**

The chapter presents and analyses the data collected with reference to the results obtained from the questionnaire, interviews and observations and learner non-standardised tests.

### **Chapter 5: Findings, recommendations and conclusions**

The chapter summarises the findings with reference to the problem statement, research questions and research aims. Conclusions will be derived from the results. Recommendations and suggestions for improving the teaching and learning of science for improved results will be given.

## **1.13 CONCLUDING REMARKS**

This chapter sets the tone for the investigation undertaken in this study in that it elucidates certain key concepts pertaining to the study and provides a brief outline of the manner in which the study was conducted. It gave a background regarding the necessity of passing physical science in Grade 12 as part of the drive for getting more professionals in science - oriented jobs in South Africa. The research questions, aims, objectives and the purpose of the study were also discussed. The next chapter focusses on the literature review by concentrating on theories and models of learning and also by focusing on previous research on the factors that cause poor performance in physical science.

## **CHAPTER 2: THEORIES AND MODELS OF LEARNING AND PREVIOUS RESEARCH**

### **2.1 INTRODUCTION**

This section will look at the theories and models of learning and their relevance to the study of the factors associated with poor performance in physical science amongst high school learners in the Libode District in the Eastern Cape. In the literature review, the factors associated with poor performance in physical science at Further Education and Training (FET) school level (Grades 10-12) and which contribute to the high failure rate in Grade 12 in the Libode District will be discussed. It will also look at the theories of learning in relation to the factors contributing to the success of some learners.

In order to answer the research questions effectively, the literature review will be discussed with the South African physical science learner, the physical science educator and the parent in mind. For the purpose of this study, attention will be focussed on constructivism, discovery and the receptive models of learning, the social learning theories, behaviourism and learning styles.

#### **2.1.2 Importance of learning theories in teaching and learning science**

Learning theories give a better idea of the purpose behind teaching and learning, they enhance teaching and learning and also provide a guide to the educator and learner with regard to achieving grades and getting results (Berk 2006:265).

De Witt (2009:52) asserts that learning theories arm the educator with effective ways of meeting the learning needs of learners and provide an insight into the background of learners. Learning theories also give us a guide to the different methods that can be used to enhance learning in the classroom and are also used to guide students based on the different learning styles that exist (De Witt 2009:52).

### **2.2 CONSTRUCTIVISM AND THE LEARNING OF SCIENCE**

One strand of constructivism has its origins in Piaget's genetic epistemology and related science views. This is called the individual constructivist view of learning.

Piaget (in Berk 2006:221), postulates the existence of cognitive schemes that are formed and developed through the coordination and internalisation of a person's actions with regard to the realities in the world. These schemes evolve as a result of equilibrium that involves the process of adaptation to more complex experiences. New schemes thus come into being and modify old ones (Berk 2006:215). According to the individual's constructivist's view, meaning is made by individuals and depends on the individual's current knowledge schemes (Donald, Lazarus & Lolwana 2006:52). Therefore, learning occurs when these schemes are changed (Donald *et al.* 2006:52).

The other strand of constructivism comes from both Vygotskian and non-Vygotskian psychology. This is called a social constructivist's view of learning that recognises that learning involves being introduced to a specific cultural community (Berk 2006:220). This theory is also linked to the social learning theory which according to (Cherry 2010) explains that people can learn new information and behaviours by watching other people. The social learning theory was discussed in section 2.5

### **2.2.1 Features of constructivism and their relevance for science**

Constructivism in learning science suggests that students that are strongly influenced by social environments, construct their own knowledge, that is, they learn science through the process of constructing, interpreting and modifying their own representations of reality based on their experiences (Kearney 2004:435). This, according to Shaffer & Kipp (2007:255), means that constructivists acknowledge the social dimension of learning such as the classroom and learning community, whereby students create a meaning of the world through both personal and social processes.

Miha (2006:8) supports this viewpoint, by asserting that the most important thing in science learning and teaching is providing students with learning environments that promote their understanding of science by constructing and negotiating ideas through meaningful peer and teacher interactions.

### **2.2.1.1 Prior knowledge and its value**

In terms of individual constructivism, students are supposed to build their new knowledge based on their prior knowledge. According to this perspective on learning, in order to predict how learners will respond to attempts to teach science, it is necessary to understand their prior knowledge, the knowledge that learners bring to a given teaching situation (Leach & Scott 2003:95).

Students come to a science class with a range of strongly held personal science views. Savinainen and Scott (2002:45-52) assert that it is the duty of educators to identify common alternative conceptions and to design subsequent episodes in order to cause cognitive conflicts in students. Therefore, this means that the teaching sequence should be designed on the basis of a detailed conceptual analysis of the science to be taught and students' typical prior knowledge (Leach & Scott 2003:99-100).

### **2.2.1.2 Importance of learning activities**

From the individual's constructivist point of view, the teaching approach in science should focus on providing learners with physical experiences that induce cognitive conflicts and hence encourage them to develop new knowledge schemes that are better adapted to experience (Miha 2006:10). For example, if students engage in learning activities that require them to explain, master evidence and find examples, generalise and apply concepts, they create a new understanding that is built on their prior knowledge (Leach & Scott 2003:105). For instance, activities such as performing experiments and engaging in discussions about the results with peers can help students to build their understanding.

### **2.2.1.3 Importance of contextualisation**

Roth (1994, in Miha 2006:11) states that actively constructing knowledge requires that learners become immersed within the context of the discipline. This is supported by Singer, Marx and Krajcik (2000:170) who argue that grasping a concept depends on recognising how it functions within the discipline as such disciplinary contexts provide situations within which novices can learn through increasingly autonomous activity in the presence of social and intellectual support.

Social interaction is critical as learners become involved in a community of practice which embroilers certain beliefs and behaviours to be acquired (Miha 2006:12).

In order to understand the principles of science, science educators must immerse students in a scientific culture. This can be done through extended inquiry as students will learn skills such as debating ideas, designing and conducting investigations, reasoning logically and proposing the interpretations of findings (Singer *et al.* 2000:173-174).

## **2.3 SOCIAL LEARNING THEORY AND SCIENCE LEARNING**

Social learning theory explains that people can learn new information and behaviours by watching other people (Cherry 2010). Social learning according to Kumpulainen & Wray (2002) is characterised by the following concepts:

### **2.3.1 People can learn through observations**

Bandura carried out the bob and doll experiment which demonstrated that children can learn and imitate behaviours they have observed in other people. The children in Bandura's experiment observed adults acting violently towards a bob doll and when the children were allowed to play in a room with a doll, they began to imitate the aggressive actions they have previously observed (Cherry 2010). This led to the discovery of the three models of social learning theory that are:

- A live model which involves an actual individual acting out a behaviour.
- A verbal instruction model that involves descriptions and explanations of behaviour.
- A symbolic model that involves real or fictional characters displaying behaviours in books and television (Kumpulainen & Wray 2002).

### **2.3.2 Learning does not automatically result in a change in behaviour.**

Cherry (2010) asserts that in order for a person to learn, one needs to be paying attention, as anything that distracts one's attention is going to have negative effects on social learning, one must be able to store information and one must have the

ability to perform the behaviour observed as a result of social learning. Lastly, in order to imitate the behaviour that has been modelled, one has to be motivated through reinforcement and punishment. This according to the researcher means that it is vital for educators to always emphasize the behaviour several times so that learners may eventually learn it.

The social learning theory is extremely vital in the teaching and learning of science. For example attention is important in communication circles because if students want to learn, they must pay attention, so that they can easily understand what is being taught. This according to Cherry (2010), can be achieved by manipulating the classroom environment to promote the positive aspects of socialisation.

## **2.4 DISCOVERY MODELS AND SCIENCE LEARNING**

Discovery learning is an active process of inquiry-based instruction that encourages learners to build prior knowledge through experience and to search for new information and relationship based on their interests (Coffey 2010). Saab, Van Joolingen and Van Hout-Wolters (2005:615) list the following as characteristics of discovery learning

- Learning is active and students must participate in hands- on and problem solving activities rather than knowledge transfer.
- Discovery learning emphasises the process instead of the product, thus encouraging mastery and application.
- The lessons learnt from failure within this model of instruction encourage the student to continue to search for solutions.
- Feedback is an essential part of the process of learning and that collaboration and discussion allows students to develop deeper understanding.
- Discovery learning satisfies natural human curiosity and promotes individual interests.

In a science class, the discovery model of learning promotes a deep understanding, develops metacognitive skills and encourages a high level of student engagement (Castronova 2002). For example, the South African science curriculum is based on discovery learning as learners conducting experiments are expected to identify variables, collect data and generate hypotheses in order to describe and understand concepts and finally interpret the data, reject hypotheses and make conclusions about the acquired information (Republic of South Africa 2011:4-9)

If students are taught science through discovery learning, they will get opportunities to share their own ideas and responsibilities, develop the art of communication and cooperate in effective teamwork in such a way that they become familiar and confident with regard to handling apparatus (Flick & Lederman 2006:5).

## **2.5 RECEPTIVE MODEL AND SCIENCE LEARNING**

Ausubel's receptive model stresses that learners acquire knowledge through reception rather than through discovery (Mwamwenda 2004:194). Kramer (2002:109) asserts that in receptive learning, science learners should be presented with all the possible information on a given topic in its final form. For example if the science class is looking at the concept of separating mixtures, the receptive model suggests that the educator should provide learners with all the concepts about mixtures including information such as types of mixtures, while all the mixtures are separated by physical methods and examples of physical methods.

Ausubel (in Kramer 2002:109), further advocates that teaching and learning should involve advanced organisers where the educator may use details such as models, charts and illustrations or pictures. The use of such advanced organisers in science is extremely crucial because they assist learners to assimilate and accommodate scientific concepts.

## **2.6 BEHAVIOURISM AND SCIENCE LEARNING**

Sternberg (2003:444) asserts that learning reveals itself only through behaviours that can be observed. It is also believed that during learning, new behaviours are learned and people's inner thoughts and feelings are only of importance if they are

expressed in observable actions or affect their behaviour in some way (Morrison 2009:113, De Witt 2009:52).

Based on historical research, it is believed that behaviour is shaped by consequences and the role of conditioning in the learning process is stressed (De Witt 2009:53, Mwamwenda 2004:171). This implies that behaviourism regards both classical conditioning and operant conditioning as the prototype of a large proportion of what the child learns daily such as the learning of names of objects, events and language (Shaffer & Kipp 2007:187). For example, in science, conditioning is also useful for early learning when learning the new chemical symbols of elements of the periodic table as it may be easy to make a mistake of thinking that the symbol for the element is the first letter of the name of that element, chemical formulae of compounds, scientific equations, scientific laws and science principles.

Classical conditioning and operant conditioning have been criticised since both are believed to promote rote learning whereby learners recite certain concepts over and over again (Mwamwenda 2004:196). New approaches to human learning do not favour rote learning and do not consider it as meaningful, since materials learnt through rote learning cannot be integrated into the existing knowledge (Kramer 2002:109).

Furthermore, such traditional methods of teaching are educator centred and emphasise knowing rather than the process of knowing and entail an extremely limited approach. The educator is regarded as an expert in both scientific activities who presents facts, information, concepts and demonstrates to learners how the world works rather than learners discovering their own (Kramer 2002:112). Learning is also determined by the quantity of scientific knowledge absorbed and recalled by the learner (Schneider, Krajcik, Marx & Soloway 2002:411).

Scientific concepts learnt in this way do not go far enough to explain the advanced processes of thinking because the aim of science and learning should be seen beyond the acquisition of scientific concepts and skills (Republic of South Africa 2011:4-9). This results in the memorisation of scientific rules, scientific laws,

scientific principles and cramming of formula without understanding (Harlen 2000:17).

The Republic of South Africa (2011:8) asserts that the learning of science occurs by investigation of physical and chemical phenomena through scientific inquiry. De Witt (2009:53) describes conditioning as a passive form of learning since it only explains the connection between the existing responses and new stimuli but does not provide an explanation for the emergence of new forms of behaviour.

Berk (2006:239) and De Witt (2009:14) assert that it is extremely crucial for science educators to realise that real science learning occurs only when the learner is actively engaged in operating on, or mentally processing the incoming stimulus and that the interpretation of the stimulus depends on previously constructed learning. This does not mean that science educators should ignore learning completely by conditioning in their classes provided they do not see as the only way of teaching and learning during a lesson. This is supported by Kramer (2002:110) when he declares that not all rote learning is useless since it may be necessary in certain circumstances. For example, the learning of multiplication tables used for calculating problems in science and the learning of other important scientific terminology requires a learner to recite them over and over again in order to remember them.

### **2.6.1 Reinforcement and science learning**

Behaviourists assert that the behaviour that is rewarded tends to be strengthened and is likely to be repeated while behaviour that is punished is weakened and is reduced in future (Mwamwenda 2004:173-174). The role of the environmental stimuli in teaching and learning that produce changes in observable behaviour is strongly emphasised and reinforced through a reward system determined by the educator (Sternberg 2003:9) and Daron, Branscombe & Byene (2009:154) summarise that learning takes place in terms of three variables, namely stimulus, response and reinforcement.

With regard to stimulus, response and reinforcement, learning can be described as the process in which responses that lead to positive behaviours are strengthened by means of rewards and punishment (Daron *et al.* 2009:156). In the classroom

situation, classroom educators should first ask themselves what kind of behaviour they expect in their learners from a science learning experience and then determine the reinforcers and the stimuli such as the environment, subject content, teaching methods, apparatus, motivation, rewards and experiments and how the reinforcers can be best used in order to contribute in the best way to the behavioural change which the educator has in mind (Trowbridge, Bybee & Powell 2004:258).

De Witt (2009:53) asserts that the approval and rewards by the science educator may be regarded as methods of reinforcement of most of the learners' behaviour in class. However, the magnitude of the reward should vary from situation to situation. Among others, these range from a simple nod of the head by the science educator as praise for good work, bringing the good work of the learner to the attention of others to a written statement on the learner's paper (De Witt 2009:56).

If the science educator notices a learner taking the readings correctly from the scientific apparatus during a group activity, he may praise the learner or support the learner by asking probing questions in an interesting, challenging and curiosity arousing manner (Kramer 2002:120). This is extremely useful for training or shaping skill performance in science because pleasant behaviour can be increased where a learner experiences positive reinforcement (Donald *et al.* 2006:105, Fenstermacher & Soltis 2009:15).

Harlen (2000:44) asserts that some people do not agree with the idea of reinforcement since it is believed to have negative impacts in other circumstances in class. According to the researcher's experience as an educator, some negative comments or behaviour of the educator tend to reinforce the general trend of the learners' performance negatively. This may occur, for instance, when the science educator keeps on discouraging the learner from performing an experimental task. In such a case, the learner will then think that he or she is not good at this experimental task or at participating in class. Furthermore, the learner may think that it is not worth making an effort during the science lesson and the feeling of being not good enough or capable is reinforced, leading to the learner not making an effort and losing interest and eventually failing.

Trowbridge *et al.* (2004:26) assert that the educator's decision to offer praise for correct work, give recognition for proper behaviour and provide personal criticism for incorrect responses, can have an effect on learners' academic achievement. This is similar to the statement supported by Harlen (2000:46) who claims that a classroom organisation in which learners are grouped according to ability during scientific activities leads to learners labelling themselves. From the researcher's experience as a science educator, it means that a group of learners who always struggle may eventually lose interest in the tasks assigned to them and hence, negative reinforcement is provided unconsciously by the science educator.

Harlen (2000:46) also asserts that in science learning, rewarding a learner may also not be beneficial, since this kind of motivation engages the learner in scientific activities to gain the approval of others and perhaps offers rewards that have little to do with the scientific activities themselves. Such learners lack a willingness to undertake scientific tasks to persevere and complete, yet the development of ideas by scientists depends on a desire to understand and persist with natural phenomena until they are satisfied rather than because of the rewards offered (Republic of South Africa 2011:9).

## **2.7 ACCOMMODATE INDIVIDUAL DIFFERENCES IN CLASS**

Kramer (2002:12) and Lee & Luykx (2006:3) indicate that a normal class has learners that are uniquely different from each other in terms of cognitive development levels, home languages, intelligence, prior knowledge, learning styles, ways of solving problems, ways of perceiving things, culture, socio-economic backgrounds, ethnic background, parents' educational levels, family and community attitudes. This, according to the researcher is very important for science educators as it is extremely crucial for them to take the differences among his learners into consideration and focus his energy on understanding the learners and planning activities for individuals and not for the whole class. This is further supported by Kramer (2002:12) who argues that the teaching materials and styles that are appropriate for one learner may not be appropriate for another learner.

### **2.7.1 Learning styles**

Rief and Heimburge (2006:13) assert that learners have different learning styles that affect their way of thinking, how they behave, how they approach learning and how they process information. Morrison (2009:435) defines a learning style as the way learners of every age are affected by their immediate environment, own emotionality, sociological needs, physical characteristics and psychological inclinations when concentrating and trying to master and remember new or difficult information.

Research studies have established that learners learn best in classroom environments that are compatible with their own learning styles (Lemmer 2000:68, Schneider *et al.* 2002:413). Some learners do not succeed as well as others in class if they are not given the opportunity to use their own learning styles and hence, academic achievement is enhanced where educators accommodate the different learning styles and preferences of learners (Norman, Ault, Bentz & Meskimen 2001:1106).

In order to teach science classes effectively, it is necessary to suggest the awareness of and sensitivity to the needs, attributes and learning styles by science educators (Kramer 2002:12, Morrison 2009:435). This, according to the researcher means that if educators understand individual learning styles, they can plan the instructional methods, prepare learning activities and organise the learning environment accordingly in order to make learning more relevant and effective for each learner.

Although each learner has his/her own learning styles, it does not mean that the learner only learns in that particular way (Reif & Heimburge 2006:12). It is the way the learner learns best or finds it easier to learn and process information (Kramer 2002:13). In this regard, the educators can cluster learning styles for instructional purposes (Morrison 2009:434). The educator also needs to realise that there is no right or wrong way to learn, but instead, assists learners by providing the support and opportunities each learner requires to have an equal chance of achieving success (Rief & Heimburge 2006:11).

The reviewed literature revealed that the sensory channels of visual, auditory, kinaesthetic and tactile styles are the most commonly used styles in most classrooms (De Witt 2009:52, Morrison 2009:435). A critical analysis of this literature reveals that visual learners learn best by seeing, watching and observing and are therefore good at remembering visual details through pictures, images, graphics and information written using different bright colours to which they can refer (Reif & Heimburge 2006:13).

In order to teach science effectively, educators are therefore encouraged to use a variety of visuals in class such as charts, posters, models, pictures, science equipment, chemicals, DVDs, computers, Power point, cards and different objects for learners to observe (Trowbridge *et al.* 2004:28). An analysis of the literature also reveals that auditory learners prefer spoken messages and learn best by listening and verbalising (Reif & Heimburge 2006:12). In such circumstances, science educators should encourage and provide opportunities for oral presentations, debates, discussions, radios, videos, films and create sessions for questions and answers (Trowbridge *et al.* 2004:29). An analysis of this literature also reveals that both kinaesthetic and tactile learners learn best by doing, touching, smelling, moving and assembling objects and direct involvement (Reif & Heimburge 2006:13). In order to teach such learners effectively, science educators should organise practical activities for learners. Research by Kramer (2002:24) also suggests that all learners can succeed if they are allowed to learn in ways and at the pace that is natural for and preferred by them as individuals since they are all different and learn differently.

### **2.7.2 Kolb's four stages and learning styles**

Kolb (in Kramer 2002:10) believes that each learner uses all learning styles in some way at some time in association with the four stages namely the concrete experience, reflective observation, abstract conceptualisation and active experimentation stages.

Kolb's model clearly indicates that for learning to take place, learners need to complete the whole cycle, which involves four stages and sensory channels (Kramer 2002:12):

- Concrete experience: where learners rely on experience and intuition. experience involves the interaction of the senses with things or objects and therefore, the learning style involves seeing, hearing, smelling, feeling and tasting.
- Reflective observation: where learners try to make sense, understand the experience, think about and analyse the experience. They learn through perception, observation and demonstration.
- Abstract conceptualisation: where learners think about the experience and try to create mental models, theories and ideas that explain it. They learn by making logical analyses and conclusions.

Active experimentation: this last stage involves testing the learner's understanding by doing something. During this stage, learners experiment and they learn by trying things out. The researcher therefore suggests that if science educators use Kolb's model by integrating the four stages with the sensory channels in planning instruction, and in the teaching process, learners may complete the learning cycle and develop skills that require them to hypothesise, observe, analyse, reflect and predict during an investigation rather than replicating an activity given in the book.

## **2.8 FACTORS ASSOCIATED WITH POOR PERFORMANCE IN SCIENCE**

This section will provide an account of the literature reviewed on the associated with poor performance of high school learners in physical science. It will outline the factors that contribute towards the poor performance in physical science amongst high school learners as researched both internationally and within South Africa, by focussing on both home related factors and school related factors and their relevance to various learning theories. A number of these studies link the poor performance in physical science to the lack of material resources, qualified science educators, environments within the school and outside the school as the major factors contributing to the poor performance in physical science (Ruby 2006:1002-1015, Fonseca & Conboy 2006:82-85).

Before these factors are identified and discussed, it is important to discuss the value of physical science as a subject. Republic of South Africa (2011:8) asserts that physical science is a subject that focusses on investigating physical and chemical phenomena through scientific enquiry by applying scientific models, theories and laws as it seeks to explain and predict events in our physical environment. Physical science also deals with society's desire to understand how the physical environment works, how to benefit from it and how to care for it responsibly (Republic of South Africa 2011:8). The subject physical science also helps us to understand the natural world through the use of observation and the testing of ideas (Republic of South Africa 2011:4-11).

Research in both the developed and developing countries indicate that the South African perspective is no different from the international perspective since poor performance by high school learners in physical science affects all high school learners (Phurutse 2005:86;Taylor 2009:12-18).

### **2.8.1 Theoretical Framework**

This study touches on what affects the academic performance in physical science. In this regard, both the school related and home related factors respectively, are listed below.

#### **Home related factors**

- Unpredictable home environment
- Self-concept
- Parent's educational levels
- Socio economic status
- Marital status of parents

#### **School related factors**

- Medium of instruction
- Attitude towards learning science
- Laboratory work
- Curriculum change
- Large class sizes

- Educator qualifications and subject content

## **2.8.2 Home related factors**

Family plays a vital role in the progress and educational development of children. Adell (2002:91) supports this by contending that “the family background is the most important and weighty factor in determining the academic performance of learners.” When schools, families and community groups work together to support learning, the children tend to do better at school, stay in school and like school more (Adell 2002:93). The researcher supports these findings as he has spent many years teaching in rural South African schools where parents do not involve themselves much in the education of their children. Most of these learners were not performing well especially in physical science.

### **2.8.2.1 Unpredictable home environments**

Unpredictable home environments include a loss in the family through death, divorce, separation or substance abuse, domestic quarrels between by parents, which result in child neglect (Evans 2006:394). A study conducted in African-American students (Evans 2006:393-395) reveals that children who do better at school tend to come from homes that are quieter, more organised and have a predictable routine, regardless of their socio- economic status. Brown and Low (2008:922) assert that children living in the midst of environmental confusion have lower expectations, a lack of persistence and a tendency to withdraw from academic challenges.

The above literature search speaks to the constructivism theory of learning which according to Kearney (2004:435) suggests that students that are strongly influenced by their social environment construct their own knowledge. This according to Shaffer & Kipp (2007:255) mean that constructivism acknowledges the social dimension of learning such as the classroom and community whereby students create meaning of the world through both personal and social process. Children who grow out of broken home environments will tend to role model the bad behaviour of their parents as a result they end up withdrawing from academic challenges. The literature search also supports the social learning theory which states that people can learn new information and behaviours by watching other people (Cherry 2010). If students come from homes where parents are into

substance abuse and disorganised, chances are high that such student will learn such behaviours and consequently perform poorly at school.

### **2.8.2.2 Self-concept**

Cramer & Tiller (2003:12) states that how someone is to behave depends on his/her self-concept, which pertains to what he/she thinks about himself or herself, including his/her strengths, weaknesses and personality. A person will engage with his/her self-concept when judging whether he/she will succeed or fail in his/her effort (Azizi, Shahrin, Jamaludin, Yosof & Abdul 2006). A study conducted by Azizi *et al.* (2006) on the relationship between the self-concept and the student's self-academic performance in Kluang revealed that of the self-concept dimensions—family is the most dominant among the students. This shows that students who feel that they are accepted, needed; loved and appreciated will in turn, have high respect to their families (Marsiglia 2002). Azizi *et al.* (2006) assert that such children will have a higher chance of succeeding than failing.

The literature search supports the behaviourism theory of learning which states that learning reveals itself only through behaviours that can be observed. If learners have parents that constantly reward them for doing well, this will intern boost their self-concept and such learners are likely to repeat the same behaviour. This will improve their academic performance. Research on the impact of teachers on student's self- concept revealed that several teacher variables such as amount of teacher involvement and support, the degree to which teachers stressed order and organisation and innovation are associated with higher student self- concept. (Scott & Murray 2001).

### **2.8.2.3 Parents' educational levels**

Merrill (2009:224-249) asserts that parents who are educated raise children who have healthy self-perceptions when it comes to their academic abilities, engage them in intellectual activities that help them develop a healthy attitude towards learning and generally have children with fewer behavioural problems that may hinder their learning experiences. This literature search speaks to the social learning theory as students will tend to learn positive behaviours from their parents which will intern motivate them to learn at school. This will also positive behaviours

will also mould them (students), thus increasing their chances of performing well in a science class.

Schemo (2007:224-249) states that according to the statistics reported in 2006 by the “National Centre for Children in Poverty Report,” parents with lower education levels earn a lower income and behavioural problems such as aggression are commonly found in families with a lower income and lower educational levels and such students are frequently punished and so they end up developing a negative attitude towards school, which in turn affects the child’s desire to learn and his motivation to achieve academic success. Merrill (2009:224-249) avers that if a child’s parents read books, attend ongoing education classes and engage with him in a number of direct-learning experiences that will help him value achievement and success. Research conducted by Merrill (2009:224-249) reveals that parents with higher educational levels have greater confidence in their children’s academic abilities and they also have higher expectations of their children. In effect, these expectations will motivate the child to do well.

#### **2.8.2.4 Socio- economic status of parents**

Should a member of the immediate family be unemployed, the change in the *status quo* can affect the entire family. Dahl and Lonce (2005:1279) assert that such a dramatic shift can alter the dynamics of the family and as a result, it can affect the performance of school aged children adversely. Along with a change in routine, it is common for households affected by unemployment to also need to contend with a reduced amount of income, smaller social networks and the looming threats of relocation to a less affluent neighbourhood (Kjetil &Mark 2007:22).

Research by Jeffrey and Lynn (2005) show that some parents become depressed and choose not to monitor the change in behaviour of the children and this results in a general lack of enthusiasm for school and disinterest in studying. In another study by Blank (2002:1108-1166) it was reported that when a father becomes unemployed, this often leads to a negative effect on student’s work, yet when a mother becomes unemployed, this frequently contributes to a positive impact on a student’s schoolwork.

The literature search speaks to the behaviourism theory of learning as learners will observe that their parents are no longer interested in motivating them and this may lead to poor performance in a science class

#### **2.8.2.5 Marital status of parents**

McLanah and Sandefur (1994, in De Lange, Dronkers & Maarten 2013) give an extensive description of two types of resources (loss of parental involvement and loss of social resources) that are important in explaining the impact of living with a single parent on children's chances of future success. Parental involvement is supposed to affect children's educational outcomes positively, it pertains to the time parents spend with their children on reading, helping with their homework and listening to the stories about their experiences at school (Park, Bynn & Kim 2011:7-10). After a divorce or separation, the quality and quantity of parental involvement decreases (Dronkers 2010:252-256).

Research conducted by McLanah and Sanderfur (1994) reports that children from divorced or separated families may experience a loss of social resources. After the divorce or separation, single parents may not find the time or energy to keep investing in personal relationships because of stress and depression and consequently lose friends without making new ones (De Lange *et al.* 2013). This might disturb the overall social networks of divorced parents and so they will have less information about the teachers teaching their children and consequently, this will influence the children's educational performance negatively. The literature search supports the social learning theory as it may be difficult for single parents to motivate their children through reinforcement and punishment. This means that such learners may not learn new behaviours easily which are expected from them in a science class

#### **2.8.3 School related factors**

Saiduddin (2003:2) is of the view that it is convenient to find a scapegoat by passing the blame and responsibility for the low academic performance to factors such as asserting that the family and the learner are less intelligent than other parents and children. Research conducted at high schools in Dakota has shown that all learners are educable and the way in which the school is managed is the most

critical factor in determining the quality of education for its learners. Researchers at the Ohi State University attribute the academic failure to the economic and social conditions while administrators and educators have also developed this mind-set (Saiduddin 2003). This argument can be disputed based on the status quo of most rural schools in South Africa because how can learners perform well in physical science without the necessary facilities such as laboratory and chemicals that are necessary for them to perform experiments.

### **2.8.3.1 Medium of instruction**

Research conducted by the Trends in Mathematics and Science Study (TIMSS) (Mullis, Martin, Gonzalez, Kelvin, Garden, O'Connor, Chrostowski & Smith 1999) indicated a correlation between lower achievement levels in science and home language which is different from school language (Barker & Johns 2005:150). This is further supported by Lee & Luykx (2006:35) who asserts that when learners are taught in a language that is not their mother tongue, learning becomes difficult for them.

A wide range of communication problems between the educator and the learner emerge when science is taught in English which may be a foreign language to learners and this may lead to poor performance (Marshall 2002:5). For example, non-English speaking learners need to develop English language literacy skills in the context of content area instruction while content area should provide a meaningful context for English language and literacy development. Van der Poll & Van der Poll (2007) asserts that when learners are required to learn content in a second language, they are faced with the problem of content literacy and therefore, it becomes difficult for them to master the content being taught. This in turn affects the learner's performance in science because language plays a vital role in the understanding of technical terms in a subject (Van der Poll & Van der Poll 2007).

### **2.8.3.2 Attitudes towards learning science**

Research conducted by TIMSS (1999) reported that the generation of positive attitudes towards science is an important and integral goal of science education. Mullin (2005) asserts that many learners tend to avoid science because of their fear of the subject and a lack of a positive self-concept which may result in learner's

underperformance as a result of being unable to get the required results for university entrance. This fear of physical science has resulted in a decrease in the number of learners taking the subject both at secondary and tertiary level (Gough 2009:184). Research on psychological effects has found that students self-concept of ability to perform in science correlates positively with achievement. It has been observed that many students fear science as a result their achievement in science subjects is extremely low (Gough 2009:184).

### **2.8.3.3 Laboratory work**

A research project and development work carried out in five European countries in the context of European project in science education, revealed that learners performed poorly in science because:

- Most laboratory activities are poorly designed and planned with regard to the levels of understanding of the learners so that learners end up manipulating equipment but not ideas.
- Of poor laboratory practices that are ineffective.
- Much time is usually wasted in laboratory when learners engage in data gathering without knowing why they are doing it and,
- Learners are not given adequate opportunities for processing and analysing (Psillos & Niedderrer 2006:2-4).

Lunetta (2004) suggests that the laboratory is a unique social setting with a considerable potential in enhancing social interactions that can contribute positively to developing attitudes and cognitive growth. Several studies reported that laboratory work in certain courses and that laboratory experiences resulted in positive attitudes and interest in science. For example, Kerr, Rynearson and Kerr (2004:1-9) state that chemistry students who were asked to rate their perceptions of relative effectiveness of instructional methods of promoting their interests in and attitudes towards learning chemistry reported that personal involvement in a chemistry laboratory was the most effective instructional method for promoting their

interest in chemistry studies in contrast with teacher's demonstrations, filmed experiments, classroom discussions and teachers lecture.

#### **2.8.3.4 Curriculum change**

Political, economic, social and technological needs are drivers for curriculum change. It is therefore the duty of the government to address such needs through a change in the curriculum. Glatthorn, Boshee & Whitehead (2006:256) are of the view that change in a country's curriculum is usually a response to changing political, economic or social needs or a combination of these. This, according to the researcher, means that the new curriculum will require the thorough training of teachers, the provision of proper material resources, and proper procedures for assessment of learner's performance. Glatthorn *at al.* (2006:257) further argue that a high level of curriculum implementation can be expected if the curriculum changes are not unduly complex and are clearly explained to teachers, if quality material supporting the new curriculum are made available to teachers and if administrators take the necessary steps to prevent and respond to the problem of overload when teachers feel overwhelmed with regard to implementing the curriculum.

Kelly (2004) is of the view that lack of space, learning support materials, competent educators in science, long- term support systems, inadequate in-service training and the lack of shared vision and commitment are critical factors that could impact negatively on practical implementation. When the ANC government took over in 1994, plans for changing the curriculum were put in place. Curriculum 2005, which was outcomes- based education, was introduced. Curriculum 2005 was revised in 2001 due to the challenges faced by the new curriculum. The revised National Curriculum Statement (NCS) was introduced. In 2011, the NCS was further revised and the Curriculum and Assessment Policy statement (CAPS) was introduced and there was a severe shortage of resources such as textbooks, teachers, furniture and classrooms; which impacted negatively on the implementation of the new curriculum. Kelly (2004:126) asserts that each new curriculum requires extra time for teachers to prepare lessons and materials, to familiarise themselves with the new concepts and skills to be taught.

In a nutshell, the researcher is of the view that improper implementation of the physical science curriculum will result in poor performance by learners.

#### **2.8.3.5 Large class sizes**

Phurutse (2005:6) asserts that the quality of a science educator's teaching, his/her interaction with learners, the learning process, satisfaction and active learner's participation decline with an increase in the size of the class. This is supported by Howie (2003:6-7) who assert that achievement in smaller science classes of less than 15 learners exceeds achievement in both average science classes of about 25 and large classes of more than 30 learners, while the achievement of 25 learners is only marginally better than the achievement of learners in a bigger science class.

Different studies carried out in South Africa showed that large classes are common in South African schools and negatively affect teaching and learning of science (Howie 2003:3; Mji & Makgato 2006:254). The studies also revealed that science educators who teach smaller classes experience more positive attitudes from learners and produce better results in comparison to those who teach larger classes (Howie 2003:4).

#### **2.8.3.6 Educator qualifications and depth of the curriculum**

Cameron (2009:16) and Howie (2003:1-2) are of the view that the poor performance of learners in South Africa is a result of a serious shortage of properly qualified and competent science educators. A further literature search on similar issues revealed that irrespective of significant investments in science educator development by the department of education through offering in-service works, lack of content structure for instruction remain a serious challenge in this field (Aldous 2004:65-67). These challenges have resulted in the government hiring science educators from other countries and these educators are overloaded, thus affecting the quality of science teaching (Madibeng 2006:12). This also resulted in cognitive, instructional and affective problems due to recruitment of locally unqualified and poorly qualified science educators who lack both subject knowledge and teaching methods as a result of the apartheid legacy (Madibeng 2006:12).

Trowbridge *et al.* (2004:26) assert that having subject content knowledge only without methods does not make one a better science educator. This implies that the role and development of the science educator's knowledge of the subject in relation to the teaching methods forms the base of science teaching and learning and is essential for instructional theory (Trowbridge *et al.* 2004:27-32). This is supported by Duit, Niedderer & Schecker (2007:601) when they say that the science educator should have the knowledge to simplify the science concepts in order to make them accessible for learners and enrich concepts by putting them into contexts that make sense to learners.

Trowbridge *et al.* (2004:25) views the science educator's knowledge in three different interdependent perspectives namely; the content knowledge of the subject, the pedagogical knowledge of the subject and the curriculum knowledge of the educators lack both knowledge content and pedagogical knowledge (Makgato 2007:95) and most are deficient in curriculum knowledge and experiencing ambiguity in its interpretation since it is ever changing (Mwanga-Zake 2008:8-9).

## **2.9 CONCLUDING REMARKS**

The chapter looked at the major roles of learning theories in teaching and learning science, how the learning can be applied and be integrated in the teaching and learning of science. The above literature review supports the assumption by Morrison (2009:13) who notes that learning theories play a major role in the science curriculum that is selected for learners and the way learners are taught. This, according to the researcher, means that the experiences that make up the science curriculum are at the core of the learning process and experiences provided to learners by educators should be based on how they learn.

The chapter also looked at the literature pertaining to previous research on both home as well as school related factors that cause high failure rates in physical science at high school level. It was impossible within the scope of this chapter to include every significant research in the field of science education that addresses all home related factors and school related factors that cause high failure rates. This chapter has only cited research studies that best provide an overview of the

key home related factors and school related factors through sampling of the relevant research in the opinion of the researcher. The next chapter will discuss the research methodology to be adopted for this study.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 INTRODUCTION**

According to Somekh and Lewin (2005:346), the methodology entails the collection of methods or rules by means of which a particular piece of research is undertaken and the principles, theories and values that underpin a particular approach to research. Walter (2006:35) argues that methodology is the frame of reference for the research that is influenced by the paradigm in which our theoretical perspective is developed. This, according to the researcher means that the methodology in research is critical as it is linked to the paradigm and the methodology to be used must be carefully chosen.

This chapter will, therefore, discuss the research methodology to be used in order to establish both school related factors and home related factors that cause poor performance in physical science amongst high school learners in the Libode District in the Eastern Cape. The following details will be discussed: the research design, the population and sampling, the research instruments, the validity and reliability of the research instruments, data collection, data analysis and ethical considerations when conducting research.

### **3.2 RESEARCH DESIGN**

A research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby ensuring that you will address the research problem effectively. It constitutes the blueprint for the collection, measurement and analysis of data (Burns & Grove 2003:195).

The purpose of this study is to understand how school related factors cause poor performance in physical science in the public high schools of the Libode District, Eastern Cape with the aim of formulating recommendations for solutions to underperformance in physical science. With reference to this purpose, a mixed methods research design, which combines both qualitative and quantitative methods was used. A mixed methods research design according to Johnson *et al.* (2007:122) is a research approach focusing on research questions to call for real-

life contextual understandings, multi- level perspectives and cultural influences, employing rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research explaining the meaning and understanding of constructs, utilising multiple methods, for example, interviews, intervention trials, intentionally integrating or combining these methods to draw on the strengths of each and framing the investigation within philosophical and theoretical positions.

Leech and Onwuegbuzie (2006:478) assert that mixed methods research design provides a bridge between qualitative and quantitative paradigms. As a result of this, many researchers are utilizing mixed methods approach. Mixed methods approach has the ability to match the purpose of the method to the need in the study; there is a complementary relationship between qualitative and quantitative data, one clarifying the other throughout the study. The combination of both methods provides a better understanding than either the qualitative or quantitative method alone and using the different processes can lead to unexpected information that would not have come to light (Leech & Onwuegbuzie 2006:480).

### **3.3 POPULATION AND SAMPLING**

In this section, the population, target population, accessible population and sampling methods are discussed. The steps involved in the sample selection and the factors that determine the sample size are also discussed.

#### **3.3.1 Population**

A population is the total of all the individuals who have certain characteristics and are of interest to the researcher (Lavirkas 2008:876)

#### **3.3.2 Target population**

A target population refers to the entire group of individuals or objects to which researchers are interested in generalising the conclusions (Lavirkas 2008:876). The Libode District has forty-two public high schools that offer physical science; therefore the target population will be all the high school physical science

educators, physical science learners and parents of learners in the Libode District, Eastern Cape.

### **3.3.3 Accessible population**

The accessible population is the population in research to which the researchers can apply their conclusions. It is from this accessible population that researchers draw their samples (Lavirkas 2008:876). High schools in the Libode District are divided into clusters and there are four of these clusters. For purposes of this study, the accessible population will be high school physical science teachers, physical science learners and their parents in eight underperforming public high schools (two high schools per cluster) and two performing high schools in the Libode District.

### **3.3.4 Sampling**

Sampling is the process of selecting people, events, behaviours or other elements on which to conduct a study (Johnson & Christensen 2008:223). A sample is then the selected element (people or object) chosen for participation in the study. People are referred to as subjects or participants (Johnson & Christensen 2008:223). Yount (2006:8) asserts that it is important that samples provide a representative cross-section of the population they supposedly represent, otherwise the results from the sample will be misleading when applied to the population as a whole. For example, in this study, selecting all the schools in one cluster will give the researcher a biased sample as such schools may not reflect the same characteristics as schools across the district.

Yount (2006:9) suggests randomisation as the key to building representation and defines it as “the process of randomly selecting population members from a given sample in such a way that every member of the population has an equal chance of being selected.”

Due to the geographical location of public high schools in the Libode District, it will be costly and time consuming to conduct research in all ten public high schools, therefore a sample of four underperforming public high schools was selected

randomly (one school per cluster) and two performing high school in the Libode District.

### **3.3.5 Sample selection**

Johnson & Christensen (2008:225) identify the following as the steps involved in sample selection:

**Identifying the target population** – For purposes of this study, the target population will be high school physical sciences educators, physical science learners and their parents in the Libode District in the Eastern Cape

**Identifying the accessible population** – For purposes of this study, the accessible population will be high school physical science teachers, Physical science learners and their parents in eight underperforming high schools and two performing high schools in the Libode District in the Eastern Cape

**Determining the size of the sample** – Yount (2006:10) asserts that the larger the sample, the better it represents the population, while Johnson & Christensen (2008:225) are of the view that if the sample is too large, the value of sampling is negligible and identify the following as the factors that determine the proper sampling size

- Accuracy – As the population size increases, random errors tend to cancel each other. leaving a better picture of the measure of population
- Cost - An increasing sample size translates into increasing costs in terms of both money and time. Yount (2006:10) asserts that inaccurate data are useless but a study, which cannot be completed due to a lack of funds is not any better
- Homogeneity of the population- Homogeneity in a population means that members of the population are similar with regard to the characteristics under study, the greater the variability in the population, the larger the sample needs to be (Johnson & Christensen 2006:225).

In the light of the above factors, four underperforming schools and two performing schools will be selected. An extreme- case sampling method was used. Extreme – case sampling according to Johnson and Christensen (2008:244) is a method of selecting cases from the extremes or poles and compares them. The selection was

based on the recent 2013 matric results. Schools A, B, C and D will be selected because they had a pass rate of less than 30% while Schools E and F were selected because they had a pass rate greater than 80%.

The sample of the study consisted of 120 Grade 11 physical science learners, twelve physical science teachers and twelve parents. A larger sample were used in order to safeguard the sampling error because the larger the sample, the smaller the error and the more representative and accurate conclusions and generalisations (Johnson & Christensen 2008:241). Grade 11 physical science learners were included as this will be a representation of the relevant population. Proportional stratified random sampling was used, which, according to Jonson and Christensen (2008:233), is a technique in which a population is divided into sub-groups according to stratification variables such as gender, age, socio- economic status and the sample is selected randomly for each sub-group in the same proportion in which they exist in the population.

The proportional stratified random sampling used in selecting a sample of learners involved the following process:

- A list of all Grade 11 learners was acquired beforehand on the first day of visiting each school
- The learners were divided into sub groups on the basis of gender and separate lists of males and females were made for that particular school
- The names of learners were written on pieces of paper and put into two separate containers for boys and girls
- A boy's name was selected randomly followed by a girl's name from the other container to offset gender bias

The physical science educators were included because of their expert knowledge in the subject. All the selected schools had a maximum of two physical science educators per school, implying that the population of educators was small. Therefore, all the physical science educators were used for this study. The parents were included because they were always at home with their children and they were familiar with the challenges they faced (the learners). The selected learners wrote

the names of their parents or guardians down, after which, these names were then put into a box and the parent's name was then selected at random.

### **3.4 RESEARCH INSTRUMENTS**

Research instruments are measurement tools designed to obtain data on a topic of interest (McMillan & Schumacher 2001:168). The BMRA Research Tool (2003) is of the view that anyone developing a research instrument must ensure that he/she starts with a statement about:

- The focus and aims of the research project
- How the person's data will be used
- Who will assess his/her data
- How long the interview or survey will take place
- They use age appropriate language
- Any questionnaires use an appropriate scale

The research instruments for this study were questionnaires, interviews, learner non-standardised tests and observations.

#### **3.4.1 Questionnaires**

A questionnaire is a self-report data collection instrument that each research respondent completes as part of a research study (Johnson & Christensen 2008:171). A questionnaire was used in this study for the following reasons

- Considerable amounts of information can be collected from a large number of people in a short period of time and in a relatively cost effective way.
- It can be administered by the researcher or by any number of people with limited effects on its validity and reliability.
- The results of the questionnaire can usually be quantified quickly and easily by either a researcher or through the use of a software package.
- They are familiar to many people, therefore, it is easy for anyone to complete them (BMRA Research Tool Kit 2003)

In order to gather useful and relevant information, it is essential that careful consideration is given to the design of a questionnaire. A well-designed questionnaire requires careful thought and effort and needs to be planned and developed in a number of stages (BMRA Research Tool 2003). In this study, it was achieved by spending time and developing questionnaires that were then pretested with twenty Grade 11 learners, experienced researchers, and science specialists to identify any ambiguity in the questionnaire. After refining the questionnaire, it was then completed anonymously by respondents. The questionnaires were accompanied by a covering letter explaining the purpose of the research and giving assurance of confidentiality.

### **3.4.2 Design of questionnaires**

Two sets of closed questionnaires were designed and distributed to four underperforming and two performing public high schools in the Libode District. McMillan and Schumacher (2001:27) assert that closed ended questions limit the answers of respondents to response options provided by the questionnaire. Closed questionnaires were used instead of open ended questionnaires for the following reasons given by McMillan & Schumacher (2001:26)

- They are easier and quicker for respondents to answer
- The answers of different respondents are easy to compare
- The answers are easy to code and statistically analyse
- Respondents are more likely to answer about sensitive topics
- The response questions can clarify question meanings for respondents
- There are fewer irrelevant and confused answers to questions
- Less literate respondents are not at a disadvantage
- Replication is easier.

There was a questionnaire for educators and a questionnaire for learners. The purpose of both questionnaires was to establish both school related and home related factors that caused poor performance in physical science amongst high school learners in the Libode District, Eastern Cape.

### **3.4.3 Contents of questionnaires**

The contents of the questionnaires will now be discussed.

#### **3.4.3.1 Educators' questionnaire**

The questionnaire consisted of five sections.

##### **Section A**

This section requested the following information from the educators:

The gender, number of years of teaching physical science, highest qualification, subject qualified to teach, post level as a physical science educator.

##### **Section B**

This section was aimed at determining the availability of the following resources at school: Laboratories, qualified physical science educators, furniture, classrooms.

##### **Section C**

This section asked questions that sought to establish whether the educator knew the content of the subject, explained the concepts using the language of instruction in physical science and whether the educator exposed his/ her learners to the calculations in physical science.

##### **Section D**

This section asked questions to determine the attitudes of educators towards physical science, the views of educators on the changing curriculum, the effectiveness of the methods used by educators to teach physical science.

##### **Section E**

This section asked questions to determine the extent of parental involvement in the education of their children.

### **3.4.3.2 Learners' questionnaire**

#### **Section A**

This section elicited the following information from learners: The gender, age, number of years in the grade

#### **Section B**

Questions regarding to the following were asked: Attitudes of learners towards science, medium of instruction during the learning of physical science, the views of learners on the curriculum that was always changing, laboratory work and the number of learners in one class

#### **Section C**

Section C asked questions that sought to determine the effect of the home environments, the self-concept, the marital status of the parents, the educational levels of parents and the employment status of parents on the performance of learners in physical science.

### **3.5 INTERVIEWS**

Turner (2010:756) explains that interviews provide in-depth information pertaining to the participant's experiences and viewpoints regarding a particular topic. Turner (2010:754) defines an interview as a data collection method in which the interviewer asks the interviewee or participant questions, while aiming at entering the inner world of the respondent and gaining an understanding of that person's perspectives. Semi- structured interviews were used in this study for the following reasons:

- They provide a simple and efficient way of getting data about aspects that cannot be observed easily, for example, feelings and emotions.
- People are able to talk about something in detail and in depth. The meanings behind an action may be revealed as the interviewee is able to speak for him/herself with little direction from the interviewer.

- The interviewer can probe areas suggested by the respondent's answers, picking up information that had either not occurred to the interviewer or of which the interviewer had no prior knowledge.
- The problem of the researcher with pre-determining what will or will not be discussed in the interview is resolved; the interviewer is judging what is and what is not important information (Chenail 2009:18)

On the other hand, McNamara (2009, in Turner 2010:756), is of the view that semi-structured interviews can only be effective if the interviewer has the ability to think of questions during the interview and the researcher does not have a way of knowing if the respondent is lying.

### **3.5.1 Features of semi- structured interviews**

During semi-structured interviews, the interviewer and the respondent engage in a formal interview, the interviewer develops and uses an interview guide, the interviewer follows the guide but is able to follow topical trajectories in the conversation that may stray from the guide when he or she feels this is appropriate (Cohen & Crabtree 2006:1). This means that the researcher had an opportunity to explore the feelings and views of parents about their involvement in the education of their children as well as the views and feelings of physical science educators in the teaching of physical science and the challenges they faced.

### **3.5.2 Planning of interviews**

The planning involved the following steps:

**Identifying respondents:** Laforest (2009:2) asserts that key informants from the community under study are privileged witnesses or people who, because of their position, activities or responsibilities have a good understanding of the problem to be explored. In this study, the respondents were physical science educators, Grade 11 physical science learners and the parents of Grade 11 physical science learners.

**Number of interviews:** Laforest (2009:2) is of the view that semi-structured interviews are a way of supplementing other data collection methods and it may be

sufficient to conduct only a few interviews with key informants from the study and they can also be a way of capturing the concerns and perceptions of groups that have not been contacted via other data sources. In this study, semi-structured interviews were conducted with twelve parents and at least twelve educators. The researcher felt that it would be a sufficient number since it was not the only instrument used in this study.

**Preparing interviews and interviewing respondents:** Planning involves studying the interview plan, drawing up a consent form specifying the rules of the interview and confidentiality commitment, contacting the respondent, sending the consent form and interview plan to the respondent, preparing the equipment for recording the interview and contacting the respondent again to confirm the date and location of the interview (Chenail 2009:20).

During the interview which lasted between thirty to sixty minutes, physical science educators were asked about the challenges they experienced with the teaching of physical science while the parents were asked about the extent in the understanding of the importance of science and their involvement in the education of their children. These interviews were conducted when both the parents and physical science educators were free. The educators and parents were assured of the confidentiality of the study and were informed that a tape recorder was used with the interviewee's permission during the sessions.

### **3.6 OBSERVATIONS**

Marshal & Rossman (1989, in Kawulich 2005:78) define observations as a systematic description of events, behaviours and artefacts in the social setting chosen for the study. Accordingly, observations enabled the researcher to describe the existing situations using all five senses in a written paragraph about the situation under study.

Observations according to Kawulich (2005):

- Provide researchers with ways to check for non-verbal expressions of feelings
- Determine who interacts with whom
- Grasp how participants communicate with each other

- Check how much time is spent on various activities.

Tylor and Bogdan (1984, in Kawulich 2005:82) suggest the following as tips for collecting useful observational data. They suggest that researchers should be unobtrusive with regard to dress and actions, become familiar with the setting before beginning to collect data, keep the observations short at first to avoid becoming overwhelmed, they should be honest, but not too detailed, in explaining to participants what he or she is doing.

For the purpose of this study, permission was sought from the Eastern Cape Provincial Education Department, the District Director in the Libode District and the principals of the chosen schools to do observations.

While gathering data through interviews, observations were also carried out and hesitations in answering or facial expressions reflecting various unspoken emotions, fears, aspirations and hopes were also noted. In addition, the physical resources in the schools were also observed. In addition, the learners were observed during the teaching time and much attention was focussed on the attitudes of learners towards physical science during the lessons.

### **3.7 NON- STANDARDISED TESTING**

In order to determine whether high school physical science learners knew the basic Grade 10 physical science concepts, a non-standardised test was administered to Grade 11 physical science learners. The test was also aimed at assessing the learners' level of competency with regard to most physical science fundamental concepts.

The test contained questions on laboratory safety, the laboratory apparatus, the common names of chemicals found in the laboratory, conversion from other units to SI units and vice-versa and lastly, the basic knowledge of physical science concepts was tested.

### **3.8 VALIDITY AND RELIABILITY OF RESEARCH INSTRUMENTS**

Due to the multiplicity of measuring instruments available to researchers conducting either qualitative or quantitative research, the need to set out criteria for the evaluation of such instruments is inevitable. The validity and reliability of the instruments are therefore two important criteria for evaluating the research instruments (Olowatayo 2012:394).

#### **3.8.1 Validity**

McBurney & White (2007:169) define validity as the degree to which a test or measuring instrument actually measures what it purports to measure or how well the test or measuring instrument fulfils its function. In this study, both the content and construct validity of the research instruments were considered. Babbie (2007:114) defines content validity as that which shows the degree to which a measuring instrument covers the range of meanings included in that concept, while Walden (2012) in Olowatayo (2012:398) defines the construct validity as the extent to which the operational definition of a variable reflects the actual theoretical meaning of the concept.

In order to ensure the validity, after drafting the research instruments, the researcher asked the supervisor to check the validity of the instruments before administering them.

#### **3.8.2 Reliability**

Blowing (2009:163-164) views reliability in quantitative research as synonymous to dependability, reproducibility or replicability over time, over instruments and over groups of respondents, while reliability in qualitative research is that which strives to record the multiple interpretations of intentions and meanings accorded to situations and events. Golafshani (2003:599) suggests that reliability in qualitative research should be replaced with terms such as credibility, neutrality, conformability, dependability, consistence, applicability, trustworthiness and transformability.

In order to guard against unreliability, the researcher made sure that the measuring instruments are piloted, revised and given to supervisor for final checking.

### **3.9 DATA COLLECTION**

The letter from the Eastern Cape Provincial Education Department granted the researcher permission to conduct research in six public high schools in the Libode District. The researcher visited each school for four consecutive days. The first day at each school was used by the researcher to introduce himself to the school management, explain the main purpose of the research and collect lists of all Grade 11 physical science learners as well as making arrangements with the science department .

The second day was used for the self- administering of questionnaires and the completion of questionnaires by both learners and educators in the presence of the researcher. The questionnaires were collected after completion to ensure the following:

- A 100% response rate
- An opportunity to further elaborate the purpose of the study
- To establish rapport
- To clear any misunderstandings from respondents
- To give the researcher a chance to judge the seriousness with which the respondents took the whole exercise which will also be useful when interpreting data.

Day three was used for conducting interviews with physical science educators and parents. The interviews were expected to last between thirty to sixty minutes and the researcher first assured both parents and teachers of the confidentiality that was kept throughout the interview and a tape recorder was used in the interview with the permission of the interviewees. The last day was used to give standardised tests to grade 11 physical science learners and to do observations.

### **3.10 DATA ANALYSIS**

Shamoo & Resnik (2003:98) defines data analysis as the process of systematically applying statistical and or logical techniques to describe and illustrate, condense and recapitulate and evaluate data. Various analytic procedures provide a way of

drawing inductive inference from the data and distinguishing the signal from the noise present in the data (Savenye & Robinson 2004:261). The data were analysed on the basis of the responses given by the respondents. A total of 120 learner's questionnaires and twelve educator's questionnaires were completed and collected. Twelve educators and twelve parents were also interviewed. The researcher examined each of the responses and analysed the data elicited from the responses given by the respondents.

The main methods of data analysis used were descriptive statistics and inferential statistics for quantitative research. White (2002:85) lists the following advantages of descriptive statistics and inferential statistics. Descriptive statistics are essential for arranging and displaying data and form the basis of rigorous data analysis as this is much easier to use, interpret and discuss than raw data. It also examines the tendencies, spread, normality and reliability of the data. Inferential statistics provide more detailed information than descriptive statistics and also give insight into relationships between variables and generate convincing support for a given theory. In qualitative research, "quote research" is used to analyse the data. White (2002:95) asserts that we use quote research from the interviews as illustrations or confirming examples. Interviews can also be analysed by taking constructions gathered from the context and reconstructing them into meaningful whole (Johnson & Christensen 2008:210)

### **3.11 ETHICAL CONSIDERATIONS**

Welman, Kruger and Mitchell (2005:181) assert that ethical and legal practices are imperative in any research that is undertaken. This implies that everyone must adhere to universal ethics such as honesty and maintaining respect to the rights of the individuals. Johnson and Christensen (2008:143) identify the following ethical issues that researchers should take into account: Informed consent, avoidance of harm, violation of privacy, anonymity, confidentiality, deceiving respondents and respect for human dignity.

Before collecting any data, permission was sought from the Eastern Cape Education Department. The researcher then took the approval letter to the district office where the district director wrote a letter that was taken to the principals of six

schools in the Libode District. Meetings were arranged with school principals to discuss how and when the research would be conducted. Informed consent letters were also sent to physical science educators, learners and parents. The researcher also maintained confidentiality with regard to the research.

### **3.12 CONCLUDING REMARKS**

In this chapter, the researcher discussed the research design, population and sampling, the research instruments, the validity and reliability of research instruments, the data collection process, data analysis and ethical considerations when conducting research. After collecting the data, they were analysed and results derived from this analysis are interpreted and discussed in the next chapter.

## **CHAPTER 4: DATA ANALYSIS AND PRESENTATION OF FINDINGS**

### **4.1 INTRODUCTION**

This chapter will analyse and present the data collected in order to understand how school related factors and home related factors are associated with poor performance in physical science in selected schools in the Libode District, Eastern Cape. A mixed methods approach was used during this investigation and the tools used included an educator questionnaire, a learner questionnaire, an interview guide for physical science educators and an interview guide for parents, learner non-standardised tests. These tools are in Appendices A, B, C, D, E and F respectively. Lastly, the physical resources and observable behaviours of learners were also observed.

#### **4.1.1 Analysis and presentation of questionnaires and interviews**

An educator questionnaire was administered to physical science educators and a learner's questionnaire was administered to physical science learners. Interviews were held with physical science educators and the parents of learners who were doing physical science. The data were analysed and are presented in accordance with the views of physical science educators, physical science learners and parents. Their views obtained by means of questionnaires will be presented as tables, while descriptive statistics are used to report the results. The analysed data can help us to understand how both school related and home related factors cause poor performance in physical science so that solutions and meaningful recommendations can be offered to solve this problem.

One hundred and twenty learner questionnaires were administered to and collected from learners. Twelve questionnaires were also issued and collected from educators. Twelve physical science educators and twelve parents of children who were doing physical science were also interviewed. This means that all the selected respondents responded providing a combined response rate of 100%.

## **4.2 DATA ANALYSIS OF THE RESPONSES RECEIVED FROM THE EDUCATORS' QUESTIONNAIRES AND THE INTERVIEWS HELD WITH THEM**

This section presents an analysis and discussion of the data obtained from both the educators' questionnaires as well as the interviews with the educators.

### **4.2.1 Personal information of the physical science educators**

The personal information of the physical science educators was obtained from section A of the questionnaire and includes the gender, number of years of teaching physical science, the highest qualification obtained, the post level of the educator and whether the educator was teaching the subjects that he or she was qualified to teach.

#### **4.2.1.1 Gender of physical science educators**

It was important to note the number of female teachers that participated in this study to determine whether they would provide significantly different views from male teachers. Table 4.1 presents the data related to the gender of physical science educators participating in this study.

**Table 4.1: Gender of physical science educators**

<b>Physical sciences educators</b>	<b>Total number</b>	<b>Percentage</b>
Male	9	75
Female	3	25
<b>Total</b>	<b>12</b>	<b>100</b>

The information provided in Table 4.1 indicates that the population of male teachers (75%) is much higher than that of female teachers (25%).

#### **4.2.1.2 Number of years of teaching experience**

Table 4.2 shows the data concerning the responses of physical science educators regarding the number of years they had been teaching physical science. The majority of the educators (58%) were inexperienced as they had between 0 and 6

years of teaching experience, while 25% of the educators had between 6 and 10 years of teaching experience and 16,7% had between 11 and 15 years of teaching experience. There were no educators who had teaching experience of more than 15 years.

**Table 4.2: Number of years of teaching physical science**

Number of years of teaching experience	Number	Percentage
0-6 years	7	58,3
6-10 years	3	25
11-15 years	2	16,7
More than 15 years	0	0
<b>Total</b>	<b>12</b>	<b>100</b>

#### 4.2.1.3 Highest teaching qualification of educators

The table represents the highest teaching qualifications of physical science educators

**Table 4.3: Highest teaching qualification of physical science educators**

Qualification	Number	%	Qualification	Number	%
National Professional Diploma in Education	0	0	Post- Graduate Diploma in Education	0	0
3 Year Diploma	0	0	Bachelor of Technology	0	0
4 year diploma	0	0	National Diploma (Technical)	1	8,4
Bachelor of Education	5	41,6	Doctorate in other fields	0	0
Advanced Certificate in Education	0	0	Master's in Education	0	0

Qualification	Number	%	Qualification	Number	%
Honours in other fields	1	8,4	Bachelor of Primary Education	0	0
Post Graduate Certificate in Education	0	0	Doctorate in Education	0	0
Bachelor of Education Honours degree	2	16,6	Advanced Diploma in Teaching	0	0
Early childhood development	0		Advanced Diploma in Education	0	0
			Other	3	25

Table 4.4 indicates the responses of physical science educators concerning their highest teaching qualifications. The majority of these educators had a Bachelor of Education degree as their highest qualification (41, 6%). Some educators indicated that they had an honours degree in Education (16, 6%). Twenty five percent had a Bachelor of Science degree. Some educators were not officially qualified to teach physical science. Eight comma four percent (8, 4%) had a national diploma (technical) and 8, 4% had an honours degree in other fields. These qualifications are suitable for industrial purposes, but not in the classroom.

**Table 4.4: Highest teaching qualification of physical science educators**

Qualification	Number	Percentage
Bachelor of Education	5	41,6
Honours in other fields	1	8,4
Bachelor of Education Honours degree	2	16,6
National Diploma (Technical)	1	8,4
Bachelor of Science degree	3	25
Total	12	100

#### 4.2.1.4 Subject specialisation, grade and subject taught by the educator

Table 4.5 presents the responses of physical science educators regarding whether they were teaching the grades and subjects in which they had specialised during their training courses.

**Table 4.5: Subject specialisation, grade and subject taught by educators**

Teaching the grade and subject specialised in during teacher training course	Number	Percentage
Yes	7	58,3
No	5	41,7
<b>Total</b>	<b>12</b>	<b>100</b>

Fifty-eight comma three percent (58, 3%) of the educators answered by saying yes while 41, 7% of the educators answered by saying *no*.

#### 4.2.1.5 Post levels of physical science educators

Table 4.6 shows the post levels of physical science educators in selected schools in the Libode District.

**Table 4.6: Post levels of physical science educators**

Post Level	Number of educators	%
Post level 1	11	91,7
Post level 2	1	8,3
Principal/ Deputy Principal	0	0
<b>Total</b>	<b>12</b>	<b>100</b>

Table 4.6 indicates that 91, 7 % of the physical science educators were on post level 1 while only 8, 3% of the educators were on post level 2. There were no physical science educators who were principals or deputy principals.

#### 4.2.2 Availability of resources

This section of the questionnaire attempted to find out the extent to which physical science educators rated the availability of different resources in their schools that were vital for teaching and learning to take place.

##### 4.2.2.1 Availability of laboratories

The information in Table 4.7 indicates that 83, 3% of the educators conducted physical science lessons in the classroom, while only 16, 7% taught physical science classes in the laboratory.

**Table 4.7: Educators' responses on the availability of laboratories**

	Number	Percentage
Laboratory	2	16,7
Classroom	10	83,3
<b>Total</b>	<b>12</b>	<b>100</b>

##### 4.2.2.2 Availability of material resources and human resources

Table 4.8 contains variables that attempt to ascertain the availability of various resources whose availability affects teaching and learning in a physical science classroom. For the purpose of the discussion of the tables, the variables were rated according to the scale of *more than enough*, *enough* and *not enough*. The values attributed to *more than enough* and *enough* were grouped together to mean that the resources were available.

A critical analysis of Table 4.8 reveals that the majority of physical science educators indicated that there was a shortage of physical science resources. Resources that were rated as in shortage included: chemicals to conduct practicals (66, 6%), chairs for learners to sit on (83, 3 %), enough physical science educators (66, 6%), tables for learners to write on (83, 3%) tables to perform experiments (83, 3%), technological equipment (66, 6%). Resources that were rated as enough by physical science educators included: physical science textbooks and policy documents (100%).

**Table 4.8: Availability of material and physical science resources**

Resources	Rating				Total
		More than enough	Enough	Not enough	
Chemicals to conduct practicals	N	2	2	8	12
	%	16,7	16,7	66,6	100
Chairs for learners to sit on	N	0	2	10	12
	%	0	16,7	83,3	100
Tables for learners to write on	N	0	2	10	12
	%	0	16,7	83,3	100
Tables to perform experiments on	N	0	2	10	12
	%	0	16,7	83,3	100
Physical science textbooks and policy documents	N	4	8	0	12
	%	33,4	66,6	0	100
Enough physical science educators	N	0	4	8	12
	%	0	33,4	66,6	100
Technological equipment (computers, projectors, tablet)	N	2	2	8	12
	%	16,7	16,7	66,6	100

The physical science educators were also interviewed and they cited the shortage of resources as a challenge hindering effective lesson delivery. The following question was posed to physical science educators: “As a physical science educator, what are the challenges that you encounter during lesson delivery?”

These are some of their responses:

- *It is difficult to introduce a new topic due to the fact that learners may have gone for a year or two without a physical science educator and so, they may not have the background content for the previous grade.*
- *No laboratories; It is difficult to teach topics that require practical work.*
- *Classes are overcrowded due to the shortage of teachers, meaning that you cannot attend to each and every learner.*

Through observations of learners, it was clear that classrooms were overcrowded as the chairs and desks were not enough for learners to sit on. Some learners were

sitting on bricks while others were standing whilst the teacher was delivering his lesson. Only School F had enough chairs and desks for the learners plus a fully equipped laboratory. The physical science educators also revealed that even if they were confident about doing practical work, the overcrowding of classrooms together with the shortage of equipment hinder them from administering these practicals effectively.

The physical science educators were also asked the following question: “Is there any link between the availability of resources and the strategies that you use when teaching physical science? Explain.” These are some of their responses:

- *Yes, there is a strong link because if you have a laboratory, it is easy to demonstrate practicals and complement it with theory.*
- *Yes, our school does not have a laboratory so our learners rely on text books and so we only explain the practical aspects of the topic to the learners.*
- *Yes, our school does not have computers and projectors so we use the chalkboard to teach and it is difficult to clearly explain some of the concepts.*

According to the 2015 National Senior Certificate Diagnostic Report, most candidates failed to answer questions that required them to know the basic skills to interpret graphs. This clearly shows that learners were not exposed to exercises that required practical work from Grade 10 already (Republic of South Africa 2015:185). The following question was also posed to physical science educators: “How are the Grade 12 learners performing at your school?” One educator responded by saying that their performance is far below average because they had had no physical sciences educator for the past three years.

#### **4.2.3 Depth of the physical science curriculum**

Table 4.9 presents the responses from physical science educators to the following question “Which section of physical science do you find challenging to teach?”

**Table 4.9: Depth of the physical science curriculum**

<b>Subject content</b>	<b>Number</b>	<b>Percentage</b>
Chemistry	5	41,6
Physics	2	16,7
Both physics and chemistry	3	25

Subject content	Number	Percentage
Non	2	16,7
<b>Total</b>	<b>12</b>	<b>100</b>

It can be seen from Table 4.9 that 41, 6 % of the physical science educators had difficulties with teaching chemistry, while 16, 7% had difficulties with teaching either physics or were uncomfortable with teaching both physics and chemistry. Twenty-five percent (25%) of the physical science educators had difficulties with teaching both physics and chemistry.

As a follow up to this, physical science educators were asked the following question: “How often do you give learners problems that require mathematical calculations in physical science?” It can be seen in Table 4.10, that only a small number of educators gave learners problems that required mathematical calculations in physical science and every lesson on those topics involved calculations (16,7%), while the majority of educators gave the problems after completing a topic (75%) or after completing two topics (8, 3%).

**Table 4.10: Problems that involve mathematical calculations**

How often do you give learners problems that involve mathematical calculation	Number	Percentage
Every lesson in topics that involve calculations	2	16,7
After completing one topic	9	75
After completing two topics	1	8,30
<b>Total</b>	<b>12</b>	<b>100</b>

Physical science educators were also interviewed on aspects related to subject content. The following question was posed to physical science teachers: “How confident are you when doing practicals?” These are some of their responses:

- *Very confident.*

- *100% confident; at university we were doing a lot of practicals.*
- *Confident but there is no material.*
- *Very confident; I usually do the practical prior to doing the practical with learners.*

Some physical science educators also indicated that they had challenges with explaining calculations to learners. This resulted in learners performing extremely badly in problems that involved calculations (Department of Education 2015:175).

#### 4.2.4 Medium of instruction

In an attempt to find out what language of instruction was used frequently by physical science educators in class, the following question was asked: “What language do you use for teaching in your physical science class?” Table 4.11 presents the responses of the physical science educators.

**Table 4.11: Language used for teaching in a physical science class**

Language used for teaching in a physical science class	Number	Percentage
English only	4	33,3
Combination of home language and English	8	66,7
Educator’s home language	0	0
Other languages	0	0
<b>Total</b>	<b>12</b>	<b>100</b>

The responses presented, show that less than 40% of the educators used English only as the language of instruction during a physical science class, while 66, 7% used a combination of both English and the learner’s home language as the medium of instruction in a physical science. None of the educators used their home language and other languages found in South Africa.

When physical science educators were asked about the challenges that they encountered during the lesson delivery, some of them gave the following responses:

- *Learners are not able to speak or understand English so the teacher has to interpret in IsiXhosa.*
- *Learners are not good in English and so it is difficult for them to understand some scientific terms.*
- *English is like a barrier in rural areas and so it takes time for learners to comprehend what you will be explaining to them.*

The following question was also posed to physical science educators: “Do learners whose home language differs from the medium of instruction have problems in understanding content in physical science?” These are some of their responses:

- *Yes, those with a poor English language background do have problems because physical science is a practical subject which has terms centred on the use of English Language.*
- *Yes, even if the teacher uses both their (learner’s) home language and English language, learners have difficulties in answering questions in the examinations.*

Through observations of the learners, it was clear that most of them had difficulties with communicating with their teachers due to language barriers. In instances where the educator used the learners’ home language (Isixhosa), most learners would not hesitate to communicate with the educator without any difficulties. For those learners who used English, their ability to express themselves was extremely poor and more often, they would require the assistance of their friends to translate what was said by the educator and such learners were hesitant about communicating with their educators.

### 4.3 TEACHING METHODS

Table 4.12 gives the responses of physical science educators on aspects related to the teaching methods that they used in their physical science classes.

**Table 4.12: Teaching methods**

		Never	Seldom	Usually	Always	Total
Allow learners to discover the lesson content by using interesting teaching Strategies	Number	0	7	5	0	<b>12</b>
	%	0	58,3	41,7	0	<b>100</b>
Succeed in capturing learner's interests during the process of learning	Number	0	4	8	0	<b>12</b>
	%	0	33,3	66,7	0	<b>100</b>
Use a variety of teaching methods	Number	0	1	5	6	<b>12</b>
	%	0	8,3	41,7	50,0	<b>100</b>
Make use of different learning activities	Number	0	5	7	0	<b>12</b>
	%	0	41,7	58,3	0	<b>100</b>

Close to sixty percent (60%) of the educators rarely allow their learners to discover the lesson content by using interesting teaching strategies. It can be noted that some educators used different teaching strategies as teaching and learning approaches in their physical science classes. Educators responded positively to the following statements: Make use of different learning activities (58.3%), Succeed in capturing learner's interests (66, 7%). More than forty percent (41,7%) of the educators responded by saying that "they usually do" to the following statements:

“How often do you use a variety of teaching methods as teaching and learning approaches in your physical science class?”, “How often do you allow learners to discover lesson content by using interesting teaching strategies?” Although fifty percent (50%) of the educators used a variety of teaching methods in their physical science classes, there were some educators who rarely succeeded in capturing the learner’s interest in the learning process (33, 3%) and who used a variety of these teaching methods (8, 3%).

#### 4.4 ATTITUDES TOWARDS PHYSICAL SCIENCE

Table 4.13 represents the responses of physical science educators to the following question: “Do you enjoy teaching physical science?”

**Table 4.13: Attitudes of physical science educators towards the subject**

Do you enjoy Physical science?	Number	Percentage
Yes	8	66,7
No	4	33,3
<b>Total</b>	<b>12</b>	<b>100</b>

Table 4.13 indicates that (66, 7%) responded by saying *yes*, while 33, 3% responded by saying *no*. The following question was posed to physical science educators: “How are the grade 12 learners performing at your school?” The following were some of their responses:

- *Bad because, most learners were pushed to grade 12 and they are not serious with their school work.*
- *Below average because they (learners) seem not to be serious. They do very little reading after school.*

Only educators from School F replied that they were satisfied with the performance of their learners. School F seem to have enough resources in comparison with other schools.

## 4.5 THE CHANGING CURRICULUM

Table 4.14 gives the responses of physical science educators to the following question: “What are your views on the changing curriculum?”

**Table 4.14: Views of physical science educators on the changing curriculum**

Views on changing curriculum	Number	Percentage
Confuses learners	3	25
Learners easily adapt to the new curriculum	2	16,7
Teachers easily adapt to the new curriculum	2	16,7
Confuses teachers	5	41,6
<b>Total</b>	<b>12</b>	<b>100</b>

Most physical science educators were of the view that continuous change in the curriculum by the Department of Education confused educators (41, 6%). The same number of educators were of the view that learners and educators easily adapted to the new curriculum (16, 7%) while twenty-five percent 25% of the educators were of the view that changing the curriculum confuses learners.

The following question was posed to physical science educators: “Do you think the continuous change in curriculum by the Department of Education affects the performance of learners in physical science?” These are some of their responses:

- *Yes; the questioning style also changes.*
- *Yes; teachers do not easily adapt to changes in curriculum so they might end up teaching learners the wrong content.*

According to the Curriculum and Assessment Policy Statement (CAPS), Grade 11 learners are supposed to add three vectors by resolving them into horizontal and vertical components. During a lesson observation on the addition of vectors, most educators were using the triangle method which was relevant in the National

Curriculum Statement (NCS) curriculum. In addition, the question papers for the March and June 2015 examinations for three of the selected schools were set using the old National Curriculum Statement (NCS) format.

Physical science educators were asked the following question: “In your opinion, what do you think can be done in order to improve performance in physical science? Some of them were of the opinion that the performance in physical science could only improve if there was a change in attitudes on the learner’s side, if natural science (Grades 7 to 9) was taught by qualified science educators, if learners were grouped according to their abilities and if physical science learners were exposed to practical work.

#### 4.6 PARENTAL INVOLVEMENT

This section seeks to examine the extent to which parents are involved in the education of their children and to find out how the performance of learners in physical science is affected by parental involvement. For purposes of discussion, the items are rated on the tables according to the scale of never, rarely, sometimes, frequently and *very frequently*, the values attributed to *frequently* and *very frequently* are grouped together while those related to *rarely* and *sometimes* were also grouped together as they all mean less frequently.

**Table 4.15: Physical science educators’ opinions on parental involvement**

		Never	Rarely	Sometimes	Frequently	Very frequently
Do parents come to school to discuss the education of their children?	Number	2	8	2	0	0
	%	16,7	66,6	16,7	0	0
Do parents provide their children with enough materials/ resources to do their school work?	Number	5	2	5	0	0
	%	41,7	16,6	41,7	0	0
	Number	7	4	1	0	0

		Never	Rarely	Sometimes	Frequently	Very frequently
Do parents help their children to complete assignments and homework?	%	58,3	33,3	8,4	0	0
If there are educational trips, do parents pay for their children's expenses?	Number	5	2	2	2	1
	%	41,6	16,7	16,7	16,7	8,3

Table 4.15 gives the responses of physical science educators to aspects related to the involvement of parents in the education of their children. More than forty percent (40%) of the educators signified that parents were never involved when asked the following questions: “Do parents provide their children with enough materials/ resources to do their schoolwork” (41, 7%), “Do parents help their children to complete assignments and homework” (58, 3%), “If there are educational trips, do parents pay for their children’s expenses?” (41, 7%). Most parents did not come to school to discuss the education of their children. More than eighty percent (80%) of the educators asserted that parents usually come less often to school when asked the following question: “Do parents come to school to discuss the education of their children?” (83, 3%) while 16% of the educators replied that parents never came to school. Less than sixty percent (60%) of the educators also selected *less often* with regard to parents doing the following: “Do parents provide their children with enough material/ resources to do their schoolwork?” (58, 3%), “Do parents help their children to complete assignments and homework?” (41, 4%), “if there are educational trips, do parents pay for their children’s expenses?” (33, 4%). Twenty five percent (25%) of the educators indicated that parents often paid for their children’s expenses if there were educational trips.

The physical science educators were also asked to give their opinions on whether the socio- economic status of the parents affected the performance of learners. These were some of their responses:

- *To a certain extent, most learners are not exposed due to family background.*
- *Yes, most learners from well up families do not take their school work seriously while those from poor families may not concentrate in class because of issues at home.*

#### **4.7 DATA ANALYSIS OF RESPONSES RECEIVED FROM BOTH THE LEARNERS' QUESTIONNAIRES AND THE INTERVIEWS WITH THEIR PARENTS**

The information presented was collected from one hundred and twenty (120) questionnaires received from Grade 11 physical science learners and twelve (12) parents. The questionnaire was designed to obtain information about what learners view as school related factors associated with poor performance in physical science in the Libode District in the Eastern Cape and the responses from parents were sought to understand how home related factors affected the performance in physical science.

##### **4.7.1 Personal Information of physical science learners**

This information includes:

- Gender
- Age
- Number of years in grade.

##### **4.7.1.1 Gender of learners**

It is important to see how many female learners participated to determine if they will provide any significantly different views from the male learners. Table 4.16 represents data regarding the gender of physical science learners.

**Table 4.16: Gender of learners**

	<b>Number of learners</b>	<b>Percentage (%)</b>
Male	49	41
Female	71	59
Total	120	100

According to the information obtained from the table, fifty-nine (59%) of the learners were females and 41% of the learners were males.

#### 4.7.1.2 Age groups of learners

It is clear from Figure 4.17 that 5% of the learners were aged 16 years and younger, 18% were aged 17 years, 23% were aged 18 years, 29% were 19 years old and 25% were 20 years old and above. This age distribution shows that a small number of learners reached Grade 11 at the age of 16 years and below, whilst the majority reached Grade 11 when they were 17 years of age and above. The reason may be that most of these learners have repeated a grade in their school careers or had started school late. This viewpoint is supported by the information in Figure 4.18 which shows the number of years the learner was enrolled in Grade 11.

**Table 4.17: Age groups of learners in six schools**

Age group of learners	Number	Percentage
16 years and younger	6	5
17 years	22	18
18 years	27	23
19 years	35	29
20 years and older	30	25
Total	120	100

**Table 4.18: Number of years in Grade 11**

Number of years in grade 11	Number	Percentage
1 year	83	69,2
2 years	29	24,2
3 years	7	5,8
4 years	1	0,8
Total	120	100

The appropriate age for Grade 11 is 16 years and younger. According to Figure 4.17, only six learners were 16 years and younger, this means that most of the learners started school late or had repeated a grade.

#### 4.8 MEDIUM OF INSTRUCTION

All the schools in the Libode District consisted of learners whose home language was isiXhosa. In physical science, the language of instruction and assessment was English. This section therefore sought to find out whether learners from the Libode District were efficient in English and how English as a medium of teaching and learning affected the performance of learners in physical science.

##### 4.8.1 Language of instruction used by the educator

Table 4.19 presents the responses of physical science learners regarding the language of communication used by educators during their physical science lessons.

**Table 4.19: Language used by physical science educators during a science class**

Language used by educator during a Physical science class	Number	Percentage
Teacher's home language	1	0,8
Learner's home language	2	1,7
Learner's home language and English	61	50,8
English only	56	46,7
Other	0	0
<b>Total</b>	<b>120</b>	<b>100</b>

Table 4.19 reveals that 50, 8 % of the learners responded that their educators used a combination of the learner's home language and English language as the medium of instruction during the lesson. This is followed by 46, 7% who indicated that their physical science educators were using English only. This is followed by

1, 7% who revealed that their educators used IsiXhosa only and 0, 8% who stated that their educators used their home language only (educator's home language).

#### 4.8.2 Number of learners who understood the language of instruction

Table 4.20 presents the responses of physical science learners to the question: "Do you understand the language used by your educator during the physical science lesson?"

**Table 4.20: Number of learners who understood the language of instruction**

Do you understand the language used by the educator in the Physical science class?	Number	Percentage
Yes	99	82,5
No	21	17,5
<b>Total</b>	<b>120</b>	<b>100</b>

Table 4.20 shows that 82, 5 % responded with yes, while 17, 5% responded with a *no*. This may mean that such learners would have problems in understanding important concepts in a physical science class.

#### 4.8.3 Language of instruction learners would prefer their physical science educator to use

Table 4.21 represents the responses of physical science learners on aspects related to the language of instruction they would prefer their physical science educator to use.

**Table 4.21: Language of instruction preferred by learners in a physical science class**

Language of instruction preferred by learners in a Physical science class	Number	Percentage
Learner's home language	7	5,8
English only	22	18,4

Language of instruction preferred by learners in a Physical science class	Number	Percentage
Both home language and English	91	75,8
Other	0	0
<b>Total</b>	<b>120</b>	<b>100</b>

Seventy-five comma eight percent (75, 8%) of the learners preferred both English and their home language, while 18, 4% preferred English only and 5, 8% preferred their home language.

#### 4.9 OPINION SURVEY

This section attempted to determine the opinions of physical science learners on the different variables listed. For the purpose of the discussion, where items were rated according to the scale of *strongly disagree*, *disagree*, *uncertain*, *agree* and *strongly agree*, the values attributed to *strongly disagree* and *disagree* were grouped together while those attributed to *agree* and *strongly agree* were also grouped together on the tables.

##### 4.9.1 Educators' ways of teaching

Table 4.22 gives the responses of physical science learners on matters related to their educators' ways of teaching.

**Table 4.22: Responses of learners on aspects related to educators' ways of teaching**

Statement related to ways of teaching		Rating					Total
		Strongly disagreed	Disagree	Uncertain	Agree	Strongly agree	
I enjoy physical science lessons.	Number	22	13	9	66	10	<b>120</b>
	%	18,3	10,9	7,5	55	8,3	<b>100</b>
	Number	9	24	15	43	29	<b>120</b>

Statement related to ways of teaching		Rating					Total
		Strongly disagreed	Disagree	Uncertain	Agree	Strongly agree	
I am inspired by my physical science teacher to work extra hard.	%	7,5	20	12,5	35,8	24,2	<b>100</b>
We always do experiments during our physical science lessons.	Number	21	42	21	30	6	<b>120</b>
	%	17,5	35	17,5	25	5	<b>100</b>
Science has relevance in life.	Number	5	9	17	60	29	<b>120</b>
	%	4,2	7,5	14,2	50	24,1	<b>100</b>
I am confident that I will pass physical science	Number	8	15	23	38	36	<b>120</b>
	%	6,7	12,5	19,2	31,6	30	<b>100</b>

More than half of the physical science learners agreed or strongly agreed to the following statements: “I enjoy physical science lessons” (63, 3%), “I am inspired by my physical science educator to work extra hard” (60%), “Physical science has relevance in life” (74, 2%).

It is extremely important to note that a number of learners disagreed or strongly disagreed with the following statement: “We always do experiments during our physical science lessons” (69, 2%). Some of the learners were uncertain about the following statements: “I enjoy physical science lessons” (7, 5%), “I am inspired by my physical science educator to work extra hard” (12, 5%), “We always do

experiments during our physical science lessons” (17, 5%). Most of the learners were confident that they were going to pass physical science. Sixty-one comma seven percent (61, 7%) of the physical science learners agreed or strongly agreed with the following statement: “I am confident that I will pass physical science.” However, some learners disagreed or strongly disagreed to the statement (19, 2%), while 19, 1% of the learners are uncertain as to whether they would pass or not.

#### 4.9.2 Class sizes

Table 4.23 reflects that 55, 8% of the physical science learners agreed that their classrooms were overcrowded, while 30% learners were of the opinion that their classrooms were not overcrowded. Fourteen comma two percent (14, 2%) of the physical science learners did not know whether their classrooms were overcrowded or not.

**Table 4.23: Responses of learners on aspects related to class size**

		Rating					Total
		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	
Our classrooms are overcrowded	Number	14	22	17	37	30	<b>120</b>
	%	11,7	18,3	14,2	30,8	25	<b>100</b>

#### 4.9.3 Continuous changes in the curriculum by the government

Some learners felt that it was not a good idea for the government to change the curriculum often. Table 4.24 shows that 40% of the physical science learners strongly disagreed or disagreed with the continuous changes in the curriculum. Since the government is always changing its curriculum, some physical science learners were of the opinion that it was a good idea with 41, 2% agreeing or strongly agreeing with the statement. This may mean that such learners could adapt to the new curriculum easily. Fifteen comma eight percent (15, 8%) of the physical science learners were uncertain regarding whether it was a good idea to change

the curriculum or not. For such learners, it may mean that whether the curriculum was changed or not, the content in physical science remained the same.

**Table 4.24: Responses of learners on aspects related to changes in the curriculum**

		Rating					Total
		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	
		It is a good idea for the government to change the curriculum often	Number	20	28	19	
	%	16,7	23,3	15,8	24,2	20	<b>100</b>

#### **4.10 PARENTAL INVOLVEMENT**

This section seeks to examine the extent to which parents were involved in the education of their children and to find out how the performance of learners in physical science was affected by parental involvement.

##### **4.10.1 Parents' ages**

A total of one hundred and twenty learners (120) from selected schools were asked to complete a questionnaire with questions based on parental involvement. These learners lived with one of the parent categories listed below:

- Both parents (mother and father)
- Mothers only
- Fathers only
- Guardian only

For discussion purposes, the responses are grouped according to the parents with whom the learners lived and the ages of their parents are presented in Tables 4.25 to 4.28

**Table 4.25: Ages of parents where learners lived with both their parents**

Age	Mother	%	Father	%
50 years and above	10	20,8	16	33,3
45 – 50 years	8	16,7	16	33,3
40 -45 years	10	20,8	13	27,1
35 – 40 years	13	27,1	3	6,3
30 – 35 years	7	14,6	0	0
Below 30 years	0	0	0	0
<b>Total</b>	<b>48</b>	<b>100</b>	<b>48</b>	<b>100</b>

Table 4.25 reveals that forty-eight (48) learners indicated that they were living with both parents. Of these 48 learners, 20, 8% stated that their mothers were between the ages 50 years and above with 33, 3% of their fathers between the ages of 50 years and above. Sixteen comma seven (16, 7%) shared that their mothers were between the ages of 45 and 50 years with 33, 3% of their fathers were in the same age range of 45 to 50 years. Some learners had parents who were between the ages of 40 and 45 years. Table 4.25 depicts that 20, 8% had mothers who were between the ages of 40 and 45 years and 27, 1% had fathers who were between the ages of 40 and 45 years. Twenty-seven comma one (27, 1%) had mothers who were between the ages of 35 and 40 years and 6, 3 % of the learners had fathers who were between the ages of 35 and 40 years. Table 4.25 also shows that 14, 6 % of the learners indicated that their mothers were between the ages of 30 and 35 years and there were no learners with fathers who were in this age group. It can be noted that none of the learners had parents below 30 years of age.

**Table 4.26: Ages of parents where learners lived with their mothers only**

Age	Mother	%
50 years and above	10	20,8
45 -50 years	8	16,7
40-45 years	14	29,1
35- 40 years	6	12,5
30 – 35 years	6	12,5
Below 30 years	4	8,4

Age	Mother	%
Total	40	100

The total number of learners who intimated that they lived with their mothers, was again forty- eight (48). Table 4.26 shows that 20,8% of such learners had parents who were 50 years of age and above, while 16, 8% of the learners indicated that their mothers were between the ages of 45 and 50 years. Twenty-nine comma one (29,1%) indicated that the ages of their mothers ranged between 40 and 45 years while 12,5% stated that their mothers were between the ages of 35 and 40 years and 30 to 35 years. Eight comma four percent (8, 4%) of the learners replied that their mothers were below 30 years of age.

**Table 4.27: Ages of parents where learners lived with their fathers only**

Age	Father	%
50 years and above	3	50
45 – 50 years	2	33,3
40 -45 years	1	16,7
35 – 40 years	0	0
30 – 35 years	0	0
Below 30 years	0	0
<b>Total</b>	<b>6</b>	<b>100</b>

A small number of learners were living with their fathers only. Table 4.27 indicates that only six (6) learners lived with their fathers only. Fifty percent (50%) of the learners indicated that their fathers were 50 years and above, while 33,3% indicated that the ages of their fathers ranged between 45 and 50 years .Only one learner (16, 7%) indicated that his father's age was between 40 and45 years.

**Table 4.28: Ages of parents where learners lived with their guardians only**

Ages	Guardian	%
50 years and above	14	77,7
45 – 50 years	1	5,6
40 -45 years	0	0
35 – 40 years	2	11,1

Ages	Guardian	%
30 – 35 years	0	0
Below 30 years	1	5,6
<b>Total</b>	<b>18</b>	<b>100</b>

Table 4.28 indicates the ages of parents who were guardians to Grade 11 physical science learners. Out of eighteen learners who indicated that they lived with guardians, 77, 7% of these guardians were 50 years and above and only one guardian (5, 6%) was below the age of 30 years. Again, 11, 1% of the learners indicated that their guardians were between the ages of 35 and 40 years while one learner (5, 6%) indicated that their guardian was between the ages of 45 and 50 years.

#### 4.10.2 Parents' occupations

Table 4.29 shows the responses of Grade 11 physical science learners concerning the employment status of their parents. The responses are from learners who stay with mothers only, guardian only or fathers only.

**Table 4.29: Occupation of parents of learners who lived with their mothers only, or their guardians only or their fathers only**

Occupation	Mothers only	%	Guardian only	%	Fathers only	%
Professional/ technical for example teacher, nurse, accountant, engineer	4	8,3	0	0	0	0
Unemployed	42	87,5	17	94,4	3	50
Upper management, for example, senior manager	0	0	0	0	0	0
Middle management, for example, manager	0	0	0	0	0	0
Sales/ manager for example, businessperson	1	2,1	1	5,6	1	16,7
Service work, for example clerk	1	2,1	0	0	0	0

<b>Occupation</b>	<b>Mothers only</b>	<b>%</b>	<b>Guardian only</b>	<b>%</b>	<b>Fathers only</b>	<b>%</b>
Tradesperson, for example, technician	0	0	0	0	2	33,3
<b>Total</b>	<b>48</b>	<b>100</b>	<b>18</b>	<b>100</b>	<b>6</b>	<b>100</b>

Table 4.29 concerning the employment status of their parents, shows the responses of learners who lived with their mothers alone, with their fathers alone or with their guardian alone. The majority of learners (n=48) lived with their mothers only, while only six (6) learners lived with their fathers and eighteen (18) learners lived with their guardians. Eighty-seven point five (87, 5%) of these mothers were unemployed and 50% of the fathers were unemployed, while 94, 4% of the guardians were unemployed. Only 8, 3 % of the mothers were professionals, while there were no fathers or guardians who were professionals. There were no parents in the upper and middle management levels. Two learners (33, 3%) reported that their fathers were tradesman, while there were no mothers or guardians in this occupation. However, 16, 7% of fathers, 5, 6 % of guardians and 2, 1% of the fathers worked in businesses. Only one of the mothers (2, 1%) was in service work while none of the guardians or fathers were in this type of occupation.

**Table 4.30: Occupation of parents of learners who lived with both their parents**

<b>Occupation</b>	<b>Mother</b>	<b>%</b>	<b>Father</b>	<b>%</b>
Professional/ technical, for example, teacher, nurse, accountant, engineer	3	6,2	4	8
Unemployed	42	87,5	38	79,4
Upper management, for example, senior manager	0	0	1	2,1
Middle management, for example, manager	1	2,1	2	4,2
Sales/ manager, for example, businessperson	2	4,2	1	2,1
Service work, for example, clerk	0	0	0	0
Tradesman, for example, technician	0	0	2	4,2
<b>Total</b>	<b>48</b>	<b>100</b>	<b>48</b>	<b>100</b>

Table 4.30 concerning the employment status of their parents, shows the responses of forty-eight physical science learners who lived with both parents. These learners did not have parents employed as service workers. Neither did these learners mothers in upper management position or who were tradespeople. Seventy-nine percent (79%) of the fathers and 87, 5% of the mothers were unemployed. Two comma one percent (2, 1%) and 4, 2% of the fathers worked in the business and trade sectors respectively. Six comma two percent (6, 2 %) of the mothers and 8% of the fathers were employed as professionals while 2, 1% of the mothers and 4, 2% of the fathers were employed as middle managers. Lastly, 4, 2% of the mothers and 2, 1% of the fathers were business men and woman.

#### 4.10.3 Parents' total monthly income

Table 4.31 shows the total monthly income of the parents of learners who stayed with either the mother only or the father only or the guardian only. Out of seventy-two (72) parents, only six of them (6, 2%) mothers, (5, 6%) guardian and (33, 3%) fathers had a total monthly income of R10 000 and above, while fifty-nine of them (87, 5%) mothers, (77, 7%) guardians and (50%) fathers earned less than R3 000 a month. This income might have been be the child support or the disability grant from the government. However, 4, 2% of the mothers and 16, 7% of the fathers had an income ranging between R5 000 to R10 000 a month and only four parents 2, 1 % of the mothers and 16, 7% of the fathers had an income ranging between R3 000 and R5 000.

**Table 4.31: Total monthly income of parents of learners who lived with either their father only or their mother only or their guardian only**

Total monthly income	Mothers only	%	Guardian only	%	Father s only	%
R10 000 and above	3	6,2	1	5,6	2	33,3
R5 000 – R10 000	2	4,2	0	0	1	16,7
R3 000 – R5 000	1	2,1	3	16,7	0	0
Less than R3 000	42	87,5	14	77,7	3	50

Total monthly income	Mothers only	%	Guardian only	%	Fathers only	%
<b>Total</b>	<b>48</b>	<b>100</b>	<b>18</b>	<b>100</b>	<b>6</b>	<b>100</b>

Table 4.32 represents the total monthly income of forty-eight parents of learners who stayed with both parents. Eighty-one percent (81, 3 %) of the mothers and 64, 4% of the fathers received an income less than R3 000 a month. A total of eight parents (n= 2) mothers and n = 6 fathers received an income of R10 000 and above. Lastly, 6, 2% of the mothers and 10, 4% of the fathers received an income ranging between R5 000 and R10 000, while four mothers (8, 3%) and six fathers (12, 5%) had an income ranging between R3 000 and R5 000 a month.

**Table 4.32: Total monthly income of parents of learners who stayed with both their parents**

Total monthly income	Mother	%	Father	%
R10 000 and above	2	4,2	6	12,5
R5 000 – R10 000	3	6,2	5	10,4
R3 000 – R5 000	4	8,3	6	12,5
Less than R3 000	39	81,3	31	64,6
<b>Total</b>	<b>48</b>	<b>100</b>	<b>48</b>	<b>100</b>

#### 4.11 OPINION SURVEY

This section summarises the opinions of physical science learners related to the involvement of their parents in their education at home and at school. Twelve parents were also interviewed in order to establish the extent of their involvement in the education of their children. Regarding the tables, where items were rated according to the scale of *strongly disagree*, *disagree*, *uncertain*, *agree* and *strongly agree*, the values attributed to *strongly disagree* and *disagree* were grouped while those attributed to *agree* and *strongly agree* were also grouped together.

#### 4.11.1 Behaviour of parents at home

Table 4.33 gives the responses of learners on aspects related the behaviour of their parents at home. More than forty percent (40%) of the learners agreed or strongly agreed with the following statements: “My parents provide a comfortable place for me to complete my schoolwork” (44, 1%); “My parents remove things that distract me from doing my schoolwork” (41, 7%). Only a few parents asked their learners about their day at school (19, 2%). However some learners were not certain about the following statements:” My parents remove things that distract me from doing my schoolwork” (30%), “My parents ask me about my day at school” (35%), “My parents provide a comfortable place for me to complete my schoolwork” (27,5%), “My parents remove things that distract me from doing my schoolwork” (30%). Some parents did not care about the education of their learners when they got home. This is supported by the responses to the following statements: “My parents remove things that distract me from doing my school work” (28, 3%), “My parents provide a comfortable place for me to complete my homework” (27, 5%), “My parents ask me about my schoolwork” (46, 6%)

All the parents believed that involving themselves in their children’s work could help to improve their performance. This is what some parents had to say:

- *Getting involved in my child’s work helps him because I usually see some improvements where she had no understanding of concepts.*
- *Yes, because children are not the same, some can do better if there is someone helping them.*
- *Great improvement; If the child is enjoying the involvement of the parent.*

Most parents also indicated that their children did not usually ask for their help when faced with a problem with regard to completing their homework. This is what they had to say:

- *No, they think that we do not know the answers.*
- *They do not ask, they leave their books at school.*

All the parents indicated that they did show interest in the education of their children. These were some of their responses to the following question: “Do you show interest in your child’s studies? How?”

- *Very much; I show it by asking her books and see what was done at school.*
- *Very much; I buy everything that he needs at school.*

All the parents thought that it was a good idea for them to get involved in their children's work. Some gave the following reasons:

- *It is important because you will see the strength and the weakness of the child.*
- *The child gets motivated.*
- *I want my child to pass at the end of the year.*
- *It gives the child some confidence.*

Parents were also asked the following question: "Do you think your involvement will make your child comfortable? Why? The following were some of their responses:

- *No, they feel that we are not educated.*
- *Yes, especially if they see some improvement.*
- *They do not feel comfortable; they become grumpy when you try to help them.*

#### **4.11.2 Attitudes of parents towards the education of their children**

Table 4.33 also depicts the responses of learners on aspects related to the attitudes of their parents towards their (the learners') education. Some learners were uncertain as to whether their parents showed some positive attitudes or negative attitudes towards their education. The reason may be that these parents had never discussed anything that had to do with the schoolwork of their children. This was supported by the responses of learners to the following statements: "My parents do not usually ask about my schoolwork" (50,7%), "My parents check my books" (40%), "My parents explain to me about my schoolwork" (35%), "My parents praise me when I complete my work" (32,5%), "My parents provide enough material in helping me do my schoolwork" (29,2%), "My parents come to school to discuss about my education with my teachers" (23,4%)

Some parents showed interest in the schoolwork of their children. More than 30 percent (30%) of the learners agreed or strongly agreed with the following statements: “My parents praise me when I complete my work” (33, 3%), “My parents provide enough material in helping me do my school work” (35, 7%). A few learners agreed or strongly agreed with the following statements about their parents: “My parents check my books” (23, 3%), “My parents explain to me about my school work” (19, 2%).

Some parents were not concerned about the schoolwork of their children. This is supported by the responses of the learners who disagreed or strongly disagreed with the following statements: “My parents explain to me about school work” (46, 7%), “My parents check my books” (36, 7%), “My parents praise me when I complete my work” (34, 2%). Some learners also strongly disagreed or disagreed to the following statements: “My parents do not ask about my school work” (28, 4%), “My parents provide enough material in helping me do my homework” (33, 3%)

The following question was asked of parents: “What is your perception towards parental involvement in children’s work?” These are some of their responses:

- *It is a good practice.*
- *The parent has to witness the strength and weakness of his child.*
- *The parent has to be involved all year round so as to provide the teacher with enough feedback concerning the child.*
- *It is helpful if the parent is involved because it gives the child confidence in doing his work.*

When asked about the kind of help that they gave to their children with regard to reading assignments and homework, some parents gave the following responses:

- *I am not educated, they do not tell us that they were given some work at school, when they get home they just go and play soccer.*
- *I do not help them at all because I am not educated.*
- *I sometimes help where I can.*
- *I do the house chores when my child is doing her homework.*

### 4.11.3 Parental involvement in the school

Table 4.33 depicts the responses of learners on aspects related to the involvement of their parents with their school (the learner’s school). Many learners disagreed or strongly disagreed with the following statement: “My parents come to school to discuss about my education with my teachers” (63, 3%). Twenty–eight learners (2, 4%) were not certain about the same statement while sixteen learners (13, 3%) agreed or strongly agreed with the same statement.

Most parents thought that it was beneficial to have a good connection with their child’s educator. Here is what they had to say:

- *It is a good idea to have a relationship with my child’s educator in order to know whether the child is with me or with the educator.*
- *If I work with the educator, the learner will work extra hard in order to please both me and the teacher.*
- *We must have a relationship as the educator is the parent at school and I am the parent at home.*
- *It becomes easier for me to follow the progress of the child through the educator.*
- *It is important because educators can easily notice if the child has a problem.*

**Table 4.33: Opinion survey**

	1	%	2	%	3	%	4	%	5	%	Total	Total %
My parents do not usually ask me about my school work	23	19,2	11	9,2	61	50,7	23	19,2	2	1,7	120	100
My parents check my books	27	22,5	17	14,2	48	40	26	21,6	2	1,7	120	100
My parents explain to me	34	28,3	22	18,4	42	35	21	17,5	1	0,8	120	100

	1	%	2	%	3	%	4	%	5	%	Total	Total %
about my school work												
My parents ask me about my day at school	30	25	25	20,8	42	35	20	16,7	3	2,5	120	100
My parents come to school to discuss about my education with my teachers	51	42,5	25	20,8	28	23,4	15	12,5	1	0,8	120	100
My parents praise me when I complete my school work	21	17,5	20	16,7	39	32,5	39	32,5	1	0,8	120	100
My parents provide enough material in helping me to do my school work	13	10,8	27	22,5	35	29,2	43	35,8	2	1,7	120	100
My parents provide a comfortable place for me to complete my school work	14	11,7	20	16,7	33	27,5	52	43,3	1	0,8	120	100
My parents ask me if I need to buy anything in order to complete my school work	20	16,7	21	17,5	41	34,2	37	30,8	1	0,8	120	100

	1	%	2	%	3	%	4	%	5	%	Total	Total %
My parents remove things that distract me from doing my school work	19	15,8	15	12,5	36	30	48	40	2	1,7	120	100

#### 4.12 ANALYSIS AND PRESENTATION OF LEARNER NON- STANDARDISED TESTS

The learners' non- standardised tests tried to determine the basic knowledge with which every Grade 11 learner should be familiar with regard to the following concepts

- Laboratory safety
- Laboratory apparatus
- Common names of chemicals found in the laboratory
- Conversions from other units to SI units
- Basic knowledge of physical science concepts

This knowledge is needed by all learners if they are to perform well in physical science. The results of the non-standardised tests are summarised in Table 4.34.

**Table 4.34: Distribution of test scores of learners in each school**

Score (%)	School A (frequency)	School B (frequency)	School C (frequency)	School D (frequency)	School E (frequency)	School F (frequency)
1-5	1	0	1	1	0	0
6-10	0	1	2	1	0	0
11-15	1	0	0	1	0	0
16-20	1	1	3	7	1	0
21-25	1	3	2	2	0	0
26- 30	4	2	2	4	1	0
31-35	4	4	1	1	2	0
36-40	3	2	0	1	7	0
41-45	4	1	5	2	2	0

Score (%)	School A (frequency)	School B (frequency)	School C (frequency)	School D (frequency)	School E (frequency)	School F (frequency)
46-50	1	6	4	0	3	0
51-55	0	0	0	0	4	3
56-60	0	0	0	0	0	9
61-65	0	0	0	0	0	1
66-70	0	0	0	0	0	5
71-75	0	0	0	0	0	1
76-80	0	0	0	0	0	1
81-85	0	0	0	0	0	0
86-90	0	0	0	0	0	0
91-95	0	0	0	0	0	0
96-100	0	0	0	0	0	0
<b>N</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>

The mean for the six schools was calculated as follows:

**Table 4.35: Calculating the mean for the schools**

<b>School A</b> $\bar{x} = \sum x / n$ $= 635/20$ $= 31,75$	<b>School B</b> $\bar{x} = \sum x / n$ $= 690/20$ $= 34,5$	<b>School C</b> $\bar{x} = \sum x / n$ $= 615/20$ $= 30,75$
<b>School D</b> $\bar{x} = \sum x / n$ $= 465/20$ $= 23,25$	<b>School E</b> $\bar{x} = \sum x / n$ $= 820/20$ $= 41$	<b>School F</b> $\bar{x} = \sum x / n$ $= 1235/20$ $= 61,75$

The calculations for the mean are descriptive statistics that summarise the data gathered from the sample population. The performance levels per single schools are narrowed down to a single number. Based on the results obtained for the mean, it can be seen that 61, 75% of physical science learners for School F were familiar with the concepts of physical science taught in Grade 10. The rest of the schools had a mean that is far below 50% meaning that they were re not familiar with the physical science concepts taught in Grade 10. School D had the lowest mean of 23, 25% while School A, B and C had a mean just above 30%, School E had a

mean of 41%. The median was also calculated and the results are shown in the table below.

$$\text{Median} = L_m + \left( \frac{\frac{n}{2} - F}{F_m} \right) i$$

Where: n = total frequency

F = cumulative frequency before class median

F<sub>m</sub> = the frequency of the class median

i = the class width

L<sub>m</sub> = the lower boundary of the class median

Consider School A:

**Table 4.36: Calculating the median for the schools**

Score (%)	Frequency	Cumulative frequency
1-5	1	1
6-10	0	1
11-15	1	2
16-20	1	3
21-25	1	4
26- 30	4	8
31-35	4	12
36-40	3	15
41-45	4	19
46-50	1	20
51-55	0	20
56-60	0	20
61-65	0	20
66-70	0	20
71-75	0	20
76-80	0	20
81-85	0	20
86-90	0	20
91-95	0	20
96-100	0	20

Median class: 31-35,  $F = 8$ ,  $F_m = 4$ ,  $i = 5$ ,  $L_m = 30,5$  and  $n = 20$

$$\begin{aligned}\text{Therefore Median} &= 30,5 + \left(\frac{10-8}{4}\right) 5 \\ &= 33\end{aligned}$$

The same method was used to calculate the median for Schools B, C, D, E and F.

**Table 4.37: Median values for the six schools**

School	Median
School B	31,8
School C	30,5
School D	20,5
School E	39,8
School F	59,4

The mode for the six schools was also calculated and presented in the table below

**Table 4.38: Modes for the six schools**

School	Mode
School A	30, 35 and 45
School B	50
School C	45
School D	20
School E	40
School F	60

Based on the descriptive statistics above, it is clear that learners from five schools (School A to School D) were struggling with physical science while learners from two schools (School E and F) were doing well in physical science.

Most of the learners were not able to identify the apparatus used in the laboratory which could be a clear indication that they might not be doing experiments in their schools. For instance, some learners referred to the thermometer as a stick and a glass beaker as a water bucket.

Most learners failed to answer questions that required them to apply Newton's Laws of motion. Such questions require learners to think abstractly, formulate hypothesis, use deductive reasoning and check the solutions. All these expectations according to Piaget's stages of cognitive development are normal for learners operating at the formal operations stage (Simatwa 2010:370). Therefore, this implies that the brains of most learners these schools were not fully developed even when they are above eleven years for them to be able to solve such problems.

The researcher observed that most learners did not have scientific calculators; some were using their phones to perform calculations. It was also noted that the classrooms were overcrowded, as a result, there were not enough chairs and desks for the learners. Some learners were sitting on bricks while others were standing, whilst the educator was delivering his lesson. Only School D and F had a laboratory with equipment and all the learners had textbooks for physical science.

#### **4.13 CONCLUDING REMARKS**

In this chapter, the results acquired from the learner questionnaire, the educator questionnaire, parents' interviews, educators' interviews, learner non-standardised tests and observations were classified, analysed, interpreted and discussed. The results were classified into various aspects related to resources, medium of instruction, educator qualification and depth of the physical science curriculum, class sizes, curriculum change, teaching methods and attitudes towards learning. The results were also classified into aspects related to the socio-economic status of parents, parent's educational levels, the self-concept and parental involvement. This made the analysis and interpretation of the data easier.

A number of both school and home related factors have been identified as contributors to the poor performance in physical science amongst high school learners in the Libode District. The conclusions and recommendations are presented in the next chapter.

## **CHAPTER 5: FINDINGS, RECOMMENDATIONS AND CONCLUSION**

### **5.1 INTRODUCTION**

It was established from literature search that we live in a world where science and technology have become an integral part of the world's culture, therefore, for any nation to be relevant, it must not overlook the importance of science in its education system (Mji & Makgato 2006:86). It is worrying if learners continue to fail physical science as this will mean that South Africa will always struggle to have a large enough skilled science workforce. This in turn, will affect the economic growth of the country.

This chapter summarises the findings with reference to the problem statement, research questions and research aims. Recommendations for the improvement of physical science teaching and learning based on the analysis of data are also presented and lastly, the areas for future research will be suggested.

#### **5.1.1 Summary of the findings**

This section summarises the major research findings as they appear in the data analysis and presentation of questionnaires, interviews, learner non standardised tests and observations in chapter four. Even though some of the research findings in this study are the same as the results of previous studies done elsewhere in South Africa, particularly in public high schools of Kwazulu Natal's Pinetown District and in public high school of Alexandra Township, it is crucial to realise that this study extends those findings to high school physical science teaching and learning in the Libode District, in the Eastern Cape.

The study results suggest that both school and home related factors are associated with poor performance in physical science in the Libode District, Eastern Cape. School related factors include: attitudes towards learning physical science, a shortage of resources, medium of instruction, curriculum changes, teaching methods, large class sizes, educator qualifications and subject content. Home related factors include: parental involvement, self-concept, parents' educational levels and unemployment of parents.

## 5.2 SCHOOL RELATED FACTORS

The following section will summarise the major findings on school related factors associated with poor performance in physical science in the Libode District, in the Eastern Cape.

### 5.2.1 Shortage of resources

The majority of learners and educators in the Libode District, Eastern Cape, agree that their schools are under resourced. The study has shown that schools in the Libode District were under resourced in terms of material resources such as chairs on which learners could sit and tables on which the learners could write (Table 4.8), human resources such as enough physical science educators and physical science resources such as laboratories (Table 4.7), chemicals to conduct practical, tables to perform experiments and technological equipment (Table 4.8). This shortage of resources means that most laboratory activities may be poorly designed and planned with regard to the level and understanding of learners so that learners end up manipulating equipment but not manipulating ideas, thus leading to the poor performance of learners (Psillos & Niedderrer 2006:3). Learners from school E and F are performing because the two schools have enough resources.

Due to the shortage of resources learners from the Libode District were used to their educators improvising when they had to do some practicals. As a result, learners in the under resourced schools in the Libode District did not have basic knowledge about laboratory safety, laboratory apparatus and they did not know the common names of chemicals found in the laboratory (Table 4.34 to Table 4.38). Kerr *et al.* (2004:7) reveal that laboratory experiences result in positive attitudes and an interest in science. This, in turn, produces a learner who is quite familiar with the following: laboratory safety, laboratory apparatus and basic knowledge of physical science concepts, disciplined, thus increasing the chances of performing exceptionally well in physical science. It can be concluded from this study that little attention was given to practical work (Table 4.22) therefore most learners the under resourced schools in Libode District did not have the required skills. This, according

to physical science educators in the Libode District, hampered lesson delivery as it was difficult for them (educators) to teach topics that required practical work.

The shortage of educators also hindered effective lesson delivery. Educators that were interviewed revealed that learners in some schools usually went for two years without a physical science educator, thus making it difficult to introduce a new topic in Grade 11 or Grade 12 when learners do not have the knowledge of the grade 10 or 11 content. This is also supported by the results of the learners in non-standardised tests that also revealed that learners in the Libode District lacked a basic knowledge of physical science (Table 4.34 to Table 4.38). The shortage of educators also resulted in classes that are overcrowded making it difficult for educators to attend to every learner. Lastly, most learners did not have calculators. This made it almost impossible for such learners to carry mathematical calculations out effectively.

### **5.2.2 Medium of instruction**

This study also reveals that learners in the Libode District were taught physical science in both their home language (isiXhosa) and English (Table 4.11) and Table (4.19). Lee and Luykx (2006:35) assert that when learners are taught in a language that is not their mother tongue, learning becomes difficult for them. This, in turn, may be associated with poor performance in physical science.

Physical science educators in the Libode District acknowledge the fact that English is the language of teaching and learning in physical science, but they faced a considerable challenge with trying to teach in English as it would be difficult for learners to understand certain scientific terms and if they did (Table 4.20), it took time for them (learners) to comprehend what the educator was saying and in most instances, they (educators) were forced to interpret the material in their learners' home language (isiXhosa). Howie (2003:12) asserts that learners who are taught in both English and their home language tend to have difficulties in articulating their answers to open-ended questions and apparently have trouble comprehending certain questions. This, in turn, contributed to the poor performance of learners in physical science in the Libode District.

The study also revealed that most learners were comfortable with their educators using both English and their home language (Isixhosa) (Table 4.21). This, according to Marshal (2002:5), eliminates a range of communication problems between the educator and the learner. Since the examination was set in English, such learners would have difficulties with answering questions, thus, resulting in their poor performance. The study also showed that there was extremely little communication between the learner and the educator due to language barriers, especially if the educator communicated in English. Furthermore, learners tended to communicate amongst themselves using their home language, thus disrupting effective lesson delivery; this resulted in the poor performance by learners in physical science in the Libode District.

### **5.2.3 Educator qualifications and depth of the physical science curriculum**

The study revealed that certain educators in the Libode District were not qualified to teach physical science (Table 4.5), most of them had difficulties with teaching either physics or chemistry or both physics and chemistry (Table 4.9). This study also revealed that physical science educators in the Libode District had difficulties with teaching topics that involved mathematical calculations (Table 4.10, Table 4.34 to Table 4.38). This made it possible to conclude that the physical science curriculum is challenging to educators in the Libode District in the Eastern Cape Aldous (2004:65-67) asserts that irrespective of significant investments in science educator development by the Department of Education through offering in-service workshops, the lack of subject content knowledge in physical science remains a challenge. This, according to Madibeng (2006:12), affected the quality of science teaching. This lack of subject content knowledge resulted in the poor performance in physical science by learners in the Libode District.

### **5.2.4 Large classes**

Kennedy (2010: 594) asserts that teacher behaviour tends to be influenced more by the situations they face than by their personal qualities. It can be accepted from the data analysis that physical science educators in the Libode District were overloaded with work to such an extent that the quality of their teaching was

compromised. Large classes were identified as the factor that led to the overloading of physical science educators in the Libode District in the Eastern Cape.

Table 4.23 shows that learners in the Libode District were taught in overcrowded classrooms. According to the Frontiers Academy Faculty (2014):

- Teachers in overcrowded classrooms may be spread too thin and unable to give each student the individual attention he or she needs
- If children are not given the attention they need in the classroom, they may fall behind and this may affect their enjoyment of school and learning, setting them up for failure in future.
- Teachers in overcrowded classes may be more stressed out and overwhelmed, and feel as though they lack the time and resources to really make a difference. This can lead to teacher burnout.

Learners in the Libode District did not receive individual attention and they were not given enough attention in the classroom. This, therefore, resulted in the poor performance in physical science by learners in the Libode District.

### **5.2.5 Curriculum changes**

The study has shown that the continuous change in curriculum by the Department of Education confused educators in the Libode District in the Eastern Cape (Table 4.14). The study has also shown that learners were not comfortable with this continuous change in the curriculum (Table 4.24). Kelly (2004) asserts that the lack of space, learning support material, competent educators, long term support systems, inadequate in- service training and commitment are critical factors that could impact negatively on practical implementation. It can be accepted that physical science educators in the Libode district did not usually receive thorough training ahead of this new change in the curriculum and the schools in the Libode District did not have sufficient resources and therefore, it became extremely difficult for educators to commit themselves to the effective implementation of the new curriculum. This led to the poor performance in physical science by learners in the Libode District.

It can also be accepted from the responses of physical science educators during an interview regarding the fact that the continuous changes in the curriculum caused the poor performance in physical science because the questioning style changes and educators did not adapt easily to the change in curriculum as shown by the continuous use of methods that were in the NCS curriculum to solve problems in physics and the resistance to changing the structure of the question papers by educators in the Libode District to suit the needs of the new curriculum: CAPS.

### **5.2.6 Teaching methods**

The study shows that the teaching methods used by physical science educators in the Libode District did not allow learners to discover lesson content by using interesting teaching strategies and some educators in the Libode District rarely succeeded in capturing the learner's interest in the learning of physical science (Table 4:12). This according to Republic of South Africa (2008:2) promotes rote learning. This, in turn, resulted in the poor performance in physical science by learners in the Libode District.

The study also shows that educators in the Libode District do not conduct experiments during physical science lessons (Table 4:22) and that the learners in the Libode District were not familiar with the concepts in physical science (Table 4, 34, to table 4, 38). Most of the learners in the Libode District were not able to identify the apparatus used in the laboratory that could be a clear indication that they were not doing practicals in their schools. This, in turn, resulted in the poor performance of learners in physical science in the Libode District, Eastern Cape.

The study also showed that physical science educators in the Libode District are limited to a few teaching strategies due to limited resources. This hinders effective lesson delivery, thus causing poor performance in physical science by learners in the Libode District.

### **5.2.7 Attitudes towards learning physical science**

This study has shown that even if most educators enjoyed teaching physical science (Table 4.13), Most of the educators were not satisfied with the performance of their learners in physical science because of their negative attitude towards the subject (physical science). Gough (2009:183-185) asserts that many students fear science as a result, their achievement in science subjects was extremely low. This, in turn, resulted in the poor performance of learners as they would end up repeating the grade (see Table 4.17 and Table 4.18).

## **5.3 HOME RELATED FACTORS**

The following section will summarise the major findings on the home related factors associated with poor performance in physical science in the Libode District in the Eastern Cape.

### **5.3.1 Socio- economic status of parents**

The socio – economic status of parents caused the poor performance of learners in physical science in the Libode District. Jeffry and Lynn (2005) assert that if parents are unemployed, they become depressed and choose not to monitor the behaviour of their children and this result in a general lack of enthusiasm for school and a disinterest in studying. Most parents in the Libode district were unemployed (Table 4.29 and Table 4.30) and most parents in the Libode District had a low monthly income (Table 4.31 and Table 4.32) and so they did not provide their children with enough material to do their schoolwork, and they did not pay for educational trips for their children (Table 4.15). This, according to physical science educators in the Libode District meant that learners lacked some exposure due to their family background. The study also showed that the few learners from well to do families did not take their schoolwork seriously.

### **5.3.2 Parents' educational levels**

The parents' educational level plays an important role in the manner in which they are involved in the education of their children. Parents who are educated raise children to have healthy self-perceptions when it comes to their academic abilities,

engage them in intellectual activities that help them develop a healthy attitude about learning and generally have children with fewer behavioural problems that may hinder their learning experiences (Merrill 2009:224-229). This study revealed that most parents in the Libode District had low levels of education (Table 4.15). It can therefore be accepted that such parents experienced difficulties when trying to assist their children with homework and assignments. This, in turn, caused the poor performance of learners in the Libode District.

In addition, this study also revealed that even though parents believed that involving themselves in their children's work could help improve their performance, their children did not usually ask for help since they thought that their parents did not know the answers because of their low educational levels. The study also revealed most parents in the Libode district did not check their children's books, did not try to motivate their children and did not even try to remove things that could prevent their children from doing their school work. This resulted in learners who did not see the importance of schoolwork, thus resulting in their poor performance. Facial expressions from some parents showed that it was not in their mind that it was their duty to check their children's work. Some parents looked surprised as they did not expect such a question.

### **5.3.3 Self-concept**

A self-concept entails what a person thinks about himself or herself, including his/her strengths, weaknesses and personality. A person will use his/her self-concept while judging whether he/she will succeed or fail (Cramer 2003: 12). Educators in the Libode District were of the view that most parents in the Libode District who were less educated tend to have an inferiority complex, they tend to think that educators would look down upon them and so they did not usually go to school to discuss the education of their children. Most parents were not comfortable even discussing with the researcher. This, in turn, will affect the performance of learners negatively in the Libode District.

### **5.3.4 Parental involvement**

The study has shown that parents in the Libode District believed that involving themselves in their children's work could help to improve their performance. However, the parents revealed that they faced a number of challenges in trying to involve themselves as they were looked down on by both their children and their educators because of their low educational levels. Some parents indicated that even if they wished to help their children with their school work, they were not able to do that because they were not educated and they did not have enough money to take care of their children's needs. This, in turn, caused the poor performance of high school learners in the Libode District.

## **5.4 RECOMMENDATIONS**

In view of the purpose of the research and its key findings, the researcher recommends that:

- Each school must have a working enrolment policy that is informed by the capacity of the school's infrastructure and resources to curb overcrowding in the classrooms.
- The government must treat all schools equally, regardless of the geographic location of the school. Schools in rural areas such as the Libode District must also have functional laboratories like schools in urban areas.
- The government must review the staff situation in schools continuously and hire educators according to the staff situation of the school.
- Schools must use the money allocated to them by the government to order certain resources such as calculators and enforce learners so that they can always use them as this may help learners to get used to them before examinations.
- Schools must adhere to applicable language policies throughout all levels of schooling to ensure that learners are able to cope with the demands of English as a medium of instruction at secondary school level.
- The government must motivate educators by paying for their studies if ever they decide to further their studies. This will result in the district having competent

educators. This recommendation is made notwithstanding the fact that this may lead to a flight of teachers from the district as better qualified teachers tend to migrate to a more developed area.

- The government must also train educators effectively if ever there is a change in the curriculum and provide adequate resources to implement the new curriculum
- Teachers must equip themselves with knowledge about current issues that affect science education so that they can adapt easily and use teaching methods that are in line with the current situation with regard to science education
- Schools must introduce adult education classes to reduce the illiteracy level in their communities. This, in turn, will make community members realise the importance of the education of their children
- Schools must have more parents meetings and must involve teachers in those meetings so that parents will get to know teachers well.
- Schools must assist learners choose subjects according to their abilities and interest.
- Schools must make sure that learners who are doing physical science should also do mathematics.
- High schools in the Libode District must start at Grade 8 and not at Grade 10 so that science learners are monitored from Grade 8 onwards.

#### **5.4 SUGGESTIONS FOR FURTHER RESEARCH**

The researcher suggests that further research should:

- Investigate how school related factors and home related factors cause poor performance in physical science in the Libode District using a larger sample of parents, teachers and learners.
- Investigate the effectiveness and quality of teacher training programs for physical science in training institutions.
- Investigate how current issues in science education such as the continuous change in curriculum impact on the effectiveness of physical science educators.

## 5.5 CONCLUSION

This study has investigated the factors associated with poor performance in physical science amongst high school learners in the Libode District in the Eastern Cape. Importantly, this study has shown that a shortage of resources, the medium of instruction, educator qualifications, the subject content, large class sizes, curriculum changes, teaching methods used by educators and the negative attitudes of learners towards learning physical science are the school related factors that cause poor performance in physical science. In addition, this study has also shown that the socio –economic status of parents, educational levels of parents, the self-concept of learners and parental involvement with both the learner and the school are the home related factors that cause poor performance in physical science in the Libode District in the Eastern Cape.

The literature review also established that a similar study on the factors associated with of poor performance in physical science was conducted by different researchers in South Africa. However, none of the researchers conducted a study in public high schools in the Libode District in the Eastern Cape. Therefore, conducting this study in the Libode District has bridged certain gaps.

Although the participants used in this study were selected from a sample of six schools, the conclusions drawn can be generalised to the rest of the population and public high schools in other rural communities of South Africa that share the same socio economic conditions as those in the Libode District

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## APPENDICES

### Appendix A: Educator questionnaire

The data gathered from this questionnaire will be used for research purposes only. All respondents are to remain anonymous.

Instructions

Please an **X** put in the appropriate box.

#### Section A: Personal Information

1. What is your gender?

Male	1
Female	2

2. Please indicate the number of years you have been teaching Physical sciences

0-5 years	1
6- 10 years	2
11- 15 years	3
16 years or more	4

3. What is your highest teaching qualification?

Diploma in Education	1
Bachelor of Education	2
Honours Bachelor of Education	3
Other (specify _____)	4

4. Which subjects are you qualified to teach?

Science only	1
Mathematics only	2
Both science and mathematics	3
science and another subject, which is not mathematics	4

5. Which post level are you occupying as a physical sciences educator?

Post level 1	1
Post level 2	2

## Section B: Availability of resources

6. Where do you conduct your physical sciences lessons?

Laboratory	1
Classroom	2
Other (specify) _____ _____	3

7. Do you have a class allocated for physical science sons?

Yes	1
No	2
Not applicable	3

8. Is your laboratory or physical science class equipped with the following resources?

	More than enough 1	Enough 2	Not enough 3
Chemicals for practical			
Chair for learners to sit			
Tables for learners to write on			
Tables to perform experiments			

9. Does the physical sciences department have the following resources?

	More than enough 1	Enough 2	Not enough 3
Physical science text books and policy documents			
Physical sciences educators			
Technology (computers, projectors, tablet)			

**Section C: Depth of the physical science curriculum and medium of instruction**

10. Which section of physical science do you find challenging to teach?

Physics	1
Chemistry	2
Both Physics and Chemistry	3
Non	4

11. How often do you give your learners problems that require Mathematical calculations in physical science?

Every lesson	1
After completing one topic	2
After completing two topics	3
Other (Specify .....	4

12. What language do you use for teaching in your physical science class?

English only	1
Your home language only	2
Combination of home language and English	3
Other (specify).....	4

**Section D: Attitudes, Changing curriculum and teaching methods**

13. How often do you use the following as teaching and learning methods in your physical science class?

	<b>Never</b> 1	<b>Seldom</b> 2	<b>Usually</b> 3	<b>Always</b> 4
Allow learners to discover the lesson content by using interesting teaching strategies.				
Succeed in capturing learner's interests in the learning material				
Use variety of teaching methods				
Make use of different learning activities				

14. Do you enjoy teaching physical science?

Yes	1
No	2
Not always	3

15. What are your views on the changing curriculum?

Confuses learners	1
Learners easily adapt to the new curriculum	2
Confuses teachers	3

16. What is the attitude of other teachers towards physical science?

Positive	1
Negative	2

### **Section E: Parental involvement**

17. Please indicate how often the following happened. Please indicate your response according to the response format below.

1= Never

2= Rarely

3= Frequently

4= Sometimes

5= Very frequently

	1	2	3	4	5
Do parents come to school to discuss about the education of their children?					
Do parents provide their children with enough materials to do their school work?					
Do parent help their children to complete assignments and home works?					
If there are educational trips, do parents pay for their children?					

## Appendix B: Learner questionnaire

The data gathered from this questionnaire will be used for research purposes only. All respondents are to remain anonymous.

Instructions

Please an **X** put in the appropriate box.

### Section A: Personal Information

1. What is your gender?

Male	1
Female	2

2. Please indicate the number of years in grade

1	1
2	2
3	3
4	4

3. Your age?

16 years and younger	1
17 years	2
18 years	3
19 years	4
20 years and older	5

### Section B:

4. What language does your physical science educator use during a physical science lesson?

English only	1
His/ Her home language	2
Your home language	3
A combination of your home language and English	4
Others (Specify _____)	5

5. Do you understand the language used by your educator during the physical science lessons?

Yes	1
No	2

6. What language would you prefer your physical science educator to use during the lesson?

- 1 = your home language only
- 2 = English only
- 3 = Both English and home language
- 4 = Other

	1	2	3	4
Your home language only				
English only				
Both English and your home language				
Other(specify_____)				

7. Please indicate your perception according to the response format below.

- 1= strongly disagree
- 2= disagree
- 3= uncertain
- 4 = agree
- 5= strongly agree

	1	2	3	4	5
I enjoy during physical science lessons					
I am inspired by my physical science teacher to work extra hard					
We always do experiments during our physical science lessons					
science has relevance in life					
I am confident that I will pass physical science					
Our classrooms are very overcrowded					
It is a good idea for the government to change the curriculum more often					

### Section C: Parental involvement

8. Parent's age

	Father	Mother	Guardian
50 years and above			
45- 50 years			
40- 45 years			

35- 40 years			
30 – 35 years			
Below 30 years			

### 9. Parent's occupation

	Father	Mother	Guardian
Professional/ Technical For example, teacher, nurse, accountant, engineer, doctor etc.			
Unemployed			
Upper Management For example, senior manager			
Middle Management For example, manager			
Sales/Manager Businessman			
Service work For example, clerk			
Tradesman For example, technician			

### 10 Total monthly income of parents

	Father	Mother	Guardian
R10 000 and above			
R5 000 – R10 000			
R3 000- R5 000			
Less than R 3000			

### 11. Parents' level of education

	Father	Mother	Guardian
PhD			
Masters			
Degree			
Diploma			
ABET			
Matric			
Non			

12. Please indicate how often the following has happened. Indicate your responses according to the format below.

1 = never

2 = Rarely

3= Sometimes

4= Frequently

5= Very frequently

	1	2	3	4
My parents do not usually ask me about my schoolwork				
My parents check my books				
My parents explain to me about my school work				
My parents ask me about my day at school				
My parents come to school to discuss about my education with my teachers				
My parents praise me when I complete my schoolwork				
My parents provide enough material in helping me to do my schoolwork				
My parents provide a comfortable place for me to complete my schoolwork				
My parents ask me if I need to buy anything in order to complete my schoolwork				
My parents remove things that distract me from doing my school work				

## **Appendix C: Interview guide for educators**

1. As a physical science educator, what are the challenges that you encounter during lesson delivery?
2. Is there any link between availability of resources and teaching strategies that you use when teaching physical science? Explain.
3. How confident are you when doing practicals?
4. Do you experience any problems when conducting practicals? Explain.
5. How are the grade 12 learners performing at your school?
6. Do learners whose home language differs from the medium of instruction have problems in understanding content in physical science?
7. Do you think the socio- economic status of a learner affects his /her performance?
8. Do you think this continuous change in curriculum by the department of education affects the performance of learners in physical science?
9. In your opinion, what do you think can be done in order to improve the performance in physical science?

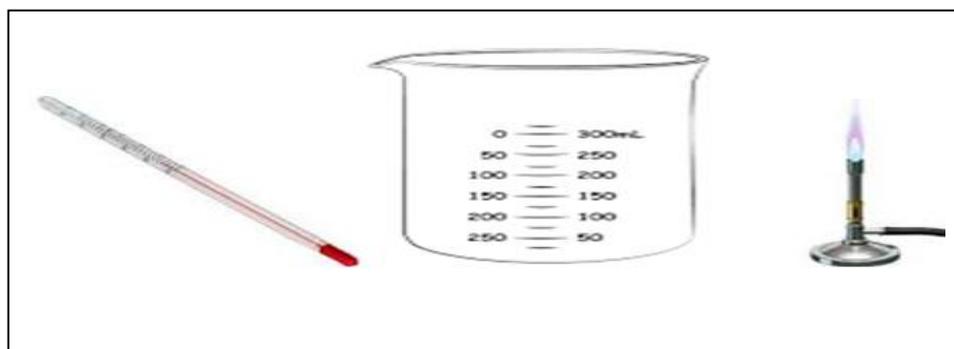
#### **Appendix D: Interview guide for parents**

1. What is your perception towards parental involvement in children's work?
2. What kind of help do you give to your children regarding assignments and homework?
3. Do you believe that involving yourself in your child's work can help to improve his/her performance? Why?
4. When your child has a problem in completing his/her homework, do they ask for your help?
5. Do you show interest in your child's study? How?
6. Do you think it is a good idea for you to get involved in your child's work?
7. Do you think your involvement will make your child feel comfortable? Why?
8. Do you think it is a good thing to have a good connection with your child's teacher? Why?

## Appendix E: Learners' non- standardised test

The questions below are based on laboratory safety, laboratory apparatus, common names of chemicals found in the laboratory, conversion from other units to SI units and lastly the basic knowledge of physical science concepts with which every Grade 11 learner should be familiar. Complete the questions below without the aid of your notebook or textbook.

1. When diluting an acid with water,
  - A. Do it quickly so that a cool fountain of toxic material is ejected from the flask.
  - B. Always add acid to water, not water to acid so that heat of reaction can be controlled.
  - C. Do not stir the flask because it might break. (2)
2. The label corrosive on a chemical container indicates,
  - A. That the material is an oxidant.
  - B. That the material can degrade rapidly upon exposure to air.
  - C. That container destroys living tissues as well as equipment.
3. Use the correct scientific terminology to identify the apparatus below. (3)



4. Sodium bicarbonate is commonly known as \_\_\_\_\_ (2)
4. Convert the following from  $\text{dm}^3$  to  $\text{m}^3$ 
  - 4.1.1  $5\text{dm}^3$  \_\_\_\_\_ (1)
  - 4.1.2  $0.2\text{dm}^3$  \_\_\_\_\_ (1)
5. Balance the following chemical equation.
  - 6.1.1  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$  (2)

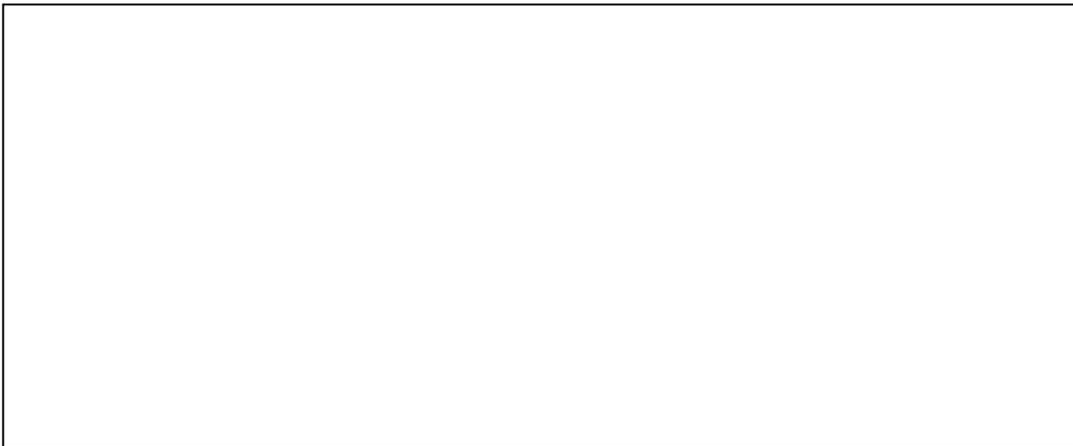
6.1.2 How many elements are there in the above reaction?  
\_\_\_\_\_ (2)

6.1.3 Name the element from the above that is important to man.  
\_\_\_\_\_ (2)

6. A 50kg box is at rest on a horizontal surface. When an 80N force is applied to the box, it slides on the surface with a constant velocity.

6.1 Draw a labelled free body diagram for the box when it is...

6.1.1 at rest (4)



6.3.1 An identical box is placed on top of the 50kg box. \_\_\_\_\_ (1)

6.3.2 The same force is applied on another 50kg box with a larger surface area. \_\_\_\_\_ (1)

(Write only INCREASE, DECREASE OR STAYS THE SAME)

## Appendix F: Permission letter from the Eastern Cape Education Department



Province of the  
**EASTERN CAPE**  
EDUCATION

STRATEGIC PLANNING POLICY RESEARCH AND SECRETARIAT SERVICES  
Steve Vukile Tshwete Complex • Zone 6 • Zwelitsha • Eastern Cape  
Private Bag X0032 • Bhisho • 5605 • REPUBLIC OF SOUTH AFRICA  
Tel: +27 (0)40 608 4773/4035/4537 • Fax: +27 (0)40 608 4574 • Website: [www.ecdoe.gov.za](http://www.ecdoe.gov.za)

Enquiries: B Pamla

Email: [babalwa.pamla@edu.ecprov.gov.za](mailto:babalwa.pamla@edu.ecprov.gov.za)

Date: 22 October 2014

Mr. Ishmael Sibanda  
50 Dikweni Street  
Ikhwezi Township  
Mthatha  
5100

Dear Mr. Sibanda

### **PERMISSION TO UNDERTAKE A MASTERS STUDY: AN INVESTIGATION INTO THE FACTORS ASSOCIATED WITH HIGH SCHOOL LEARNERS POOR PERFORMANCE IN PHYSICAL SCIENCES IN LIBODE DISTRICT**

1. Thank you for your application to conduct research.
2. Your application to conduct the above mentioned research at six selected Secondary schools under the jurisdiction of Libode District of the Eastern Cape Department of Education (ECDoE) is hereby approved on condition that:
  - a. there will be no financial implications for the Department;
  - b. institutions and respondents must not be identifiable in any way from the results of the investigation;
  - c. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Cluster and District Directors before any research is undertaken at any institutions within that particular district;
  - d. you will make all the arrangements concerning your research;
  - e. the research may not be conducted during official contact time, as educators' programmes should not be interrupted;

building blocks for growth

Page 1 of 2



*Ikamva eliqagambileyo!*

- f. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Strategic Management Monitoring and Evaluation;
  - g. the research may not be conducted during the fourth school term, except in cases where a special well motivated request is received;
  - h. your research will be limited to those schools or institutions for which approval has been granted, should changes be effected written permission must be obtained from the Chief Director: Strategic Management Monitoring and Evaluation;
  - i. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis.
  - j. you present the findings to the Research Committee and/or Senior Management of the Department when and/or where necessary.
  - k. you are requested to provide the above to the Chief Director: Strategic Management Monitoring and Evaluation upon completion of your research.
  - l. you comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you.
  - m. you comply with your ethical undertaking (commitment form).
  - n. You submit on a six monthly basis, from the date of permission of the research, concise reports to the Chief Director: Strategic Management Monitoring and Evaluation.
3. The Department reserves a right to withdraw the permission should there not be compliance to the approval letter and contract signed in the Terms and Conditions to conduct Research in the ECDoE.
  4. The Department will publish the completed Research on its website.
  5. The Department wishes you well in your undertaking. You can contact the Director, Ms. NY Kanjana on the numbers indicated in the letterhead or email [nelisakanjana@gmail.com](mailto:nelisakanjana@gmail.com) should you need any assistance.

  
 NY KANJANA  
 DIRECTOR: STRATEGIC PLANNING POLICY RESEARCH & SECRETARIAT SERVICES  
 FOR SUPERINTENDENT-GENERAL: EDUCATION



**Appendix G: Letter to the Libode District Director seeking permission to conduct research**

50 Dikweni Street  
Ikhwezi Township  
Umtata

12 August 2014

The District Manager  
Libode District  
Private Bag X218  
Libode  
5160

Dear Sir/ Madam

**Ref: Request for permission to conduct research in public high schools in Libode District.**

I am currently enrolled as a Masters of Education student with the University of South Africa under the supervision of Prof CP Loubser of the Department of Science and Technology Education.

In order to fulfil the requirements for obtaining my degree, I am required to undertake research. The title of my research is 'An investigation into the factors associated with high school learner's poor performance in physical science in the Libode District, Eastern Cape.'

The purpose of the study is to understand how school related factors and home related factors cause poor performance in physical science in public high schools of Libode District, Eastern Cape with the aim of coming up with recommendations for solutions to underperformance in physical science. To complete this research, physical science teachers need to be interviewed and to complete a questionnaire, Grade 11 learners need to complete a questionnaire and to write a non-standardized test and parents need to be interviewed in public high schools in

Libode District. The research process will not disrupt any school activities as arrangements will be made between the researcher and the participants at the time convenient to them. Permission has been granted from the Provincial office. I further request your permission to undertake research in public high schools of Libode District.

Participation of these parties will be voluntary and they will be free to withdraw should they deem necessary without any penalty. The researcher will also ensure anonymity and confidentiality during the course of the interview.

Yours sincerely

Ishmael Sibanda

Student number: 46235787

Cell: 078 597 5150

Email: 46235787@mylife.unisa.ac.za

**Appendix H: Letter to principals seeking permission to conduct research**

50 Dikweni Street  
Ikhwezi Township  
Umtata  
12 August 2014

The Principal

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

Dear Sir/ Madam

**Ref: Request for permission to conduct research at your school.**

I am currently enrolled as a Masters of Education student with the University of South Africa under the supervision of Prof CP Loubser of the department of science and Technology Education.

In order to fulfil the requirements for obtaining my degree, I am required to undertake research. The title of my research is ‘An investigation into the factors associated with high school learner’s poor performance in physical science in the Libode District, Eastern Cape.’

The purpose of the study is to understand how school related factors and home related factors cause poor performance in physical science in public high schools of Libode District, Eastern Cape with the aim of coming up with recommendations for solutions to underperformance in physical science. To complete this research, physical science teachers need to be interviewed and to complete a questionnaire, Grade 11 learners need to complete a questionnaire and to write a non-standardised test and parents need to be interviewed in public high schools in the Libode District. The research process will not disrupt any school activities as arrangements will be made between the researcher and the participants at the time convenient to them. Permission has been granted from the District office and the

Provincial office. I further request your permission to undertake research at your school.

Participation of these parties will be voluntary and they will be free to withdraw should they deem necessary without any penalty. The researcher will also ensure anonymity and confidentiality during the course of the interview.

Yours sincerely

Ishmael Sibanda

Student number: 46235787

Cell: 078 597 5150

Email: 46235787@mylife.unisa.ac.za

