# ENHANCEMENT OF GRADE 12 LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES IN MOPANI DISTRICT, LIMPOPO PROVINCE

by

**THIVHILAELI ALEX RATSHIVHADELO**

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In the

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**PROMOTER: Prof MP Mulaudzi**

**CO-PROMOTER: Dr SK Muthambi**

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## DECLARATION

**I, THIVHILAELI ALEX RATSHIVHADELO,** declare that:

**ENHANCEMENT OF GRADE 12 LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES IN MOPANI DISTRICT, LIMPOPO PROVINCE**

is my own work and has not been previously submitted in any form whatsoever, by myself or anyone to this university or any other educational institution for any degree or examination purposes. All resources that I have used or quoted have been indicated and duly acknowledged by means of complete references.

*T.A. Ratshi* **2020 – 09 -07**

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**RATSHIVHADELO THIVHILAELI ALEX** **DATE**

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## DEDICATION

This study is dedicated to my late father, Mr Erasmus Thinandavha Ratshivhadelo, my Mother, Mrs Nnditsheni Paulina Tshililo Ratshivhadelo, My children Mukhethwa Pertunia, Aluwani Alex, Funanani Felicia and my sisters, Tsumbedzo Gloria Ratshivhadelo, Tendani Constance Tshikhudo, Thivhavhudzi Agnes Mamadiaga and Phumudzo Patience Matodzi Ratshivhadelo.

## ABSTRACT

The purpose of the study was to enhance Grade 12 learners' performance in Physical Sciences in Mopani District, in the Limpopo Province. The study adopted a mixed methods research. The population of the study comprised of Grade 12 Physical Sciences learners and teachers. 10 schools from 10 circuits in the Mopani Education District were randomly sampled. The simple random sampling technique was also applied to select a quantitative sample of 100 Grade 12 Physical Sciences learners. 1 teacher and 10 learners from each school who were purposively selected participated in this study. Quantitative data were analysed through the Statistical Package for Social Sciences (SPSS) version 25. Qualitative data were analysed and interpreted thematically. The major findings of this study were that there are some modern, efficient and effective strategies that were not implemented in the system to enhance Physical Sciences learners' performance in Mopani district. These strategies included efficient use of learning text books, laboratory experiments, ICT gadgets, educational fieldtrips, appropriate teaching approaches and the best learners learning styles. The study recommends that the Department of Education should provide adequate textbooks, well-equipped laboratories, and ICT gadgets to all high schools' secondary schools in the district. Teachers should also improve their use effective teaching approaches which include hands on or student centred learning, inquiry- based learning, projects based and cooperative learning.

**Key Words:** Assessment, Curriculum, Learners' Performance, Management, Physical Sciences, Subject Advisors, Teaching and Learning.

## LIST OF ACRONYMS

| | |
|---|---|
| AC | Abstract Conceptual |
| AE | Active Experimentations |
| BCE | British Council of Teachers |
| BED | Bachelor of Education |
| BEDFET | Bachelor of Education in Further Education and Training |
| BERA | British Education Research Association |
| BSC | Bachelor of Science |
| CAPS | Curriculum and assessment Policy statement |
| CBI | Computer - Based Instructions |
| CCI | Children Challenging Industry |
| CDE | Centre for Development and Enterprise |
| CE | Concrete Experience |
| CFE | Compulsory Free Education |
| CoVis | Collaborative Visualisation Project |
| CPD | Continuing Professional Development |
| CPTD | Continuing Professional Teachers Development |
| DBE | Department of Basic Education |
| DESE | Department of Elementary and Secondary Education |
| DHET | Department of Higher Education and Training |
| DoE | Department of Education |
| DSM | District Senior Manager |
| DSM | District Senior Manager |
| ELRC | Education Labour Relation Council |
| FET | Further Education and Training |
| HED | Higher Education Diploma |
| HOD | Head of the Department |
| INSERTS | In-service Trainings |
| IQMS | Intergraded Quality Management System |
| LI | Laboratory Investigations |

| | |
|---|---|
| LP | Limpopo Province |
| LPDE | Limpopo Province Department of Education |
| MCCSST | Ministry of Education, Culture, Sports, Science and Technology |
| MDE | Michigan Department of Education |
| NASEM | National Academic of Science, Engineering and Medicines |
| NSC | National Senior Certificate |
| PCK | Pedagogical Content Knowledge |
| PGCE | Post Graduate Certificate in Education |
| PLC | Professional Learning Communities (Clusters) |
| PSP | Purposive Sampling Procedure |
| RSA | Republic of South Africa |
| SACE | South African Council of Teachers |
| SCPDI | Sadtu Curtis Nkondo Professional Development Institute |
| SES | Science Education |
| SME | Singapore Ministry of Education |
| SPSS | Statistical Package for Social Sciences |
| SPTD | Senior Primary Teachers Diploma |
| SRSP | Simple Random Sampling Procedure |
| STD | Secondary Teachers Diploma |
| TIMSS | Trends in Mathematics and Science Study |
| UK | United Kingdoms |

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# CHAPTER ONE

# INTRODUCTION AND BACKGROUND

## 1.1 INTRODUCTION

The global performance of senior high school students in Physical Sciences varies in countries and this largely depends on certain factors which include the economic status of a country, availability of suitable infrastructures, equipments and relevant resources as well as the level of teacher expertise. Levitt (2002:16) expresses that most developed countries like the United Kingdom and Japan have good school infrastructures such as class rooms and Physical Sciences laboratories. These well-equipped laboratories are usually manned by laboratory technicians. Most of their schools are also characterised by teachers who are qualified to run laboratories and conduct laboratory activities. As for the teaching of Physical Sciences, there is dominance of the adoption of problem-solving learning approaches which utilize experiments and laboratory investigations. Learners are always hands-on in their laboratory activities. This has an impact on the performance of learners because learners in Physical Sciences operate through practical work.

In developing countries, there is still a great need to improve conditions that may enhance the teaching of Physical Sciences in schools. According to Mudulia (2012:533), in Kenya, there is a need for teachers to be trained on teaching approaches to improve instructional delivery in Physical Sciences. The government of Kenya through the Department of Education identified the project method as the best option to adopt in teaching Physical Sciences. Furthermore, the government of Kenya through the Ministry of Education, Science and Technology, with the assistance of the government of Japan through the Japan International Cooperation Agency, started a programme to commit themselves to strengthening Physical Sciences teaching in secondary schools (Wachanga & Wangi, 2004:26).

In the South African context, the performance of learners in Physical Sciences declined between the years 2005 and 2007 (Kriek & Grayson, 2009:185). Makgato and Mji (2006:253) and Dhurumraj (2013:01) point out that the current performance of Grade 12 learners in Physical Sciences is not satisfactory. As measured by international standards, South African learners perform poorly in Physical Sciences (Howie, 2003:18). The Trends in Mathematics and Science Study (TIMSS) whose role is to evaluate the performance of learners in Mathematics and Physical Sciences, conducted study in 2001 and 2003 to determine the average performance of learners of different countries in these subjects (Howie, 2003:18). Thirty-eight countries participated in 2001 and fifty countries took part in those competitions in 2003. In all instances, South Africa took last positions (Makgato & Mji, 2006:254).

The poor performance of learners in Physical Sciences may be attributed to a variety of factors that revolve around the role which is played by the National and Provincial Departments of Basic Education (Mji & Makgato, 2006:263). Apparently, such factors include abrupt changes in curriculum, poor curriculum management strategies, ineffective teaching and learning methods, ineffective assessment strategies, unavailability of physical facilities, shortage of teaching and learning materials, inadequate provisioning of qualified teachers and poor discipline (Adedoyin, 2011:289).

Shortage of qualified Physical Sciences teachers may contribute to learners' poor performance in Physical Sciences. The inadequate mastery of the subject by some of the teachers has also been identified as another contributing factor to learners' poor performance in Physical Sciences (Barlia & Beeth, 1999:27). However, the Department of Basic Education expects learners to perform well in Physical Sciences. On that note, the Department of Education (DoE) has over the years, consistently reiterated its commitment to improve the state of education, particularly in science education. The Department of Education (DoE) usually intervenes to minimize the negative impact of factors that contribute towards the poor performance of learners in Physical Sciences (DoE, 2011a). The DoE at some point recruited Physical Sciences teachers from neighbouring countries and other foreign nations in an endeavour to improve the

teaching and learning of Physical Sciences in schools. In addition, the National Department of Education through all the universities of South Africa, initiated the Funza lushaka teacher training project which funds learners who are willing to train in Science Education (DoE, 2011a:03).

Inadequate monitoring of policies which are being implemented in schools is also a cause for concern. Education officials from district and circuit offices do not effectively monitor the implementation of activities that are inherent in education policies which are operational in schools (Department of Basic Education, 2011b:43). Seemingly, subject advisors are not visiting schools to support and monitor the implementation of curriculum policies to enhance the performance of learners. On the same note, it appears the heads of departments (HODs) do not conduct class visits to identify challenges that teachers may encounter in the teaching and learning of Physical sciences (DBE, 2011b:28).

**Table 1.1: Limpopo Province's Overall Achievement Rates in Physical Sciences Over the Years 2012 – 2015**

| Year | Number of Learners who Wrote | Number of who Learners Achieved at 30% - 39% | % of Learners who Achieved at 30% - 39% | Number of Learners who Achieved at 40% - 100% | % of Learners who Achieved at 40% - 100% |
|---|---|---|---|---|---|
| 2012 | 30975 | 18566 | 59.9 | 11194 | 36.1 |
| 2013 | 30758 | 20180 | 65.6 | 12233 | 39.1 |
| 2014 | 26691 | 17801 | 67.7 | 10384 | 38.9 |
| 2015 | 33680 | 20063 | 59.6 | 11928 | 35.4 |

Table depicting the Limpopo provinces achievement rates in Physical Sciences as adapted from the Department of Basic Education National Senior Certificate Examination Report (DBE, 2015:78).

Table 1.1 depicts the performance of Grade 12 learners in Physical Sciences in Limpopo Province over the period 2012 to 2015. In 2012, performance in the 30%-39% range was 59.9%, whereas performance at 40%-100% range was at 36.1%. In 2013, performance at 30%-39% range increased by 5.7% to 65.6%, whereas performance of learners at 40%-100% range improved by 3% to 39.1%. In 2014, performance between 30%-39% improved by 2.1% and went up to 67.7%. The achievement of learners at 40%-100% range dropped by 0.2% to 38.9%. In 2015, learners' performance at 30%-39% range dropped by 8.1% from 67.7% to 59.6%. In the 40%-100% range, the achievement of learners declined by 3% from 38.9% to 35.4%. This means that there was no significant improvement in the general performance of learners in Physical Sciences during the period 2012-2015. Statistics indicate that from 2013 to 2015, the performance of Grade 12 learners in Physical Sciences in the 30%-39% range declined by 5% whereas learner performance in the 40%-100% range declined by 3.7%.

**Table 1.2: The National Overall Achievement Rates of Learners in Physical Sciences Over the Years 2012 – 2015**

| Year | Number of Learners who Wrote | Number of Learners who Achieved at 30% -39% | % of Learners who Achieved at 30% - 39% | Number of Learners who Achieved at 40% - 100% | % of Learners who Achieved at 40% - 100% |
|---|---|---|---|---|---|
| 2012 | 225874 | 121970 | 54 | 80716 | 35.7 |
| 2013 | 241509 | 142666 | 59.1 | 97790 | 40.5 |
| 2014 | 225458 | 120523 | 53.5 | 79050 | 35.1 |
| 2015 | 193189 | 113121 | 58.6 | 69699 | 36.1 |

Table adapted *from the Department of Basic Education National Senior Certificate Examination Report (2015:78)*

Table 1.2 reflects the overall national performance of Grade 12 Physical Sciences learners in the years 2012-2015. In 2012, performance at 30%-39% range was at 54% which increased by 5.1% to 59.1% in 2013. In 2012, performance at 40%-100% range was at 35.7% and it improved by 4.8% to 40.5% in 2013. In 2014, performance in the 30%-39% range dropped by 5.6% to 53.5%. In the 40%-100% range the achievement declined by 5.4% to 35.1%. In 2015, performance at 30%–39% range was at 58.6% whereas at 40%-100% range, there was a slight improvement of 1% to 36.1%. From 2013 to 2015, learners' performance in Physical Sciences at 30%-39% range declined by 0.5%, from 59.1% to 58.6% whereas in the 40%-100% range, learners' performance declined by 4.4%, from 40.5% to 36.1%.

From an analysis of the performances of learners in Physical Sciences at both the national and the Limpopo Province (LP), it was evident that a lot needs to be done to improve such levels of achievement. Subsequently, the researcher is of the view that stakeholders in education should work together and take positive responsibility to enhance learners' performance in Physical Sciences in South African schools.

Over the years, the National Senior Certificate (NSC) results in Physical Sciences have attracted public attention because of the poor performance of learners at that level (DBE, 2015:78). Moreover, Keeton (2010:10) pointed out that the National Curriculum Statement (NCS) results in all provinces across the country recorded a decline in the performance of learners in Physical Sciences. Therefore, the purpose of this study was to examine the effectiveness of strategies that are used to enhance the performance of learners in Physical Sciences.

## 1.2 STATEMENT OF THE PROBLEM

Most learners in Grade 12 perform poorly in Physical Sciences as reported by the Department of Basic Education National Senior Certificate Examination Report (2015:78) in Tables 1.1 and 1.2.

Physical Sciences is a subject which depends largely on laboratory investigations (Dhurumanrajah, 2013:18). Boaventura, Faria, Chagas and Galvao (2013:802) postulate that laboratory activities make learners understand, enjoy and minimise misconceptions in Physical Sciences. However, Muwanga (2008:34) argues that some schools in South Africa do not have laboratories to facilitate effective teaching and learning in Physical Sciences. This implies that some learners are doing Physical Sciences without laboratory experimentations. The dearth of conducting practical work in laboratories seems to exacerbate poor performance in Physical Sciences because practical experiences tend to link book knowledge with real life. The intention of this study is to examine the effectiveness of strategies that are used to improve learners' performance in the subject Physical Sciences.

## 1.3 PURPOSE OF THE STUDY

The purpose of the study is to enhance learners' performance in Physical Sciences. This involves investigating how best the subject could be taught in a simple, insightful and practical way. The study also attempted to develop a teaching and learning model that could be used to improve Grade 12 learners' performance in Physical Sciences.

The objectives of the study were:

- To determine strategies to improve learners' performance in Physical Sciences.
- To investigate the effectiveness of strategies used to improve Grade 12 learners' performance in Physical Sciences.
- To identify teaching strategies that can be used to improve learners' performance in Physical Sciences.
- To establish best learning styles that would improve the performance of learners in Physical Sciences.

## 1.4 RESEARCH QUESTIONS

The main question of the study was: “How to enhance the performance of Grade 12 learners in Physical Sciences?”

The following subsidiary questions were developed to address the main research question:

- What strategies are employed to improve learners’ performance in Physical Sciences?
- How effective are the strategies used to enhance learners’ performance in Physical Sciences?
- Which teaching strategies can be used to improve learners’ performance in Physical Sciences?
- What are the best learning styles that would improve the performance of learners in Physical Sciences?

## 1.5 THEORETICAL FRAMEWORK

This study is underpinned by David Paul Ausubel’s meaningful learning theory. This theory entails that learners learn through a meaningful process of relating new material to already existing concepts. Consequently, meaning is not an implicit response but an expressed and distinguished conscious experience that takes place when meaningful signs, symbols, concepts or perceptions are related to a given individual’s cognitive structure (Rossner, 1982:16).

## 1.6 DEFINITION OF CONCEPTS

In this section, the following key concepts that are used in the study are defined to get common understanding on the strategies that can be used to enhance learners’ performance in Physical Sciences.

### 1.6.1 Assessment of Learners

Assessment is a process of collecting, analysing and interpreting information to assist teachers, parents and other stakeholders in making decisions on learners' progress (Department of Basic Education, 2011:03). Heystek, Nieman, Van Rooyen, Mosoge and Bipath (2005:102) define assessment as a systematic collection of information about learner learning using time, knowledge, expertise and resources available to inform decisions on how to improve learning. In this study, assessment relates to all formal and informal activities through which learners' performance is determined in Physical Sciences.

### 1.6.2 Learner Performance

Haar, Nielsen, Hansen and Jacobsen (2005:04) define learner performance as a demonstration of a behaviour which a true test of is, whether learning has taken place. Performance could either be good or poor. According to the Department of Education (2003:09), poor performance is when learners' scores are at or below thirty percent. Good performance is when learners score a mark from 30% and above.

In this study, learner performance refers to the level of achievement of learners in Grade 12 Physical Sciences. Learners can perform well by obtaining at least 60% and above, a score that contributes to the aggregate final score that allows a learner to gain access to universities and other higher education institutions.

### 1.6.3 Subject Advisor

A Subject Advisor is a person with deeper knowledge in a subject area and is trained to conduct workshops and share knowledge with other people, especially in schools, districts and at provincial levels. This is usually a person with functional and multi-disciplinary expertise (DoE, 2005:11).

In this study, Subject Advisor refers to a circuit-based practitioner who is responsible for Grade 12 Physical Sciences subject. A Subject Advisor gives support to teachers at schools across the circuit. A Subject Advisor trains teachers in the circuit, clusters and district on subject content and practical work. They are trained by the Ministry of Education and universities to develop competency among school based Physical Sciences teachers (DoE, 2005:11).

### 1.6.4 Physical Sciences

According to the DoE (2005:07), Physical Sciences is a learning area in the Further Education and Training (FET) Phase. Physical Sciences comprises of two sections which are: Physics and Chemistry. The subject addresses the need to understand the way in which the environment works. It focuses on the investigations of Physical and Chemical nature which are conducted through scientific inquiries. Therefore, in this study, Physical Sciences refers to Physical Sciences learning area which is offered in Further Education and training (FET) Phase.

### 1.6.6 Teaching and Learning

Teaching and learning is a process in which teachers interact with learners to facilitate knowledge transfer. According to Punch (2009:288), it is an interaction of a teacher and a learner in which a teacher gives instructions so that a learner may know about something or how to do something. Teaching and learning as a process enables a person to think or behave in a particular way. At the same time, learners get an opportunity to master knowledge and skills. Badroodich (2005:92) and Punch (2009:288) posit that teaching and learning is a process of expanding knowledge, skills and attitude for the improvement of quality of life. Teaching and learning refers to all activities which are done by teachers and learners and all interested stakeholders in and out of the class room which may enhance learners' performance in Physical Sciences.

### 1.6.6 Physical Sciences Curriculum

According to Kelly (2004:2) curriculum is defined as a collection of learning activities set out for the learner to perform or achieve certain goals prescribed by the educational system. Curriculum refers to the materials with which learners interact for achieving identified educational outcomes. Kelly (2004:2) postulates that Curriculum is concerned with the planning of the content or knowledge to be transmitted or a list of the subjects. Curriculum is viewed as a syllabus which could achieve the objectives of motivating learning, enhancing knowledge and developing positive values or even attitude. These elements could help to achieve whole person development (Deventer & Kruger, 2003:248).

In this study, Physical Sciences curriculum refers to the whole package of Physical Sciences syllabus which is used for teaching and learning of Physical Sciences.

## 1.7 RESEARCH DESIGN AND METHODOLOGY

This section addresses the research design and subsequent methods of data collection that were applied in this study.

### 1.7.1 Research Design

Research design refers to the plan and strategy through which the entire research is managed until the entire results are reported (Taylor, 2005:13). This study adopted the mixed methods research design. Mixed methods research design involves the use of both quantitative and qualitative methodologies. According to Punch (2009:290), mixed methods research design, is an empirical research design that involves the collection and analysis of both quantitative and qualitative data. Creswell (2005:510) postulates that mixed methods research design is a procedure for collecting, analysing and mixing both quantitative and qualitative data in a single study to understand a research

problem. In this design, findings from quantitative and qualitative techniques complemented each other. Punch (2005:290) points out that mixed methods research design strengthens the results of a study and avoids overlapping of weaknesses. The researcher opted to use the mixed methods research design because it provides a better understanding of the research problem than when either design is used by itself (Creswell, 2009:510). The mixed methods research design also allows the researcher to integrate methods, techniques, procedures and perspectives in examining the effectiveness of strategies that are used to enhance the performance of learners in Physical Sciences. The research methods below show the pattern in which the study unfolded.

### 1.7.2 Research Methodology

Research methodology is the strategy of inquiry which moves from the underlying assumptions to research design and data collection. It is the process used to collect data for the purpose of making decisions about a phenomenon under investigation (Creswell, 2009:510). This section presents the methods which were used in gathering research data. The study employed both quantitative and qualitative methods of data collection.

#### 1.7.2.1 Quantitative Methods

Quantitative methods are research methods that involve in the collection of data for numerical and statistical analysis (Myers, 2009:8). The study employed questionnaires to collect data from Grade 12 Physical Sciences learners. The researcher used a questionnaire because it is useful in collecting data and opinions from a larger number of participants (Burton & Bartlett, 2009:82). Questionnaires are also reliable since they encourage greater honesty, are economical and save time (Cohen, Manion, Morrison & 2000:01).

### 1.7.2.2 Qualitative Methods

Qualitative methods are techniques for gathering data based on the views of the participants in the form of words or texts (Creswell, 2005:39). Interviews were used to generate qualitative research.

**Interviews**

According to Fox (2009:04), interviews are data gathering techniques involving verbal communication between the researcher and the participant. This means that an interview is a dialogue between two people for gathering information about a phenomenon of study. In the interviews, the researcher asks participants general open-ended questions and records their answers. Boyce and Neale (2009:03) observe that interviews allow for probing and clarification during data collection. In this study, interviews were conducted with school principals, Physical Sciences teachers and Physical Sciences Heads of Departments (HODs).

## 1.8 SAMPLING

This section focusses on the identification of the population, determination of the sampling procedures and the selection of samples.

### 1.8.1 Population

Gay and Airasian (1992:102) define population as a group of interest to the researcher or the group to which the results of the study may ideally be generalised. In addition, McMillan and Schumacher (2001:129) describe population as individuals that conform to specific criteria which are used to generalise the results of the research.

The population of this study comprised of 9216 Grade 12 Physical Sciences learners and 253 Grade 12 Physical Sciences teachers of Mopani district.

### 1.8.2 Sampling Procedures

The following sampling procedures were used to select quantitative and qualitative samples.

#### 1.8.2.1 Quantitative sampling

Simple Random Sampling (SRS) technique was used to select a quantitative sample. According to McMillan and Schumacher (2006:490), Simple Random Sampling is a sampling method in which every member of a population has the same chance of being selected into the sample. Creswell (2005:598) states that quantitative sampling is a procedure in which the researcher selects participants (or units such as schools) in a way that any individual has an equal chance of being selected. The district had 24 circuits and 253 schools. 10 circuits were selected from 24 circuits. A school from each of the selected circuits was selected. 10 Physical Sciences learners were selected from each of the 10 schools.

#### 1.8.2.2 Qualitative samples

The Purposive Sampling Procedure (PSP) was employed to select a qualitative sample. McMillan and Schumacher (2006:475) state that purposive sampling technique is a way of sampling that allows the researcher to choose small groups or individuals who are knowledgeable and informative about the phenomenon of interest.

In this research, 10 Grade 12 Physical Sciences teachers were sampled through Purposive Sampling Procedure.

### 1.8.3 Sample

According to De Vos (1998:191), a sample is an element of the population considered for actual inclusion in the study or a subset of measurements drawn from a population.

The quantitative sample comprised 100 Grade 12 Physical Sciences.

The qualitative sample comprised:

- 10 Grade 12 Physical Sciences teachers.

Therefore, the total sample in this study comprised 110 participants.

## 1.9 DATA ANALYSIS

Quantitative data was analysed through the Statistical Package for Social Sciences (SPSS) Version 25. The SPSS package helps the researcher to make smart decisions, solve problems as well as improve outcomes.
Qualitative data was analysed thematically. The tape-recorded interviews were transcribed, and the transcripts were analysed per qualitative methods. Consequently, data was presented narratively.

## 1.10 MEASURES OF QUALITY CONTROL

This section presents measures that the researcher applied to ensure quality of the study. These are measures that the researcher applied to make sure that trustworthiness, validity and reliability of the study are upheld.

### 1.10.1 Validity and Reliability of Quantitative Research

According to Cohen et al. (2008:234), validity and reliability of the research instrument influence the extent to which researchers learn about the phenomenon they study. Cohen et al. (2008:134) state that validity of the research instrument refers to the demonstration that an instrument measures what it purports to measure. Validity is defined as the examination of the truthfulness or falsity of the instrument (McMillan & Schumacher, 2006:134). The instrument is said to be valid when it measures what it is meant to measure.

#### 1.10.1.1 Validity

Validity is a measurement to determine whether an instrument which is used measures what it is designed to measure (Cohen, Manion & Morrison, 2002:15). In as far as this study is concerned, validity was realised through pre-testing of the questionnaire instrument before the actual data collection started.

#### 1.10.1.2 Reliability

McMillan and Schumacher (2006:130) define reliability as the consistency of measurement, or the extent to which the scores are similar over different forms of the same instrument or occasions of data collections. Cohen et al. (2008:146) identify three principal types of reliability in quantitative research inclusive of reliability as stability, reliability as equivalence and reliability as consistency. In this study, reliability was achieved through outlining the details of the research methodology to maintain the consistency of the results.

### 1.10.2 Trustworthiness of Qualitative Research

The concept trustworthiness relates to the rigour of a research study that generates trust and confidence in the findings and conclusions made. According to Rolfe (2004:305), the four criteria for trustworthiness are credibility, transferability, dependability and confirmability.

#### 1.10.2.1 Credibility

Credibility refers to confidence in or how well the processes of analysis address the intended focus. Shenton (2004:63) points out that credibility seeks to ensure that the study measures or tests what it is intended to measure. In this study, credibility was realised by using established research methods, personal visits to research sites of interest to consult documents and source data from selected participants.

#### 1.10.2.2 Transferability

Transferability refers to the extent to which the findings of one study can be applied to other similar situations (Shenton, 2004:69). This was achieved when the researcher provided sufficient information about the self (researcher as an instrument), research context, processes, participants and researcher–participant relationship. This enables the reader to decide how the findings may be transferrable (Morrow, 2005:252).

#### 1.10.2.3 Dependability

Dependability refers to the extent to which research results are consistent over time and reflect the views of participants rather than those of the researcher (Morrow, 2005:252). Shelton (2004:71) argues that dependability in the study enables future researchers to repeat the study and get the same results. To ensure that the issue of dependability is observed in this study, the researcher made sure that all processes within the study were reported in detail. The researcher also made a proper selection of research participants.

#### 1.10.2.4 Confirmability

Confirmability refers to the acknowledgement that research is never objective. Confirmability addresses the core issue that findings should represent as far as possible the situation being researched rather than the beliefs, theories or biases of the researcher (Morrow, 2005:252). To ensure confirmability, the researcher adequately tied together the data, analytic processes, and findings in such a way that the reader can confirm the adequacy of the findings.

## 1.11 DELIMITATION OF THE STUDY

The study was conducted in the Mopani District in the Limpopo Province of South Africa. The district is located on the South-Eastern side of Vhembe District, Eastern side of Capricorn District and the North-Eastern side of Sekhukhune District. In the 10 schools that were chosen from this district, focus was given to the performance of Grade 12 learners in Physical sciences.

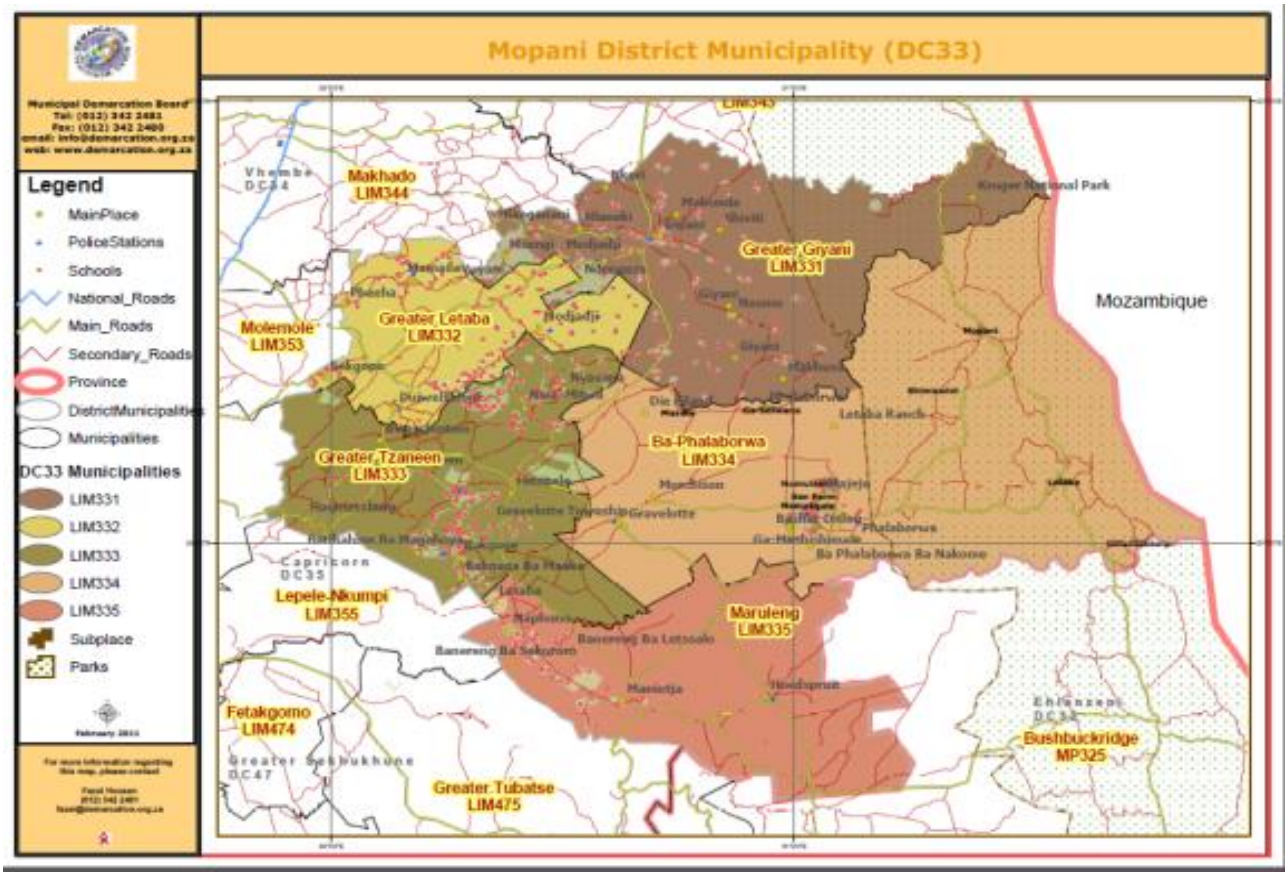



**Figure 1.1: Mopani District Municipality Map**

## 1.12 SIGNIFICANCE OF THE STUDY

The following stakeholders and institutions would benefit from this study:

- Physical Sciences learners would benefit from this study. The study would provide learners with best learning habits which they can use to master skills in Physical Sciences.
- Physical Sciences teachers would benefit from this study as it would provide teachers with teaching and learning with models that would assist them to enhance learners' performance in Physical Sciences.
- Physical Sciences teachers would know strategies and types of interventions they can use to enhance learners' performance in Physical Sciences

## 1.13 ETHICAL CONSIDERATIONS

Burton and Barlett (2009:30) explain that ethics is a systematic study of values, concepts, behaviours and general principles that justify the application of these concepts. Kumar (2014:370) argues that ethical guidelines serve as a standard or basis upon which the conduct of each researcher ought to be evaluated. For this study, the following principles were adhered to:

- The researcher requested permission from the Mopani District Office to conduct research in different sites within the district. The first thing that the researcher did upon arrival at the research sites was to present the letter of permission to conduct the study to the site managers.

- The researcher ensured that the participants' confidentiality and privacy were respected. That was realised by ascertaining that all information obtained during data collection was not released to outside individuals. This was done to avoid embarrassing the participants, schools, circuits, the district and the Department of Education.
- Questionnaires and responses of the interviewees were kept anonymous (Cohen, Manion and Morrison, 2000:62).

- Participants were not forced to participate in the research. The researcher explained to participants that participation was voluntary and that participants should feel free to participate or to withdraw from participation at any stage of the study (De Vos et al., 2005:57).

- The researcher ensured that the research would not attribute to any physical or emotional harm. Subsequently, the researcher achieved this by ascertaining that procedures which were used should not expose participants to any harm (De Vos et al., 2005:58).

## 1.14 OUTLINE OF THE STUDY

This section outlined the way in which the research unfolded.

**Chapter One**

This chapter consisted of the introduction, problem statement, and clarifications of concepts purpose of the study, significance of the study, delimitations, research methodology, research design and outline of the research.

**Chapter Two**

Chapter Two focused on the literature review based on strategies to enhance Grade 12 learners' performance in Physical Sciences.

**Chapter Three**

This chapter discussed research designs and methodologies in detail.

**Chapter Four**

Chapter Four presented data analysis and interpretation.

**Chapter Five**

The chapter detailed the summary of the study, discussions of the findings, conclusions, recommendations and the summary of the chapter.

**Chapter Six**

Summary, conclusions, recommendations, limitations and suggestions for further studies were detailed in this chapter.

# CHAPTER TWO

# THEORETICAL FRAMEWORK: AUSUBEL'S MEANINGFUL LEARNING THEORY

## 2.1 INTRODUCTION

This study had adopted Ausubel's Meaningful Learning Theory. The first part of this chapter gives an exposition of Ausubel's Meaningful Learning Theory which entails a critical analysis of the concept 'meaningful learning' and its important elements. The second part discusses the applications of this theory in the teaching and learning of Physical Sciences.

## 2.2 AN EXPOSE OF AUSUBEL'S MEANINGFUL LEARNING THEORY

In this section, Ausubel's Meaningful Learning theory, its nature and functionality were detailed.

### 2.2.1 The Concept 'Meaningful Learning'

Meaningful Learning Theory was developed and introduced into the education system in 1963 by an American Psychologist, David Paul Ausubel (1918-2008). Meaningful learning is a process that helps learners gain a deeper understanding of learning objects such as visual and auditory materials and then organising them into a coherent mental structure (Mayer & Moreno, 2003:45). Meaningful learning involves the understanding of how all pieces of a complete concept fit together. According to Novak (2013:28), meaningful learning encompasses the acquisition of new knowledge, concepts and ideas that can be integrated with what learners already know. Kaya and Akdemir (2016:36) argues that when individuals manage to relate new knowledge with their past experiences or already mastered concepts then meaningful learning takes place. On the same note, Davis (2014:21) points out that learning is said to be meaningful when learners' cognitive structures change. This denotes the incorporation

of new information into the existing cognitive structure. For example, in teaching the topic Work, Energy and Power in Physical Sciences, Physical Sciences teacher should ensure that learners have the necessary prior knowledge since the topic deals with multiple forces. Before teaching mechanics, learners must have acquired knowledge and understanding of Newton's laws of motion, types of forces and the equation of motion as the basis. A pre-test on the concepts can be helpful to determine the learners' prior knowledge. This may help to ensure that learning the new concepts in mechanics could be meaningful as learners can relate the new concepts to their prior knowledge.

Ausubel further stresses the importance of reception rather than discovery learning, and meaningful learning rather than rote learning. Ausubel believes that an understanding of concepts, principles, and ideas is achieved through deductive reasoning (Kapri, 2017:189). In other words, Ausubel's theory is more emphatic on the use of deductive reasoning and abstract thinking in learning.

According to Safdar (2013:64) Ausubel's theory is premised on three principles:

- Concepts are meaningful when the learner can visualize them and subsume them into a cognitive structure.
- Learning should proceed from the most generic concepts to the specific.
- Learners' readiness dictates that learning tasks match the current learners' developmental readiness, subject matter readiness, intellectual ability, motivation, attitude, personality as well as social factors. Beyond these pedagogical techniques, teacher characteristics are not exempted as these are also influential in learners' academic performance and development. The implication is that assessment must be done extensively so that all areas perceived to be crucial in meaningful learning are verified and necessary measures are adopted as early as possible. The following section elucidates meaningful learning in Physical Sciences.

### 2.2.2 Meaningful Learning in Physical Sciences

Physical Sciences investigates physical and chemical phenomena through scientific inquiry, application of scientific models, theories and laws (DBE, 2011:8). The aim of teaching Physical Sciences is to enable learners to be able to explain and predict new events that occur in nature. An Ausubelian approach to teaching of Physical Sciences has a potential for meaningful learning of scientific concepts.

Meaningful learning is important for the learning of Physical Sciences. For example, concepts in the Chemistry part of Physical Sciences are taught at three levels which are: the sub-microscopic level involving atoms and molecules; macroscopic level involving the tangible and visible aspects of chemistry during experiments and representational level of chemical symbols and equations (Kelly, 2017:583). Difficulties that learners experience stem from the fact that learners should explain their observations using concepts and models at the microscopic level.

To alleviate these learning difficulties, Ausubel suggests that learning should proceed from what learners already know to the new concepts. This means that learning should start by examining concepts at the macroscopic level of the visible and tangible before explaining using the sub-microscopic level of atoms and molecules. Ausubel also suggests that learners should be able to visualise phenomena for meaningful learning to occur. The use of animations and simulations has been cited as having the potential to enable learners visualize chemical phenomena and in the explanation of abstract concepts at the sub-microscopic level (Justi, 2003:310). Simulations are useful in the teaching of such topics as rate and extent of chemical reactions, chemical equilibrium, acids and bases, electrochemical reactions and organic molecules.

### 2.2.3 Advance Organizers

Ausubel's Meaningful Learning Theory suggests the use of an advance organisers as a way to help learners make connections between concepts that are already possessed and accommodation of new concepts. An advance organiser is a device or a mental learning aid that helps learners get a grip of new information. Advance organisers can

be verbal phrases or graphs. According to Ausubel (1978:251), an advance organiser is described as a bridge that connects new information that is learned with the already existing information in the mind of the learner. Advance organisers help learners to process new and incoming information. This is achieved through directing attention to what is important in the incoming materials, highlighting relationships and providing a prior knowledge. Advance organisers also play a significant role in helping learners in the processing of difficult and complex materials (Kapri, 2017:189).

The two types of advance organisers are Comparative Organizers and Expository Organisers (Woolfolk et al., 2010:289). Comparative organisers are used when new materials are relatively familiar to the previously acquired material. The role of these organisers is to provide ideational scaffolding to increase discriminability between the new materials to be learned and the previously learned concepts by pointing out the principal similarities and differences between them. Comparative organisers activate the existing schemas and act as reminders to bring new materials into the working memories (Kaya & Akdemir, 2016:35). Comparative organisers are also used to integrate and to discriminate materials. Expository advance organisers are essential to make sure that anchoring concepts are available as the determinants for new meanings. Anchoring concepts are developed in cases where these are not available to facilitate the comprehension of new knowledge.

Expository Organizers are used when new learning materials are completely unfamiliar to the material which is already learned in the cognitive structure. This is determined by the attempts that provide subsumers that are related to more detailed material in the learning content. Subsumers provide new knowledge that would enable learners to understand the new upcoming information.

Concepts which are developed at earlier stages of learning should serve as the basis of subsequent development of new knowledge. Concept such as Chemical Equilibrium sets a good example. Advance organisers that may be used in teaching Chemical Equilibrium are concept maps. As explained by Sisovic and Bojovic (2000:143) each new concept should be introduced by connecting it with other concepts, by encouraging

learners to look for similarities and differences amongst the concepts and by directing students to essential properties of the concepts. When introducing the topic Chemical Equilibrium, teachers may prepare a concept map that links concepts in the previously taught topic. The concepts to be linked include reaction rate; factors affecting reaction rate and dynamic equilibrium (This is defined as a stage in a reversible reaction when the rate of the forward reaction equals the rate of the reverse reaction). New concepts on the concept map include factors affecting equilibrium position, the equilibrium constant, Le Chatelier's Principle, effects of catalyst on equilibrium and effect of change in temperature on the equilibrium constant. In the same vein, weak anchoring concepts must be strengthened to enable the application of principles such as assimilation and association. This compels teachers to assess learners' conceptual frameworks prior to giving instructions. Learning materials should also be organised in a hierarchy and sequence for them to be understood as they are expected to relate to the natural characteristics of the cognitive structure of human beings (Cakir, 2008:194).

### 2.2.4 Proper Teaching Strategy

To achieve meaningful learning, care must be undertaken to ensure that effective teaching strategies are employed in the process. Youman (2010:55) states that Physical Sciences teachers should be well skilled and possess positive attitudes to improve the cognitive structures and experiential development of learners. They should demonstrate an understanding of Physical Sciences concepts such as Waves. In teaching Waves in Physics, learners should be introduced to the topic by using experiments. Firstly, by demonstrating wave motion through mechanical waves by using slinky spring. By exploring waves through slinky spring, learners can observe longitudinal waves. They can observe rarefactions and compressions and they also observe the motion of the waves and the medium of waves propagation. This then becomes the starting point for explaining basic concepts such as wave length, wave period and amplitude. This means concepts are introduced from concrete to abstract.

According to Chairam and Klahan (2015:953) enquiry method assists learners in drawing concept lists, phrasing scientific questions, designing experiments, presenting

the data, analyzing the results, and drawing conclusions. This shows that learners had a deeper understanding when learning reaction rates through the laboratory method of teaching. Furthermore, this method provides adequate exposure of learners to both theoretical understanding and practical engagement (Youman, 2010:55). Teachers should allow learners to discover, experiment and share information with groups as well as get involved in activities that are designed to develop both individuals.

According to Davis (2014:21), meaningful learning is effective through active participation. This advocates for learning activities that highly consider learners' participation. In teaching and learning of Physical Sciences, learners should be afforded adequate opportunity to explore, demonstrate, experiment, discover, explain, and critically analyze the world they live in. For example, when teaching electric circuits learners should be given the opportunity to design and carry out experiments. Such experiments include the investigation of Ohm's Law; determination of internal resistance of a cell, determination of the equivalent resistance of a series-parallel network of known resistors using an ammeter and a voltmeter and comparing them with their theoretical value. In the experiments, learners might reflect understanding and knowledge of electricity and magnetism by making use of electric circuit.

In the teaching of motion in Physics, learners should have opportunities to do experiments. This involves stating the investigative questions, identifying variables, planning the procedures then actually carrying out procedures and drawing up conclusions. For example, learners may be asked to determine the acceleration due to gravity. They should design the experiments, carry them out and draw conclusions.

Concepts in Physics should be taught from the concrete to the abstract. For example, in mechanics, the conservation of linear moment should be verified through experimentation. Learners may be provided with aim, apparatus, procedure and the table of results. The skills tested will be the ability of the learner to conduct the experiment, to link the observations to the theoretical concepts that the teacher would have introduced earlier and as well as to make relevant conclusions from the data they obtained.

The use of appropriate teaching strategies enables learners to be fully engaged in learning processes so that they can successfully acquire and retain knowledge. Olusegun (2015:67), upholds the opinion that the retention of information depends on the ability of learners to link the previously learnt content with new knowledge. This implies that learners' active participation in learning and the ability to use possessed and new knowledge enhance learners' ability to apply knowledge they have acquired in real life situations. Ausubel refers to this as the construction of knowledge and this makes meaningful learning to be constructive.

## 2.3 APPLICATION OF AUSUBEL'S MEANINGFUL LEARNING THEORY

This section discussed application of Ausubel's Meaningful Learning into the practical teaching of Physical Sciences.

### 2.3.1 Sequencing of Concepts

Ausubel's Meaningful Learning Theory serves as a centre piece to leverage teaching and learning in schools (Novak, 2013:3). This theory advances that learners should exhibit meaningful learning sets for them to comply with the processes of learning such as acquisition, retention, reduction and retrieval. Ausubel's Learning Theory carries a view that for learners to learn, they should be exposed to learning materials that match their academic levels (Novak, 2013:4). This calls for continuous assessment of learners' capabilities so that planning of the learning matter is guided by their needs.

According to Davies (2014:21), learners must exhibit a disposition or propensity to comprehend learning activities that are presented to them during classroom instruction. Furthermore, the level of learners' cognitive development should relate to the nature of content that is delivered to them so that they can readily comprehend the information. As such, learners in a Physical Sciences class should have developed requisite cognitive structures to master the typical standard and mind absorbing subject matter.

### 2.3.2 The Use of Pre - Formal Learning Content

Biser (1984:109) posits that the learning materials should reflect logical meaningfulness. This implies that what is learned must be plausible and non-random such that it relates well with the ideas that exist within the schema of human ability. It must link well with the anchoring concepts that already exist in the cognitive structure of the learner. These are concepts which are developed at the pre-formal learning stages of an individual and which serve as the basis for successful acquisition of new knowledge and meanings. Universal Gravitational force is one example of concepts that could have been developed as pre-formal learning contents that could serve as the basis of successful acquisition of new knowledge. As part of pre-formal experiences, learners observe fruits falling from trees, objects thrown up in the air falling and rain drops falling from the sky to the ground. Another typical example is when a ball is kicked upwards, it moves faster at first, slows down, comes to a standstill and then descends to the ground due to the force of gravity. The teacher should give these types of examples when introducing the topic vertical projectile motion to teach the new concepts in the topic. Later the teacher may then illustrate how motion is described using words, graphs and equations.

### 2.3.3 Teaching Approaches

Learners' performance in Physical Sciences demands that teachers properly plan, organize and deliver content in an orderly manner such that it relates to what already resides in the cognitive structure of learners (Cakir, 2008:203).

Teaching must gradually develop from that which learners know to the unknown. Topics related in terms of technical words and experiments should be sequenced appropriately and structured in ways that allow new meanings to be mastered and retained (DoE, 2012:24). The concept of titration in chemistry stands as relevant example in this case. This relates to the reactions that occur in acids and bases. Titration refers to a common laboratory method where solutions with known concentration are used to determine the concentration of the unknown solution. Before

learners could conduct experiments on titration, they must already have acquired knowledge of bases and acids. The teacher would have discussed definitions of acids and bases using Arrhenius Theory and Bronsted Lowry theory. This helps in explaining meanings of strong/weak acids and bases, neutralization, indicators, equivalence point and end of a titration.

All laboratory equipments and chemicals used in the titration are introduced to learners through demonstrations by the teacher on how to do titration. During the demonstration, the teacher could use the Socratic questioning technique to reinforce integration of prior concepts with new concepts. After the demonstration, the teacher may use the scaffolding technic to assist learners in calculation of the concentration of the base. The aim would be to determine the concentration of the base when it is titrated with a standard solution of an acid whose exact concentration is known.

### 2.3.4 The use of Laboratory Experiments in Teaching Physical Sciences

Ausubel's theory advocates for visualization of concepts for meaningful learning. The use of laboratory in teaching Physical Sciences is in line with these ideas. For example, in teaching electrochemical reactions, the teacher may start by a demonstration in which a zinc electrode and a copper electrode are placed in an electrolyte of sulphuric acid. The electrodes are joined by a copper wire. Learners observe the production of gas at the electrodes and the teacher asks them to explain their observations. This ensures that the teacher elucidates the prior conceptions of learners before commencing with the topic. It is only then that the teacher can explain new concepts and the electrochemical reactions occurring at the electrodes (De Jong & Treagust, 2003:332). The new concepts that follow from this demonstration include the concepts of electrode; electrolyte; galvanic cell; oxidation and reduction reactions at the electrodes; anode and cathode; half reaction and overall reaction. The demonstration serves as a bridge between what learners already know and the new concepts.

### 2.3.5 Recognition of Learners' Prior Knowledge

From Ausubel's theory, before learners are taught about electricity, the teacher should ensure that they understood concepts in electrostatic as this is the prior knowledge learners need to understand before getting to electric current. Concepts in electrostatics that are important for comprehension of electric circuits are electric field and electric potential. This is crucial since electric -current in Direct current (DC) circuits is driven by electric fields (Guisasola, 2014:147). Concepts learnt in electrostatics include that electric field is force per unit charge (E=F/q); Electric potential at a point is energy per unit charge (V=E/q) and potential difference between two points is energy required to move a unit charge between the two points. The same concepts would then be applied to teach electric circuits. The concepts in electric circuits are current, voltage and resistance. These ideas should be clearly linked to electrostatics (Guisasola, 2014:148). For example, the movement of charge between two points in a conductor should be explained in terms of potential energy. The role of the battery in the circuit is then explained as to create a constant difference in potential between its terminals (Guisasola, 2014:148). Macroscopic observations on electric circuits (measurement of current and potential difference in series and parallel circuits) are interpreted using the causal model at microscopic level using the idea of electric fields. The understanding gained in electric circuits may enable learners to apply the knowledge they acquired from Physical Sciences at smaller scales at homes and are able to understand how Eskom, the biggest supplier of electricity in South Africa can supply electricity across the country.

## 2.4 CONCLUSION

The chapter discussed the important concepts and ideas encapsulated in Ausubel's meaningful learning theory. The theory assumes that learning is basically built upon learners' anchoring concepts. These are concepts that are developed very early in life and continue to determine the learning processes as regard the cognitive structure of individuals. This structure influences the way in which knowledge and new meanings are acquired, retained and retrieved. New information must relate to existing schema or

the cognitive structure of individuals for fresh meanings to be developed. A set of organisers assist in building the bridge between relating new information with that which has already been acquired. These include advanced organisers, comparative organisers and expository organisers. The theory suggests that Physical Sciences teachers must organise instruction in such a way that it exposes learners to content developing from the known to the unknown. Learners should participate actively in the learning process as well as explore and discover new knowledge. They should be provided the opportunity to acquire information, store it in memory and retrieve it or give feedback. The main outcome of the theory is to make learning meaningful to learners for enhanced performance.

# CHAPTER 3

# ENHANCEMENT OF LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES

## 3.1 INTRODUCTION

This chapter constitutes part of literature review. The main aim of this study was to enhance Grade 12 learners' performance in Physical Sciences. This chapter served to respond to research questions, main aim and the objectives of the study. Discussions were made on the factors that enhance the performance of learners in Physical Sciences.

## 3.2 FACTORS THAT ENHANCE LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES

There are various factors that contribute towards improving the performance of learners in Physical Sciences. Such factors emanate from the teachers, learners themselves and the school resources as outlined hereunder.

### 3.2.1 Teachers' Competency in Physical Sciences

According to the British Council of Teachers (2011:10), knowing the subject involves the ability of the teacher to arrange the wide spectrum of reference materials that are relevant to the subject and using these materials to support teaching and learning. Teachers should reflect on the strengths and weaknesses in relation to their subject knowledge and applications (Rose & Reynolds, 2017:220).

According to Berliner (2005:207), competency-based perspective relates to approaching teaching and teacher preparations not in terms of teacher knowledge but in terms of teacher competency. Berliner (2005:207) expresses that teacher competency refers to the ability of a teacher to deal adequately with the demand of the teaching profession

using an integrated set of knowledge, skills, and attitude as manifested in both the performance of the teacher and the reflection on his/her performance. Wayne and Young (2003:90) point out that good teachers are required to enhance learning in the classrooms. Berliner (2005:207) describes a good teacher as a teacher who possesses a substantial amount of specialised knowledge which is referred to as pedagogical content knowledge (PCK). According to Adedoyin (2011:277), pedagogical content knowledge describes the knowledge on how to transform formal subject knowledge into meaningful learning outcomes for the learners.

Pedagogical content knowledge of Physical Sciences teachers involves an understanding of topics in Physical Sciences and how teachers should explain the concepts in a meaningful way to the learners (Adedoyin, 2011:278). Adedoyin (2011:278) contends that pedagogical content knowledge refers to teachers who have a thorough knowledge of their subjects. This concerns teachers who can use effective teaching methods to impart knowledge to learners.

In as far as learning and pedagogical content knowledge is concerned, the most important aspect is not highest qualified teachers but teachers' pedagogical content knowledge. Teachers who are knowledgeable and have the so-called pedagogical content knowledge are the ones that matter most in as far as teaching and learning of Physical Sciences is concerned. These are teachers, who have deep pedagogical knowledge.

Teachers with content knowledge are referred to as being effective (Adedoyin 2011:277). Teachers should know the topics which are typically difficult for the learners. Such teachers should also have the knowledge and understanding of why such topics are difficult for the learners. In addition, these teachers have knowledge of different strategies of lesson presentations that are useful in the teaching of Physical Sciences. (Wayne & Young, 2003:90).

Ball (2003:390) argues that teachers with pedagogical content knowledge of Physical Sciences can break down Physical Sciences concepts into less problematic and less challenging forms. Teachers who have pedagogical content knowledge have the potential, skills and ability to make Physical Sciences accessible to all learners at different cognitive levels. To develop and strengthen teachers' pedagogical content knowledge in Physical Sciences, teachers and subject heads may organise training sessions in the form of workshops, In-Service Training (INSERTS) and Continuing Professional Development programmes wherein they may address the provisioning of effective Physical Sciences teachers and teacher growth. This sentiment is supported by Ball (2003:390) who argues that to prepare effective teachers, teacher training programmes must focus on all three types of knowledge such as content knowledge, knowledge of what to teach and knowledge of how to teach specific concepts.

### 3.2.2 Appropriate Teaching Approaches

Teaching approaches are ways that are used by the teacher to facilitate teaching and learning in the class. Learners do not learn in the same way. For effective teaching of Physical Sciences to prevail, various teaching methods are applicable. The following are approaches that teachers may use to teach Physical Sciences effectively and enhance the performance of learners.

#### 3.2.2.1 Inquiry based teaching method

Low, Leen and Yeap (2011:05) posit that discovery learning is the hallmark strategy for the learning of science and Social Sciences. It is a specimen learning process in which the learner engages in during the inquiry. This includes developing questions, seeking evidence to answer questions, explaining the evidence and justifying or laying out an argument for the evidence. Inquiry Based Learning is suitable for all subjects. According to Alberta Learning (2004:54), in Inquiry Based Learning method, learners practice problem solving and critical thinking skills in order to arrive at a particular conclusion.

Ruutmann and Hants (2011:110) explain the advantages of Inquiry Based Learning when they point out that it focusses on the learners' acquisition of knowledge and the development of certain skills such as problem-solving skills and critical thinking skills. Inquiry based teaching method is learner directed and is flexible because other teaching methods can be infused during the process of its implementation. According to Low, Leen and Yeap (2011:05), this method may be modified for learners at any level. Bronwyn (2016:08) posits that teachers must first model the process to the learners for the effectiveness of this method to be achieved. The Inquiry Based teaching method is based on the constructivist theory of learning wherein knowledge is constructed from experience and processes. According to Brown (2006:04), discovery learning covers a range of approaches, including field work, case studies, investigation, individual or group projects and research projects. Although inquiry-based teaching method is good and effective, it also has its own shortfalls. Its main disadvantage is that the Inquiry Based Method takes a lot of time, energy and planning (Alberta Learning, 2004:53).

Ruutmann and Hants (2011:110) describe the Inquiry-Based Teaching Method as the best strategy of introducing learners to the world of science. This method promotes mastery of subject content and other scientific skills by learners. The Chemistry teacher may require learners to apply learnt skills to mix chemicals in the Physical Sciences laboratory. Physics teachers also may ask learners to design and develop Physics experiments, thereby giving learners the opportunity to plan as well as implement those plans.

SME (2014:13) postulate that hands-on involvement is an excellent opportunity for learners to discover scientific concepts on their own. Hands-on activities should be followed-up activities requiring learners to analyse the results of activities and explain why certain sets of events may have occurred. Follow-up exercises, tests and assignments designed for hands–on activities should reinforce learning and help learners to better understand scientific principles (Brown, 2006:29).

### 3.2.2.2 Co-operative teaching approach

Felder and Brent (2007:01) express that cooperative learning refers to the structuring of classroom so that learners can work together in small co-operative teams. This is a type of learning in which learners work in groups and get involved in the actual teaching of one another. Cooperative learning is also commonly known as collaborative or peer to peer learning. This type of learning brings about the so-called active learning as in it learners actively participate in the learning process (Dhurumajah, 2000:16).

In cooperative approach, learners are put in small groups (Laal & Laal, 2012:492). The method encourages learners to discuss and debate various scientific topics, develop questions and later draw a common conclusion. The latter was also supported by Low, Leen and Yeap (1996:03) who expressed that in cooperative learning, learners in small heterogeneous groups take roles and learn to share knowledge with one another through a variety of effective structures with strategies. Felder and Brent (2007:05) posit that features of effective cooperating learning include team building, positive interdependence, group interaction, structured activity and individual accountability.

Similarly, Dhurumajah (2000:16) postulates that Cooperative Learning/Collaborative method is a method of teaching wherein learners talk to each other through discussions on specified topics. In this method, learners are put into small groups according to their levels of understanding. Dhurumajah (2000:16) expresses that the collaborative method allows learners to actively participate in the learning process. The method encourages team work which ultimately enhances performance in the subject and it also develops learners' leadership and presentation skills (Laal & Laal, 2012:495).

According to Spinger–Verlag (2015:513), learners do not only take in information but also actively engage with learning materials in some ways. Active learning is very beneficial because it encourages learners to keep focused and engaged both with their hands and minds. Woolfolk (2007:487) points out that active teaching is characterised by high levels of teacher explanation together with demonstration. In the case of

Cooperative Learning, most of the talking is done by the learners themselves whereas the teacher is just facilitating.

Maesin, Mansor, Shati and Nayan (2009:71) postulate that active learning ensures that quality information is assimilated by learners when they interact with and amongst themselves. Dhurumajah (2000:16) further argues that active learning triggers higher order thinking skills, develops respect for the views and opinions of others and subsequently enhances learners' performance in the subject.

Collaborative learning is an effective teaching method. Maesin, Mansor, Shati and Nayan (2009:71) provide an explanation regarding the effectiveness of collaborative learning in the learning process. On the same note, Woolfolk (2007:488) observes that cooperative learning strategies promote greater academic gains for learners during instruction than learners who are using conventional classroom practices.

Spinger-Verlag (2015:513) also confirms that learners who were initially prejudiced against a given subject or topic, evidenced greater interpersonal attraction in experimental cooperative setting than learners who were working as individuals. In addition, Dhurumajah (2006:17) states that Cooperative Learning yields a variety of learning advantages as learners may benefit from the help of their peers. Learners may also benefit from the opportunity to interact and experience working with more approaches to solve problems.

Learners who are exposed to learning groups gain academically more than learners who are not working in groups. Felder and Brent (2007:2) also argue that cooperative learning strategies have the capabilities to significantly reduce achievement disparities between economically disadvantaged learners and learners coming from well to do economic backgrounds.

Working groups are useful in building the low achieving learners into hard working and good performing learners. Laal and Laal (2012:496) comment that working groups are

helpful in providing a safe place for low achievers to become effectively involved in their learning. This learning method also encourages learners to participate and cooperate, and by so doing learners are fully engaged in learning. There are three groups in the collaborative learning approach. Such groups are planned in a way that they can complement one another. According to Edmund and Brown (2010:715), the following are the groups in collaborative learning that enhance learning in Physical Sciences:

**The buzz group:** This group spends about twenty minutes trying to understand the topic. The group studies the topic and gathers information about it. Towards the end of the session, one representative from each group presents information to the entire class (Edmunds & Brown, 2010:716).

**Solution and critic group:** According to Laal and Laal (2012:498), this group is subdivided into solution group and critic group. In this group, the teacher assigns the first group of learners to gather information. After gathering the information, the assigned group presents the findings to the entire class. The second group (critic group) evaluates the presentation made by the solution group (Burke, 2011:87).

**Affinity group:** This group works together outside the classroom then presents their findings during normal class time (Burke, 2011:87). All these techniques are useful for learners to develop investigative and presentation skills that are helpful in the science classroom as well as other learning areas.

### 3.2.3 Role of Parents in the Enhancement of Learners' Performance

The Michigan Department of Education (2010:12), considers a parent as per the Elementary and Education Act as the most important component in the learning of children. The Michigan Department of Education (2010:12) expresses that a parent includes a person who is a legal guardian or other person standing in *loco parentis* such as a grandparent with whom a child lives or a person who is legally responsible for the child's welfare.

Education is a process which needs all stakeholders to participate and involve themselves in the development of their children. Parents have an important role to play in education in as far as the learning of their children is concerned. Parents' involvement at school influences a positive school culture of learning. The Michigan Department of Education (2011:02) expresses the view that parents' involvement has a significant effect on the quality of learning, creating a positive school climate, and enhancing overall learners' performance. To achieve this, parent-teacher cooperative relationship should be developed since they are both important stakeholders in the education of the child (Manheere & Hooge, 2010:12).

Kernan (2012:10) contends that parents' involvement in education is valued since they help to reduce the rate of school drop outs. Parents' involvement in education also decreases delinquency and creates more positive attitudes towards learning. Their involvement in educational matters assists the ability of learners to learn. Parents' involvement develops reliance on parental support for the learning process. Moreover, teachers will develop an overview of the learner's situation and this may assist teachers in their instructional tasks. This may also improve learners' school attendance and ultimately their academic performance.

Schools need the assistance and partnership of the parents to eliminate learning behavioural challenges and increase learners' sense of security and stability (MDoE, 2011:02). Without parents–teacher partnership, schools, and the culture of teaching and learning may hardly be maintained. Legotlo, Maaga and Sebego (2002:117) support this notion by pointing out that a school cannot work in isolation and it is a unit within a society. Legotlo et al. (2002:17) express that establishing a good school-community relationship is a key ingredient to success in securing participation of parents in decision making, assisting with school activities, problem solving, helping and offering services to schools.

Parents also play a role to encourage their children in doing their home activities or home works. Nermeen, Bachman and Votruba-Drzal (2010:35) support this view when

they express that learners benefit when their parents and other adults offer specific positive responses. Learners benefit from having information about the concept addressed in home activity. Parents' evaluative information about the learners' homework performance and information about the learning goals that are supported by the learner homework tasks. According to Marzano and Pickering (2007:07), the more specific and knowledgeable parents can be in offering feed–back and reinforcement, the stronger their impact on learning and learner self-efficacy.

Marzano and Pickering (2007:08) express that parents that have contact with their children, make efforts to complete their homework assignments, take responsibilities for the execution of those home activities. This creates cooperation between parents and their children. Such cooperation between parents and their children is necessary to make homework or assignments more important. In this case, parents get an opportunity to see what instruments and equipments their children run short of. The parents serve to supply their children with the required learning resources. They also make sure that homes are conducive learning places for studying, giving courage to their children and supporting them when doing homework.

### 3.2.4 The use of Education Technology in Teaching Physical Sciences

Education Technology refers to the use of devices that may be used in the classroom to enhance teaching and learning. This sentiment is supported by Grinager (2000:01) who expresses that education technology refers to the use of hardware, software and other digital technologies to advance teaching, learning and administration. Education technology in this study is divided into two categories: The use of technology in teaching and the use of technology in learning.

#### 3.2.4.1 Technologies and learning of Physical Sciences

The following are the technologies that are identified by Grinager (2000:01) as being available and significant in education settings:

**(a) Computers**

Computers include laptops, desktops, and hand-held devices that are being used to enhance the performance of learners in Physical Sciences.

**(b) Enterprise management software and classroom administration**

This software allows automation processes and more delivery of services. It also enables data to drive school and classroom management as well as other purposes including learner information system, transportation facilities, management, human resources, professional development, grade books, accounting and procurement (Grinager, 2000:1).

**(c) Learner information system and data warehouse**

This system enables the collection, analysis and management of learner data to inform instruction, facilitate school/state decision making and support accountability. It also increases the potential for individualized learning plans (Grinager, 2000:1).

**(d) Interactive whiteboard and LCD projectors**

The interactive whiteboard is a large interactive display that is computer driven. The interactive whiteboard allows users to access and manipulate electronic files by means of projectors. The interactive whiteboard and LCD projectors replace chalk board in classrooms (Liu & Cheng, 2005:110). It is regarded as a powerful educational technology as it raises the level of learners' interactivity in the classrooms (Liu & Cheng, 2005:110).

**(e) Classroom audio systems**

Classroom Audio System refers to the devices that are used in the class to amplify teachers' voices. These include loud speakers and wireless microphones that transmit the signal via infrared light to the receiver/amplified unit. The voice is then amplified through the loud speaker and evenly distributed throughout the classroom. The classroom audio sound system enables all learners in the classroom to clearly hear all

the speech components of the teachers' voice regardless of where a learner is seated (Bebb, 2008:3).

**(f) Televisions, videos and radios**

These are visual and audio devices. These refer to any device which by sight or audio increases the level of the individual's practice. They are those instructional devices which are used in the classrooms or at home to encourage learning and make it effective and interesting (Liu & Cheng, 2005:111). Televisions, videos and radios assist a lot in distance learning and some other learning programmes (Grinager, 2000:1).

### 3.2.4.2 Technology and teaching

Technology plays a vital role in as far as teaching of learners is concerned. The following are the areas where teachers find technology being helpful in teaching to enhance learner performance

**(a) Instructional software and digital/online content**

Software is another word for programmes written in programming language. Instructional software is application software designed specifically to deliver or assist with learner instruction on a topic (Doering, 2009:76). This software provides engagement, interactive, adaptive instruction or curricula that enables anytime, anywhere personalization of learning to meet an individual learner's needs and space (Grinager, 2000:1).

Grinager (2000:1) postulates that Education Technology simplifies learners' access to the rich and relevant resources. This is made simple and possible because most libraries and the museum record parts of their collections in digital form and distribute them through the internet as software and other programmes. This enables learners to get an access to information and other learning materials through google searches and other internet connections.

According to Alseweed (2013:65), learners can learn Physical Sciences through projects like Collaborative Visualization Project (CoVis). Through these programmes, learners obtain an opportunity to learn about some science using some or the same research tools and datasets that were used by other scientists in the field (Grinager, 2000:3).

The sophisticated software of technology enables learners to collect and examine data on the weather, temperature barometer and atmospheric chemistry and can display the information in colour-coded maps and graphs (Grinager, 2000:3). Carpenter (2006:14) further observes that technology can change dynamics, time and space in school. On the other hand, technology helps learners to work independently. It gives teachers time to work one-on-one with small groups of learners.

Assessment technology enables teachers to efficiently identify learners' strengths and weaknesses to better target instructions (Grinager, 2000:4). Digital record keeping, cell phones in the classrooms and access local networks provide an opportunity to communicate with parents, administrators and colleagues from the school. This gives teachers a chance to spend more time teaching and less on paperwork (Grinager, 2000:4). Education technology helps learners to extend their learning, if they connect from home to their school networks and other courses and sources (Grinager, 2000:4).

**(b) Significance of education technology in the enhancement of learner performance**

Grinager (2000:1) states that instructional courseware, digital contents and other electronic learning resources if well implemented, may assist learners to meet intermediary goals that can ultimately improve learner achievement. This makes technology an essential tool in teaching and learning.

According to Alseweed (2013:65), quality electronic learning resources are also aligned to State and local standards and build around effective pedagogy and instructional design and can provide many educational benefits such as:

- Engaging learners through multi–media, interactive content.
- It benefits learners in the strengthening of understanding and thinking skills through exploration, collaboration and creation.
- Education technology is adapting to support differentiated or personalised learning for learners who have specific learning styles, pace or needs.
- It is also good as it enhances accessibility for learners with physical or learning disabilities through assistive technologies and presentations of content in alternative modalities. Technologies keep knowledge and information accurate (Grinager, 2000:1).

Education technology gives teachers, learners and all education practitioners some new ways of addressing challenges pertaining to learning. Such challenges extend from shortage of learning materials, time and professional development. This is made possible because technology brings rich and diverse materials into the classroom (VSG, 2017:6). Technology also makes distance learning easily accessible (Grinager, 2000:4). Learners who have struggled in traditional classrooms often find success in virtual settings in which learners and teachers can communicate one-on-one through computer technologies. In so doing, learners can proceed to work at their own pace (Grinager, 2000:04).

Education technology can connect learners to highly qualified teachers for subjects which are difficult to staff, of which Physical Sciences area is not an exception. It provides urban and rural school learners an opportunity to take rigorous curriculum, regardless of their schools' ability to recruit and retain teachers. Modern technology makes it possible for anytime, anyplace, and any path learning (Grinager, 2000:4).

Education technology supports learners' higher order thinking skills by engaging learners in authentic and complex tasks within collaborative learning contexts. According to Grinager (2000:4), these important learning skills enable people to acquire new knowledge and skills, connect new information to the existing knowledge, analyse, develop habits of learning and work with others in the use of information. These kills

help learners to develop higher order thinking abilities and problem-solving skills (Grinager, 2000:4). Learner motivation and self-esteem can be increased using computer based and computer supported learning. The motivation of learners may increase when they cooperate in certain computer environment like Computer Based Instruction (CBI). One of the benefits of the CBI is that it gives potential to the teachers to individualize learning by adjusting instructions per the demands of the learning tasks, processing requirements and the ongoing performance of the learner (Mauco, 1994:1).

Tellerico (2013:4) also expresses that Computer–Supported Collaborative Learning (CSCL) uses instructional methods which encourage learners to work together on learning tasks. According to Tellerico (2013:4), Computer Supported Collaborative learning and Network Collaborative learning both use blogs, Wikis and Cloud Based document portals such as Google docs and Dropbox.

### 3.2.5 Motivation as a Strategy to Enhance Learners' Performance in Physical Sciences

Motivation is a concept used to rationalize the way people or organisms behave. It is an energizer or the inner force, driver, a desire or an urge that causes individuals to engage in a certain task (Ganta, 2014:222). This inner force is an effort individuals exert to satisfy their needs. Human behaviour is purposeful in the sense that it has a cause and effect. According to Ganta (2014:223), motivation is something which is done by one person or a group to another one. The implication of this usage is that individuals being motivated need to be induced to perform some action or expend a degree of effort which they would not otherwise wish to do.

Chowdhry, Sieler and Lourdes (2014:3) argue that motivation plays an important role in as far as the performance of individuals is concerned. According to Chowdhry et al. (2014:4), motivation has a lot of influence in the satisfaction of learners and it eventually enhances their performance. Teaching and learning as a process cannot take place in

isolation. For quality teaching and learning to prevail, both learners and teachers need to get motivated (McCormick & Presley, 1997:31).

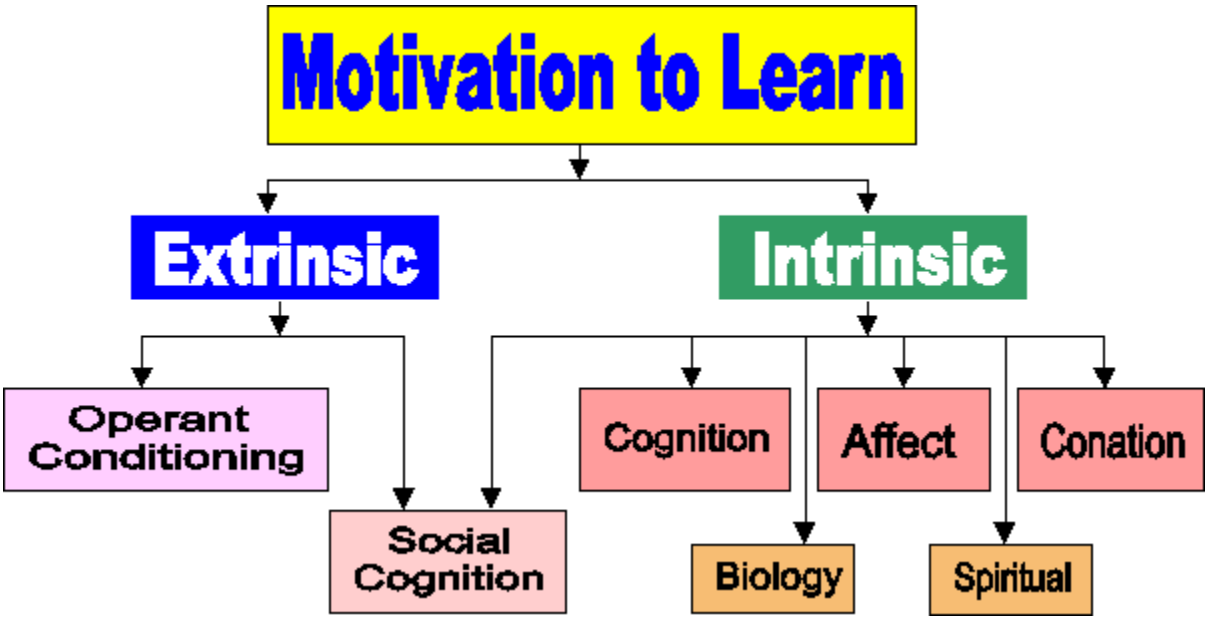



**Figure 3.1: The Model of Motivation (Adopted from Huit, 2011:02).**

Figure 3.1 displays the source(s) of motivation which can be categorized as either extrinsic (external of the person) or intrinsic (internal of the person). Intrinsic sources and corresponding theories can further be sub-categorized as either cognitive/thinking, affective/emotional, conative/volitional or transpersonal/spiritual, body/physical or mind/mental. Needs are viewed as dispositions towards action. This means that needs create a condition that is predisposed towards taking action or making a change and moving in a certain direction (Franken, 2006:16). Action may be initiated by either positive or negative incentives or a combination of both. Behaviour may be more related to emotions and/or the affective area (optimism vs pessimism) and self- esteem whereas persistence may be more related to conation (volition) or goal-orientation.

### 3.2.5.1 Teacher motivation as a strategy to enhance learners' performance

Teachers like all other employees, need motivation to feel good about their job to perform optimally. Ganta (2014:221) postulates that motivation levels at the workplace have a direct impact on employee's productivity. Like all employees in institutions,

teachers who are motivated and excited about their job out perform their responsibilities with full potential and ultimately produce pleasant performance. Ganta (2014:223) further argues that employees who are not motivated do not concentrate on their work let alone committing themselves to their duties.

According to Bantea and Angehelache (2012:256), teacher motivation refers to the performance investment level of teachers in their school work. The performance investment of teachers refers to the teachers' work that is above the minimum level of participation in the school business. Bantea and Angehelache (2012:257) add that highly motivated teachers refer to teachers who work beyond the minimum level of expectation in contrast to the lowly motivated teachers who work below the expectation. This is because such teachers are motivated and perform optimally to bring about job satisfaction.

According to Duguh and Ayaga (2014:112), job satisfaction is measured as a discrepancy between peoples' expectations of rewards and their actual accomplishments. Job satisfaction can be measured as a response to items enquiring about a person's overall experience. Contributing factors to job satisfaction can be identified as satisfiers. Some motivator factors or satisfiers that contribute to job satisfaction include achievements, recognition, work itself, responsibility and advancements. Highly motivated teachers are high achievers who take pride in their work and display professionalism (Bantea & Angehelache, 2012:256).

There are a variety of factors that may be used to cultivate teachers' commitment to their work. Teachers need to be appreciated for the good job they do. According to Ganta (2014:221), teachers like many employees need recognition from the management. These make teachers to work courageously and give their maximum ability and ultimately produce quality results.

Through recognition and a positive reward system, the employer identifies employees who perform their jobs well. Ganta (2014:221) observes that when the supervisor or

management acknowledges a job well done, it makes employees feel good and this encourages the employees to do their level best in so far as quality job results are concerned. Ganta (2014:221) adds that employees may be recognised by means of tracking progress and providing feedback about how they have improved. In addition, Ganta (2014:221) contends that employers may also make use of public recognition as a motivating means to increase workers' productivity.

Remuneration and incentives may also play a big role in teacher motivation. In Singapore, teachers' salary is an influential motivating factor (Singapore Ministry Education, 2014:07). Singapore Ministry Education (2014:07) points out that teachers are motivated by the remuneration which moves in line with those of other professions. The Ministry of Education in Singapore regularly reviews salaries of teachers to ensure that they are competitive in relation to those of other professions.

Teachers' salaries in Singapore are impressive and influence teachers to stay in their teaching profession since they get living wages (SME, 2014:07). The latter is supported by Ganta (2014:221) who posits that most of the teachers are motivated by living remuneration, for example salary increase. On the same note, Ganta (2014:221) further observes that teachers also feel motivated when they get incentives in the form of money. Incentives are generally considered the most important factors to increase employees' motivation since they offer workers more to strive for than a regular payback.

Teachers are also motivated by the availability of Physical Sciences material resources at schools. The availability of resources lifts teachers' morale to effectively perform to their best ability in their teaching duties. Bennell and Muykanuzi (2005:34) argue that teachers who work in well-resourced classes exhibit very high moral standing which ultimately improves their efforts for higher learner achievement. Bennell and Muykanuzi (2005:34) also state that classrooms which are endowed with relevant learning materials and textbooks are conducive places for the facilitation of teaching and learning programmes.

### 3.2.5.2 Learners' motivation as a Strategy to enhance performance

Good relationships between the teachers and learners may bring about positive contributions in the enhancement of learners' performance. Positive learner-teacher relationship brings unity and makes learners feel that their learning depends on full participation and commitment in the learning process. Bergeron, Chouin and Janosz (2011:273) observe that learner–teacher relationships can also influence learners' motivation in teaching and learning situation. Teachers' expectations of learners and their ability to give learners autonomy in learning influence learners' engagement and commitment to learning (Bergeron, Chouin & Janosz, 2011:273).

Teacher's methods and styles of teaching may be influential towards motivating learners to actively engage in the learning process. Malouff, Rooke, Schutte and Foster (2008:1) confirm this when they postulate that although learners have high motivation in learning Physical Sciences, teachers' teaching styles and learner beliefs about new and old concepts influence their use of superficial or deep cognitive engagements during the learning process. In that way, teachers are expected to play a fundamental role to facilitate discovery learning (Barlia & Beeth, 1999:56).

Parents' interest and involvement in their learners' educational matters play a significant role on their children's school work. Learners' progress and the general parental involvement in their children's education matters a lot in motivating learners (Gonzalez - De Hass, Willems & Holbein, 2005:375). Wu (1999:16) concurs that most learners are motivated to learn by a zeal to please their parents.

The availability of Physical Sciences laboratory and the related equipments serve as motivating factors. When learners explore new knowledge and skills in the laboratory, their interest in the subject grows. On the same note, Wu (1999:16) observes that opportunities to conduct laboratory activities are the main source of motivation to Physical Sciences learning and these stimulate learners' interest in the subject. The National Research Council (2006:77) also expresses that learners gain interest and are motivated to learn Physical Sciences as they gain experience in the laboratory,

classroom or the field that provides them with opportunities to engage directly with natural phenomena. Learners can again gain experience from data collected by others using tools, materials, data collection techniques and models.

Laboratory investigations give learners sensual excitement and serve as a motivation towards the learning of Physical Sciences. Learners are intrigued to learn more on Physical Sciences by making use of laboratory practical works (Wu, 1999:16). Tuisuz (2000:37) notes that learning in Physical Sciences is also motivated by curiosity and a strong desire to explore in Physical Sciences. Laboratory activities in Physics and Chemistry education increase learners' interest in Physical Sciences subject matter which is being covered in the class (Tuisuz, 200:37).

Rewarding learners' performance is one of the means of motivating them. This can be in the form of providing them with tablets, calculators, laptops and other educational support items. At the provincial and national level in South Africa, learners who excel in their studies receive bursaries and scholarships that assist them to further their education (DBE, 2015:15). According to Diedrich (2010:11), learners may also get the motivation to learn through positive reinforcement. Positive reinforcement refers to the presentation of rewards immediately following a desired behaviour. This is intended to make that behaviour more likely to occur in the future. Positive reinforcement is more significant to motivate learners for effective learning and to enhance their performance (Miltenberger, 2008:06).

Positive reinforcement and engaging classroom atmosphere are the most powerful tools teachers can use to encourage learners and prevent problematic behaviours (Conroy, Sutherland, Snyder, Al-Hedawi & VO, & 2008:18). Corpus and Inyenga (2005:184) also postulate that teachers can improve their learners' motivation to behave well using positive reinforcement. Positive reinforcement may also be achieved by making use of feedbacks, smiles and high marks. Diedrich (2010:12) argues that the use of reinforcement encourages and sustains desirable academic and social behaviour.

School time tables also contribute to the creation of a positive learning atmosphere. Time tabling of the subject should also be done in a manner that encourages learners to learn. According to Corpus and Iyengar (2005:184), relatively difficult subjects require more concentration and a higher level of motivation. Therefore, difficult subjects should be scheduled during the early hours of the day when learners are still energetic and their levels of motivation still high (Miltenberger, 2008:06).

### 3.2.6 Provisioning of Physical Sciences Qualified Teachers

Education is the most important aspect and a tool that may be used to develop any country. Young people and the community at large, should be educated to take the country to a better economic, social and political position. It is generally believed that development of human resources is pivotal in raising the standards of education. This implies that for real education development to prevail within a country, quality teachers should be developed.

Teacher qualifications and the level of teacher development in the subject seem to play a significant role in learners' performance in Physical Sciences. According to the Education Labour Relations Council (ELRC) (2003:68), teacher qualification is defined as a planned combination of learning outcomes which has a defined purpose, and which is intended to provide qualifying learners with applied competence and a basis for further learning. Teacher qualification ensures that teachers have the required knowledge and skills in their discipline coupled with broad understanding of instructional skills for effective teaching and learning (ELRC, (2003:68). On the same note, Employment Education Act 76 of 1998 indicates that teacher qualifications can be in the form of degrees, diplomas, certificates and other qualifications as recognized by the ministry of education as criteria of appointment as a teacher.

Qualified teachers are the most precious resource in teaching and learning of Physical Sciences. The Centre for Development and Enterprise (2014:02) confirms that relevant teacher qualifications enhance learners' performance in Physical Sciences and assist to

produce quality learners who may pursue scientific and technological training. Teacher quality is an important factor to determine gains in learners' achievement. CDE (2014:02) indicates that there is a relationship between teacher qualifications and learners' performance in Physical Sciences.

The competency of teachers is also a cause for concern. According to Armstrong (2015:124), teachers' qualifications and content knowledge in Physical Sciences raise learners' interest in the subject. Suzoysky (2003:02) also explains that some Physical Sciences teachers with subject content knowledge could clarify scientific concepts in clear comprehensive ways without any barriers. Suitable, well-trained and qualified teachers with outstanding understanding of the subject teach effectively. Berliner (2005:207) observes that even if Physical Sciences is said to be difficult, the availability of more knowledgeable and qualified teachers in the subject makes it simpler.

The South African Department of Basic Education, universities, non-governmental organizations and teacher unions are working together to make sure that the provisioning of qualified Physical Sciences teachers is a priority and is effectively achieved. Subsequently, the following strategies are applied to achieve that: Pre-service trainings, continuous professional development and training, workshops and recruitment of international expatriates.

#### 3.2.6.1 Implementation of Continuous Professional Teacher Development

Continuous Professional Teacher Development (CPTD) is defined by Francesca (2011:04) as the activities developing an individual's skills, knowledge, expertise and other characteristics required in teacher effectiveness. High quality teaching is a prerequisite for quality education and training and is achieved when teachers are competent in their professional work. The Department of Basic Education in South Africa together with the Department of Higher Education are charged with the responsibility to provide teachers, develop teachers and to respond to technological and scientific global demands. Teachers themselves are also supposed to take responsibility for their own professional development.

CPTD is an ongoing process. According to Francesca (2011:04), CPTD comprises the following activities: Developing teachers' competence in teaching heterogeneous classes, promote teachers' collaborations with and among other colleagues. Continued professional development starts with teachers identifying developmental needs and plans. Teachers should do self-evaluation against curriculum standards and competence to determine their developmental needs for training as part of CPTD. Continuous Professional Development is important because it promotes the following:

**(a) Activities of the continuous professional teacher development**

The SACE (2008:15) suggests five categories of the activities of teachers that are embodied in the Continuous Professional Development programmes. The activities are categorized taking into cognizance the initiator of those activities, for example, the employer, self, Non-Governmental Organizations (NGOs), schools and others depending on the kind of activities. These activities include qualifications, improvement of individual professional practices and school improvement. The Missouri Department of Elementary and Secondary Education (2011:2) points out that there are overlaps in these categories. To avoid this overlaps, the professional development activities are grouped into three categories. In this regard, the DoE & SACE categorize the activities into three: The first category is teacher priority activities. These are the activities chosen by the teachers themselves for their own development. The activities include self-study in the subject area, classroom-based action research projects focused on the improvement of teaching and peer group support through teacher networking (US Department of Education, 2005:03).

School priority activities are the first category of the continuing professional development. According to the DoE (2008:15), these refer to all the activities undertaken by the school leadership and staff as a collective to enhance teacher competencies. Such activities focus on the whole school development and conditions for the improvement of learning. These activities are also identified through proper administration of Quality Management System (IQMS). The third category is composed

of the professional priority activities. According to the South African Council of Educators (2013:17), these are activities which are responsible for enhancing the professional status, practices and commitments of teachers in areas of greatest need as defined by the Department of Education, SACE, national teachers' unions and other national professional bodies.

**(b) Stages of professional practices**

Professional practices are categorized into three stages which are equally important for systemic practice and implementation of the CPD. According to the British Council of Teachers (2011:03), the three stages are:

- **Awareness stage:** At this stage, the teacher is oriented to the programme of professional development.

- **Understanding stage:** The teacher knows the professional development programme. This includes an understanding of what professional practice means and why is it important.

- **Engagement stage:** This is the stage where teachers demonstrate competency in their professional practices and in their work. Integration of activities demonstrates a high level of competency in the professional practice. Consistency at this stage also forms part of what one does at work.

**(c) Professional practices of the CPTD**

According to the British Council of Teachers (2011:03), there are twelve professional practices which are included in the CPTD in Britain. Sadtu Curtis Nkondo Professional Institute (2013:14) also confirms this and adds the following elements that reinforces the practice continuing professional development:

**(d) Planning lessons and courses**

In this practice, teachers must show competency in their practices on lesson planning and planning of courses. Teachers must be able to describe learners in relation to their learning needs. This will enable teachers to define the aims and out-comes of the lessons and of the course. According to Rose and Reynolds (2017:219), teachers must be able to select and develop activities, resources and materials that can engage learners and correspond with the aims of the lesson. Challenges may arise during the lesson, but teachers must have a plan on how respond to the challenges as they arise (British Council of Educators, 2011:07).

**(e)** This involves making teaching and assessments by applying an understanding of learners' characteristics. Learners' characteristics in question include level of attainment, age, interests, preferred ways of learning, group dynamics, motivation to learning both generally and in relation to specific subjects, educational, social and linguistic background, any special additional needs, level of autonomy as well as learners' personality (MDESE, 2011:01).

**(f) Managing the lessons**

Lessons in the class need to be managed because challenges may arise during the lesson. Therefore, the teacher must have a plan of responding to such setbacks. This activity includes controlling of the pace and timing of activities, signaling transitions between stages of the lesson, adjusting classroom layout to support learning, responding to unexpected classroom events. The stage also embraces making effective use of resources and equipment, giving instructions effectively, explaining learning aims and content appropriately. Teachers should check understanding, use language appropriately in relation to level of understanding of learners and making appropriate decisions on which language to use (UDE, 2005:5).

### (g) Managing resources

Management of resources involves using materials effectively in a way that enhances learner performance in the Physical Sciences. This implies that the teacher must be able to choose from a range of available materials the one that may be effective in each lesson. As such, the teacher should have a clear criterion for the selection of materials to use. The teacher must also be able to utilize the available stationery, equipment and relevant technology to support teaching and learning. Furthermore, the teacher must reflect on the approach to develop and manage materials and resources to improve learners' performance (BCE, 2011:11).

There are elements that need to be considered in assessing learners' progress. These elements include principles and practices of assessment. Principles' of assessment should be applied to design tasks for measuring learners' progress (BCE, 2011:12). The teacher should know the different types of assessments and how to give feed-back to learners. In addition, the teacher needs to develop skills to assess different learning processes to monitor learners' understanding. The teacher must be able to define the assessment criteria and apply them consistently. The errors of learners should be adequately analysed as a basis to provide constructive feedback (USDE, 2005:5).

### (h) Taking responsibility for professional development

According to Lieberman and Miller (2008:2), taking responsibilities for professional development involves the following elements:

- Understanding teachers' professional needs, interests, and learning preferences in order to identify areas for development.
- Teachers should define their short, medium and long-term career goals.
- The teacher should understand the developmental pathways available to reach his/her specific career goals.
- Understand the technology that may be used to facilitate teachers' professional development.

- Staying up to date with the developments in education in teaching and learning.

**(i) The Use of inclusive practices**

According to Rose and Reynolds (2017:222), this involves the following elements:

- Recognizing and valuing diversity among learners in relation to areas which include language background, cognitive ability, academic ability, physical ability, social background, behavioural differences, disability, age, gender, race and ethnicity, sexual orientation, religion and belief.
- The teacher should understand the use of pedagogical strategies that encourage inclusive education within a supportive learning environment.
- Supporting learners in identifying, addressing, and assessing realistic individual learning goals based on reasonable adjustment.

**(j) Using multilingual approaches**

This practice involves the following elements:

- According to Lieberman and Miller (2011:16), using multi lingual approaches involves the following elements:

- Recognizing and valuing the multilingual nature of societies, schools and classrooms.
- The use of pedagogical strategies which promote multilingual learning environment.
- Being aware of beliefs of speakers of other languages and how they can impact on establishing and maintaining an inclusive learning environment.
- Assessing individual learners in a manner which takes their linguistic background into account.
- Giving learners appropriate opportunities to use their home languages to support and demonstrate their understanding of learning content.
- Making pedagogical decisions that respect and capitalize on learners' linguistic diversity.

- Reflecting on how effective the implementation of multilingual approaches is in promoting learning (BCE, 2011:15).

### (k) Elements of continuing professional programmes

SCPDI (2013:19) expresses that the continuing professional development programme has four different elements which are:

- **Self-study**

According to the UDE (2005:10), self-study refers to the element in which teachers take responsibility for their own development and having the discipline to get time for these activities. Self-study may take various forms as follows:

- This may include reading articles, academic journals about a subject that a teacher is teaching, researching on a new teaching methodology in a resource or text book.
- It is also done by preparing for the new teaching methods that the teacher wants to try in the classroom.
- The teacher should also enroll with distance learning institutions for a distance education course.
- Attending workshops and thereafter going over the workshop notes and thinking about how one can apply what one has learned in the teaching practice.
- Self-study may be done through organising a meeting with an expert in a subject area for guidance about the subject content or teaching strategies.

- **In–school sessions**

In-school sessions are the collaborative work place learning involving the subject teachers. In-school sessions enable teachers to work together in a variety of ways with colleagues teaching the same subject or phase. This may be done with the HOD, Principal or any other member of the school management or with the entire staff (British Educational Research Association, 2014:25).

According to BERA (2014:25), examples of school-based development activities are:

- Staff meetings to address issues such as strategies to deliver the curriculum to partially sighted learners or other learners with learning challenges, how to tackle a specific aspect of the curriculum or address social problems in the area.
- Viewing and discussing informational DVDs with colleagues.
- Staff/subject meetings where teachers talk about how to present the best lesson.
- Teacher providing a presentation or leading discussion on a specific area where the teacher is an expert or has received training in.
- The principal, HOD or the teacher leading a debate on specific topic in which teachers investigate different sides of the argument.
- Planning sessions for the week, term and a year.

This can also involve reviewing learners' exam results together, identifying areas of weaknesses, and strategizing an approach to address these weaknesses.

- **Professional learning communities**

Professional learning communities is also called professional learning clusters. These are groups of teachers and officials from the same or different schools in a cluster who regularly work together in an ongoing and structured way around collectively decided development activities (BCE, 2011:15). This means that teachers in high schools should form subject specific groups around core subjects such as Mathematics, Physical Sciences and languages. Foundation and Intermediate Phase teachers may grade or phase specific learning communities around language, literacy and numeracy (MDESE, 2011:2).

SCPDI (2013:21) listed examples of the PLCs activities as follows:

- Teachers should allow their peers to observe their lessons. This enables them to develop the quality of performance and competency.
- The teacher should identify the current level of learner achievement in the group of schools in which he/she belongs. Teachers should then work together to establish desired goals and then work together to achieve such goals.

- Individual teachers should identify areas of weaknesses and use expertise within the PLCs to help address the difficulties.
- Assist teachers to integrate their own professional knowledge with the research–based knowledge about content and practice.
- Curriculum Orientation activities to develop understanding of and the ability to use the curriculum and the assessment policy statement.
- The teacher should learn how to interpret and use curriculum support materials such as workbooks currently developed and distributed to teachers and schools by the Department of Basic Education.
- The teacher should record the teaching and learning in the classroom and then work together to learn from these video records of practice.

- **Formal workshops**

Formal courses and workshops are any formal professional development activities which are run by anyone outside of the school or PLCs. They often employ the services of the experts in a field to conduct workshops, seminars, and any other traditional forms of professional development (SCPDI, 2013:21).

The following workshops are to advance subject knowledge and effective teaching strategies:

- DBE designed courses that are useful to address teachers' systematic needs, such as courses which develop subject knowledge, enhance curriculum delivery, and explain new policies and implementation strategies.
- Structured tutorials/support groups for teachers and managers registered for distance education programmes.
- The Department of Higher Education and Training (DHET) initiated courses resulting in certificates and qualifications.
- University programmes or other accredited courses that teachers may participate in.

- **Benefits of Using CPTD**

According to Francesca (2011:4), CPTD comprises the following activities:

- Developing teachers' competence in teaching and promotes teachers' collaborations with and among other colleagues. Continued professional development starts with the teacher identifying developmental needs and then facilitates specific training and activities to meet specific outcomes.

**(i) Collaborating and networking to share knowledge, skills and experience to promote work-based learning**

According to the UDE (2005:13), CPTD benefits teachers in the following ways:

- It provides teachers with an opportunity to make team planning, in which they can also review resolutions of their meetings, make follow ups on reviews of meetings and classroom observations.

- CPTD also benefits teachers as it provides teachers with the opportunity for team teaching in which teachers assist each other in teaching. Teachers can assist each other in a phase on topics that they specialise in.

- The CPD assists learners to make sure that each teacher in a cluster is mentored. Teachers in the CPD cluster can mentor each other.

- Professional Learning Communities (PLCs) within schools, circuits and districts share experience and good practice. Members work with skilled teachers, share skills and expertise. They are involved in peer groups where they work between clusters of schools and leading professional development activities within schools.

- Shadowing and participating in Professional activities is the main objective of the Continuing Professional Development programme.

**(ii) Specific training activities to meet specific outcomes**

These include in-service training, short courses and other developmental programmes. In-service trainings (INSERTS) are some of the Continuing Professional Development strategies which are adopted by the Department of Basic Education to keep teachers abreast with new teacher developments, technological knowledge and skills applicable in teaching and learning of Physical Sciences (Richards & Farrel, 2005:04). INSERTS are the most used strategies of teacher development programmes. They are provided in all the universities across the country and are found to be helpful. INSERTS enable science teachers to stay abreast with the subject content, train teachers to effectively perform laboratory investigations and to increase knowledge in the subject (Guskey, 2000:17).

Currently, the Limpopo Department of Education (LPDE) is managing bursaries for teachers who are upgrading skills in subject areas which are considered to require critical and scarce skills on a part time basis. Physical Sciences is also amongst those subjects. Bursaries for part-time training are available to eligible candidates in the following ways: Training took place in the years 2007, 2008 and 2009 with the intakes of 577, 2234 and 3679 respectively. In 2010, there was an intake of 3000 candidates. This has proven to be an effective measure. Through this training, teachers get a chance to work as groups on apparatus and to discuss challenges they face in the subject. Teachers are given an opportunity to exchange knowledge and skills from simple home-made equipment and get clarifications on difficult sections in Physical Sciences.

INSERTS are not effective since the incentives to participate as part of Continuing Professional Development (CPD) are very limited and consequently teachers are not encouraged to participate in the CPD. The situation is also exacerbated by the fact that the responsibilities for planning and organizing CPD rest with schools or local authorities. This is a challenge because schools do not have funds to organise or fund these training sessions and teachers. Thus, teachers fail to attend the Community Learning Clusters (CLCs).

In Britain, the CPD entails the practices which are used to enhance teacher development as an individual, class, school and professional developments. Such practices are planning lessons and courses, understanding learners and managing lessons.

### 3.2.6.2 Pre-service training

To address the challenge of shortage of qualified teachers in Physical Sciences, the Department of Education made bursaries available countrywide to fund pre-service training of teachers in scarce related skills subjects. The Funza lushaka Bursary Scheme is one of those programmes which are meant to assist in teacher development and training. This is a multi–year teacher's training project with a bursary budgeted for the training and development of teachers in scarce skills related subjects. Physical Sciences like other skills related subjects is also included in this programme (DBE, 2006:21).

The DBE (2006:21) also expresses that the Funza lushaka Bursary Programme is a government's education scheme designed to attract and fund learners who are willing to study teaching in scarce skills related subjects. Physical Sciences is one such subject for which the Department of Basic Education organizes several programmes to attract learners who passed Grade 12 with good marks to study Science Education in South African Universities. The Department of Education has embarked on this programme in order to address the challenges emanating from the shortage of qualified Physical Sciences teachers in schools. The shortage of Physical Sciences teachers is also exacerbated by the mass resignation of teachers from the teaching profession.

The Department of Education pays full bursaries to eligible candidates with the primary purpose being to fill up the gap between supply and demand on scarce and critical skills which are difficult to address. Limpopo Department of Education (2006:21) also postulates that the training programme is available in all universities of South Africa. The DoE offered bursaries worth R700 million in 2006 to 4089 teachers for that

purpose. Most of the beneficiaries of Funza lushaka Bursary Scheme are learners from rural areas (Limpopo Department of Basic Education, 2006:22).

Although the Department of Education is running the training programme, there are still various challenges pertaining to the training of teachers in this programme. The number of learners who pass Grade 12 Physical Sciences with distinctions and good university entrance is still low. Even those learners with good passes when they enroll at universities they are often not interested in pursuing teaching as a profession. Instead, they opt to train for better paying professions.

### 3.2.7 Conducting Laboratory Investigations

According to Kibiringe and Tsamago (2013:425), laboratory investigations encompass all learning activities that are performed in the laboratory. According to Dhurumajah (2000:16), laboratory activities stimulate active teaching and learning. Laboratory investigation is about learners' hands on and minds on and learners work as a group on their own (Dhurumajah, 2000:16). Laboratory activities provide learners with an understanding of the content knowledge, skills of how to use the laboratory and to conduct scientific investigations. Teachers' knowledge and expertise in Physical Sciences is important for learners to diligently understand and perform laboratory activities.

Kibiringe and Tsamago (2013:425) posit that teachers' expertise helps learners to acquire skills that may assist them to understand Physical Sciences, experimental skills and content knowledge in the subject. Hampden-Thompson and Bennet (2013:1340) point out that in Portugal, failure in Physical Sciences is being exacerbated by teachers who are not familiar with proper use of the laboratory and teachers who cannot conduct experiments in the laboratory. Consequently, the Portugal government encourages teachers to register with higher education institutions to study modules on how to teach Physical Sciences effectively using laboratory investigations (Hampden-Thompson & Bennet, 2013:1340).

The DoE (2007:10) contends that learners benefit much through engaging with concepts especially when they do practical work thorough interactions, hands on activities and applications in Physical Sciences. Laboratory activities provide rich content knowledge for learner creativity (DoE, 2007:10). The National Academics of Science, Engineering and Medicines, (2006:85) demonstrated that laboratory activities are important for the effective teaching and learning of Physical Sciences. According to Hampden-Thompson and Bennet (2013:1340), laboratory activities have borne good results in Pakistan through improving learners' performance in Physical Sciences. On the same note, Hampden-Thompson and Bennet (2013:1340) describe the way in which laboratory investigations enhance learner performance in Pakistan.

NASEM (2006:80) also postulates that laboratory investigations play an important role in assessing all learning outcomes in Physical Sciences with a focus on practical work, process skills required for scientific inquiry and problem solving. According to the DoE (2007:10), laboratory investigation caters for the learners' development of practical skills. In using laboratory investigations, learners can state hypotheses, observe experimental developments, draw conclusions, explain the use of materials and develop substantive understanding of problem-solving skills (DoE, 2007:10).

The DoE (2007:11) singled out types of practical works that are done in the Physical Sciences laboratory as follows:

- Exercise to develop requisite skills.
- Investigation including hypothesis testing.
- Investigation to introduce learners to a given phenomenon.
- Demonstration to allow the teacher to develop a scientific argument or to create dramatic expressions.

This shows that practical work which is given to learners should be done to achieve specific purposes. This ensures that when teachers give learners practical work in the laboratory, there would be a link between the type of investigation and the purpose thereof (NASEM, 2006:81). According to Bennet (2003:95), the different categories of

practical work include those which develop skills, for observations, to increase learner content knowledge and understating, for enquiry of scientific concepts, laws, and principles as well as for illustrations or verifying particular concepts.

Laboratory investigations are also essential to promote and trigger the learners' interest in scientific inquiry, which is achieved through hands-on engagement in the laboratory. Scientific or laboratory investigations are also helpful in motivating learners towards self-discovery in science. In addition, Ituma, Twoli and Katele (2015:110) observe that laboratory investigations, experiments and researches provide a rich context for creativity.

Laboratory work provides learners with an opportunity to experience science by employing scientific research procedures. Moeed (2013:537 argues that learners' engagement in practical work encourages the development of critical thinking skills and creates an interest in science learning.

### 3.2.8 The Role of Subject Advisors

According to Dilotsohle, Smit and Vreken (2001:305), Physical Sciences subject advisors have a duty to enhance learners' performance in the subject. The effectiveness of subject advisors is evident when they provide optimal support and fully execute their expected duties to support teachers and learners.

The roles of subject advisors include determining grading and promotability of teachers in their subjects. This is a progressive process up to the level of senior teachers. Subject advisors are also responsible for the professional development of teachers particularly, in the In-Service Training programme (Victoria State Government, 2017:6). In Britain, subject advisors are charged with the duty to provide quality in education (Brighouse & Moon, 1995:1). They are also expected to visit schools to assist and support teachers on effective teaching of Physical Sciences (Brighouse & Moon, 1995:1).

The Department of Basic Education (2012:45) identifies seven roles and functions of subject advisors. The role of subject advisors in South Africa and Britain are similar in many ways. According to Victoria State Government (2017:06), subject advisors are responsible for the following duties:

**Instructions:** Subject advisors are of great assistance in the development of instructional material. They are also supposed to assist teachers in choosing the best learner support materials in the form of best textbooks that schools need when making their requisitions. It is also the duty assigned to the subject advisor to facilitate the implementation of curriculum changes in both public and private schools. Subject advisors also encourage learners to participate in extracurricular programmes like enrichment programmes, Saturday classes and other relevant programmes available in their vicinity.

**Curriculum:** It is the duty of subject advisors to facilitate teachers' involvement in curriculum development. Subject advisors are also charged with the responsibility of evaluating new methods and materials in the education system. They are mandated to communicate significant developments and to accomplish new programmes. According to the DBE (2011:40), the subject advisors support the teacher in the actual delivery of the curriculum in the classroom. This can be achieved by increasing teachers' content knowledge in Physical Sciences (DBE, 2011d:3).

Subject advisors should make personal visits to schools at the beginning of the year to discuss the performance of learners in the subject and also to ensure that schools are ready for instruction in terms of the availability of resources. The subject advisors should also make class visits to assess the quality of classroom interaction (DBE, 2012b:01).

**Staff Development**: Staff development is the main duty of subject advisors. This is done to keep teachers abreast with the changing world. Mandrazo and Motz (1982:42) postulate that subject advisors should make initiatives to ensure that In-Service Training

programmes are conducted to keep teachers updated with new approaches in Physical Science. Subject advisors should communicate to teachers the opportunities for professional development so that teachers may engage themselves in such programmes which are offered by various universities and colleges of their choice.

The DBE (2011d: 42) states that subject advisors should also conduct capacity building training for teachers in areas where there is need for professional development support. They must also encourage teachers to establish Professional Learning Clusters (PLCs) in their different circuits. In these PLCs, Physical Sciences teachers meet and share experiences, challenges and the best practices of Physical Sciences among themselves (DBE, 2011d:42).

**Implementation of Policies: Subject advisors make** sure that existing education policies are correctly observed and implemented in schools (DBE, 2011:43). They also ascertain that all subject teachers have the necessary policy documents required in Physical Sciences. Examples of the policy documents concerned are subject statement, assessment guidelines and protocol, subject frameworks and pacesetters (Dilotsohle et al., 2001:306).

**Assessment:** One of the primary aims of the constitution of subject advisors is to assess learners' performance. This involves an analysis of test results and the maintenance of data on learner achievement (VSG, 2017:06). The DBE (2012:2) also postulates that it is the duty of subject advisors to ascertain that learners are being assessed correctly at all levels.

They also assist teachers on self-revaluation (VSG, 2017:05). According to the DoE (2011:43), Physical Sciences subject advisors are charged with the responsibility to maintain quality in the teaching of Physical Sciences. It is the duty of the subject advisors to make sure that the assessment techniques which are used at schools are up to standard. Furthermore, Physical Sciences subject advisors are responsible for moderation of tests, class activities and examinations (DBE, 2012(b):2).

According to the DBE (2011:43), subject advisors are the experts in a subject. Therefore, the subject advisor must be able to foster commitment and collegiality among colleagues and teachers through sharing samples of good practices with the teachers. Subject advisors should network with organizations, research and consult research articles to provide teachers with additional support. The subject advisor of Physical Sciences should also subscribe to at least one professional journal (Department of Basic Education, 2011d:45).

**Development of Subject Curriculum Policies:** In 1997, the Outcomes Based Education was introduced in South Africa with the aim of overcoming curricular divisions of the past. The implementation of the curriculum prompted a review in 2000 and the Revised National Curriculum Statement Grades R–9 was introduced in 2002. In 2009, the Revised National Curriculum Statement (2002) was reviewed in favour of **National Curriculum Statement Grades 10–12:** In 2012, the two National Curricula Statements for Grades R-9 and Grades 10-12 were combined into a single National Curriculum Statement Grades R-12 (DBE, 2012: ii). To improve the implementation of curriculum, a single comprehensive curriculum policy document known as the Curriculum and Assessment Policy Statement (CAPS) was developed for each subject to replace Subject Statement, Learning Programme and Subject Assessment Guidelines for Grades R–12 (DBE, 2012: ii).

The CAPS document clearly indicates and provides guidelines on what should be done at schools particularly in the classes. According to the DBE (2012:09), CAPS document indicates the teaching time scheduled for Physical Sciences which is four hours a week or 40 weeks a year. According DBE (2012:9), the CAPS policy document clearly provides the assessment policy. Informal and formal assessment policy is detailed in minimum number of assessments and types of activities on which learners should be assessed for both informal and formal assessments. Informal assessment tasks refer to the following activities: homework, classwork, practical investigations, researches and tests (DBE, 2012:9). The following are the recommended activities for learners' assessments:

- Learners should do at least two problem-solving exercises (activities) per day. The exercises should cover all cognitive levels. These could be done as homework or classwork.
- Learners should at least do one practical activity a term and one informal test per term.
- There are three recommended informal experiments for Grade 12 (DBE, 2012:9).

Formal assessment entails-controlled tasks which are determined by the province. These are controlled and standardised tests, examinations, experiments and projects. Three prescribed experiments are done per year in Grade 12 Physical Sciences, one or two Physics experiments, one or two Chemistry experiments for Terms 1, one controlled test, midyear examination, trial examination and final examinations are meant for formal assessment (DBE, 2012:9).

### 3.2.9 Learners' Assessment in Physical Sciences

Assessment is a continuous planned process of identifying, gathering and interpreting information about the performance of learners using various forms of assessment (DBE, 2011:143). Teachers should know learners in their classes well before choosing a suitable learning method. When teaching a new class, the first step towards choosing the teaching method is to assess learners. Learners may be assessed both formally and informally. Formal assessment is done using different techniques that include standardised tests, tests from the textbook or curriculum or teacher created tests, assignments, research, practical tests and observations (Thomson, Melanle & Walker, 2018:20).

According to Thompson et al. (2018:21), informal assessment is a name that suggests less formal assessments. Teachers must have knowledge and understanding of their learners' interests, their ability levels, their learning styles and their academic strengths to facilitate instructional delivery. Four steps which the teacher should take cognizance of include generating and collecting evidence of achievement, evaluating this evidence,

recording the findings and using this information to assist learners' development to improve the learning process.

#### 3.2.9.1 The importance of assessment of learners

Assessment is administered for a purpose: Nuhad (2012:01) lists seven purposes why assessment should be done:

- Assessment helps learners in their learning because it assists them to meet certain standards.
- The teacher may use assessment data to identify strengths and weaknesses in learners' performance and to improve the quality of teaching and learning.
- Assessment is the only tool which may be used to assess and improve the effectiveness of the curriculum programmes.
- Assessment may also be useful to assess and improve teaching effectiveness.
- It is also helpful to provide data that assists in decision making.

#### 3.2.9.2 Types of assessment

There are three types of assessments which are applicable in the classroom to make teaching and learning effective. The three types of assessment include formative, diagnostic and summative assessments.

**(a) Formative assessment**

Formative assessment is a deliberate process used by teachers and learners during instruction to provide action feed-back that is used to adjust ongoing teaching and learning, to improve learners' self-assessment, reflection and attainment of curricular learning targets (Black, Harrison, Lee, Marshall & William, 2003:5).

Black and William (2009:2) define formative assessment as a practice in the class in which learners' evidence of achievement is elicited, interpreted, and used to make decisions about their next step in instruction. It helps to make better and informed decisions than those that would have been made in the absence of evidence.

According to Black, Harrison, Lee, Marshall and William (2003:6) formative assessment structures learners' metacognition, increases learners' motivation resulting in self-regulated lifelong learning. Common formative assessment in class includes summaries and short quizzes. Black et al., (2003:6) state that formative assessment is used to provide feed-back to teachers and learners over the course of instruction.

According to Nuhad (2012:1), formative assessment is considered an integral part of the teaching and learning process. Nuhad (2012:7) adds that formative assessment encompasses classroom interactions, questioning, structural classroom activities and feedback aimed at helping learners to close learning gaps. During formative assessment, learners are also involved in the assessment process through self and peer assessment. According to Nuhad (2012:7), information from the external sources may also be used formatively to identify learning needs and to adjust teaching strategies. The crucial distinction is that formative assessment only shapes subsequent learning (Black & Wiliam, 2006:5).

**(b) Diagnostic assessment**

Diagnostic assessment is a type of assessment that may occur at the beginning of a term or a unit of study. According to Black and Wiliam (2009:6), diagnostic assessment may occur whenever information about prior learning of learners is useful. Various types of diagnostic assessments are tests, journals and performance-based assessment (Black & Wiliam, 2009:6).

Nuhad (2012:6) describes diagnostic assessment as a distinction of measurement with a purpose to ascertain each learners' strengths and weaknesses, knowledge and skills.

- Black and Wiliam (2009:6) expresses the usefulness of the diagnostic assessment in the following terms:
- Diagnostic assessment is useful for the teacher and learners to find out what learners know and already can do.

- The diagnostic assessment enables teachers and learners to target difficulties and identify the precise nature of difficulties.

- The diagnostic assessment makes an informed decision regarding where to focus instructional time and efforts.

**(c) Summative assessment**

Summative assessment generally takes place after a period of instruction and requires making judgment about the learning that has occurred. Summative assessment is important for the evaluation of an individual learner. It is used for judgement or making decisions about the achievement of an individual. Nahud (2012:5) postulates that summative assessment is used for learner motivation, that is, for an individual to maintain or improve performance. Furthermore, Nahud (2012:07) observes that summative assessment is important for certification of performance, grades and promotion. For assessment to achieve its objectives, teachers should plan assessment activities to complement teaching and learning activities. The later may assist to ensure that teaching and learning is effectively done in the class (Gauteng Department of Education, 2007:3).

Summative assessment is a high-stake process for making final judgement about learner achievement and instructional effectiveness. By the time it occurs, learners would have typically exited the learning mode. Summative assessment forms the end of learning, where it sums up the performance of learners or the level of achievement. Summative assessment includes unit tests, projects and final year end promotional mark (Nuhad, 2012:7).

Continuous Assessment (CASS), either formal or informal should be administered to make sure that proper learning prevails in the class. Grade12 formal internal programme of assessment counts 25%. It is set and marked internally at schools as a

school-based assessment and moderation procedure. 75% of the final mark is for the certification, and is externally set, marked and moderated.

**Table 3.1: Recommended Assessment Tasks to be Given in the 1st or 2nd Term and in the 3rd Term in Grade 12 Physical Sciences**

| Assessment Tasks | Term 1 | Term 2 | Term 3 | Term 4 | Weighting |
|---|---|---|---|---|---|
| Controlled Tests | 1 | | 1 | | 2 x 5 = 10 |
| Examination (midyear) | | 1 | | | 1 x 10 = 10 |
| Preparatory Examinations | | | 1 | | 1 x 20 = 20 |
| Practical Investigation | 1 (Phys / Chem) | 1 (Phys / Chem) | | | 2 x 20 = 40 |
| Research Project | | | 1 | | 1 x 20 = 20 |
| Total Cass Weighting | | | | | 25% |

According to the GDE (2008:4), the content for programme of assessment for Physical Sciences is stipulated in the subject assessment guideline of 2007 as depicted in Table 3.1. This table shows two controlled tests in the 1st and 3rd terms, mid-year examinations, preparatory examinations, practical investigations and a research project which is administered in term 3.

Programme of assessment in Grade12 should be carefully designed. The main objective is to give learners an opportunity to research and explore the subject in exciting and varied ways. Assessment is imperative since it enables the teacher to make reliable judgement about a learner's progress, inform learners about their strengths, weaknesses and progress. Assessment also assists teachers, parents and

other stakeholders in making decisions about the learning process and the progress of the learners (DBE, 2011:143).

- **Informal assessment**

Informal assessment is a day to day monitoring of learners' progress. This type of assessment is done through observation, discussions, practical demonstrations, and learner–teacher conferences and informal classroom interaction. According to the DBE (2011e:143), informal assessment includes stopping during the lessons to observe learners or to discuss with them concerning how the learning is progressing. Informal assessment is imperative since it gives feed-back to learners and informs planning for teaching.

- **Formal assessment tasks**

Formal assessment tasks refer to the tests which are standardised and are prepared to assess learners' progress. Formal assessment tasks constitute the formal programme of assessment for the year (DBE, 2011e:144). These tasks are marked and formally recorded on the mark-sheets by the teacher as a stable record for use when tracking the performance of learners.

Formal tasks are subjected to moderation as a quality assurance measure. The DBE (2011e:144) expresses that questions in formal assessment tasks (tests and examinations) should assess performance at different cognitive levels with emphasis on the process skill of critical thinking. The DBE (2011e:144) comprise examples of formal assessments which include tests, examinations, practical tasks, projects, oral presentations and demonstrations. Formal assessment tasks ultimately form part of the year-long formal programme in each grade and subject.

### a) Controlled tests and examinations

According to the DBE (2011e:144), controlled tests and examinations are tests and examinations that are written under controlled conditions, within a specific period of time. Questions in the tests should assess performance at different cognitive levels emphasizing on the process skills, scientific skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environment and everyday context (DBE, 2011e:144).

According to the DBE (2011e:144), examination papers and controlled tests in Physical Sciences Grades 10-12 should adhere to the weighting of cognitive levels as given in Table 3.2.

**Table 3.2: Recommended Weighting of Cognitive Levels for the Examinations and Controlled Tests for the FET (Grades 10–12)**

| Cognitive Level | Description | P1 (Physics) | P2 Chemistry |
|---|---|---|---|
| 1 | Recall | 15% | 15% |
| 2 | Comprehension | 35% | 40% |
| 3 | Analysis, Application | 40% | 35% |
| 4 | Evaluation, Synthesis | 10% | 10% |

### b) Practical investigations and experiments

Practical activities as used in this document refer to practical demonstrations, experiments or projects used to strengthen the concepts being taught (DBE, 2011e:9). Furthermore, the DBE (2011e:09) describes experiment as a set of outlined instructions for learners to follow until they obtain results that serve to verify the established theory. Practical investigations and experiments should focus on the practical aspects and the process skills which are required for scientific inquiry and problem solving. According

to the DBE (2011e:144), assessment activities should be designed in a way that learners are assessed on scientific inquiry skills. There are a variety of practical activities that are meant to assess learners regarding content, concepts and skills in Physical Sciences as shown in Table 3.3.

**Table 3.3: Practical Investigations and Experiments**

| Grade | Term | Prescribed Practical Activities (Formal Assessment) | Practical Activities (Informal Assessment) |
|---|---|---|---|
| 12 | Term 1 | Experiment (Chemistry)<br>Preparations of Esther | Experiment (Physics)<br>Draw a graph of position, time and Velocity. Time for Free falling object AND use the data to determine the acceleration due to gravity.<br>OR<br>Experiment (Chemistry)<br>Reaction of Alkanes and Alkenes with Bromine and Potassium Permanganate OR making a polymer like “slime” or “silly putty” |
| | Term 2 | Experiment (Chemistry)<br>How do you use the titration of Oxalic Acid against Sodium Hydroxide to determine the concentration of the Sodium Hydroxide?<br>OR | Investigation (Physics)<br>Perform the simple experiments to determine the work done in walking (or Running up a flight of stairs) one can enrich the concept of power.<br>OR |

| | | | |
|---|---|---|---|
| | | Experiment (Physics)<br>Conservation of linear momentum. | Experiment (Chemistry)<br>Rate of chemical reaction with sulphite and Hydrochloric Acid OR chemical equilibrium. |
| | Term 3 | Experiment (Physics)<br><br>Part 1<br>Determine the internal resistance of a battery.<br>Part 2<br>Set up a series-parallel network with known resistor. Determine the equivalent resistance using an ammeter and a voltmeter and compare with the theoretical value. | Experiment (Chemistry)<br><br>Set up a series-parallel network with an ammeter in each branch and external circuit and voltmeter across each resistor, branch and battery, position switches in each branch and external circuit. Use this circuit to investigate short circuit and open circuits.<br>OR<br>Experiment (Chemistry)<br><br>Investigate electrolytic and galvanic cells. |
| | Term 4 | | |

**c) Projects**

Project refers to an integrated assessment task that focuses on process skill, critical thinking and scientific reasoning as well as strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday context. According to the DBE (2011e:145), this requires a learner to produce either a poster, device, model or to conduct practical investigation.

The DBE (2011e:145) states that a project will entail only one of the following: making of scientific poster, construction of a device such as an electric motor. This can also involve building a physical model to solve a challenge identified using concepts in the FET Physical Sciences curriculum and practical investigation (DBE, 2011e:145). The assessment tools used specify the assessment criteria for each task and these will be dictated by the nature of the tasks and the focus of the assessment. Assessment tools could be one or a combination of rubrics, checklists, observation schedules and memoranda (DBE, 2011e:145).

According to DBE (2012:9), the CAPS policy document is also clear on the policy of assessment. Informal and formal assessment policy is detailed on the minimum number of assessments and types of activities on which learners should be assessed.

Informal assessment tasks are referred to as homework, classwork, practical investigations, research and tests (DBE, 2012:9). The following are the recommended activities for learners' assessments:

- Learners should do at least two problem-solving exercises (activities) per day. The exercises should cover all cognitive levels. These could be done as homework or classwork.
- Learners should at least do one practical activity a term and one informal test per term.
- There are three recommended informal experiments for Grade 12 (DBE, 2012:9).

Formal assessment entails-controlled tasks which are determined by the province. They are controlled and standardised tests, examinations, experiments and projects for Grade 12 Physical Sciences (DBE, 2012:9).

Three prescribed experiments are done per year in Grade 12 Physical Sciences. These comprise one or two Physics experiments and one or two Chemistry experiments for each term. In addition, one controlled test, mid-year examination, trial examination and final examination are meant for formal assessment in Grade 12 Physical Sciences

(DBE, 2012:9). A class which is well resourced with suitable adequate textbooks is conducive for the positive facilitation of teaching and learning programme.

### 3.2.10 Provisioning of Physical Sciences Text Books

Teaching and learning materials refer to any aids that may be used to facilitate instruction in the classroom. Teaching and learning materials such as text books are important to support effective teaching and learning in Physical Sciences. According to the Global Education Report (2016:1), provisioning of appropriate and adequate text books is a key strategy to implement proper learning. Provisioning of relevant Physical Sciences textbooks improves the quality of teaching and learning. (GER, 2016:1).

The use of adequate relevant text books enhances learners' performance in a learning area. The Texas Education Agency (2009:3) expresses that under-resourced classes are very much impersonal, overpowering and result in poor performance of learners. TEA (2009:3) also argues that teachers teach well and effectively when working in well-resourced environments. In such classes, teachers work in a stress-free environment which ultimately enhances learners' performance.

A classroom with adequate suitable text books is conducive for positive facilitation of lessons and other programmes in the schools. With the availability of relevant textbooks, Physical Science teachers and learners could finish their syllabus well ahead of time. Yara and Otiena (2010:15) argue that text books are important for a sound teaching and learning process. Furthermore, TEA (2009:4) argues that the text book method of teaching improves teachers' flexibility and provides learners with new information from different sources.

Green, Ferrante and Heppard (2016:1) postulate that the textbook is the most effective teaching aid. The availability of text books assists learners to write class activities, home activities and to study. Green, Ferrante and Heppard (2016:1) also point out that learners value their text books and use them more frequently and intensively to prepare

for classroom learning. Textbooks have the potential to improve learners' experiences in the work place (Texas Education Agency, 2009:3).

### 3.2.11 The Use of Educational Fieldtrips

Educational excursions and field trips refer to any teaching and learning that takes place outside of the classroom. Fieldtrips are instructional trips, school excursions or school journeys or class trips that are designed with an educational intent. Learners interact with the setting, displays and exhibits to gain experimental connections with an idea, concept and the subject matter. Benherendt and Franklin (2014:235) avers that there are two fieldtrips which are physical fieldtrips and virtual fieldtrips. Physical field trips can take place in several areas inclusive of school playgrounds, school boards, outdoor education centres, provincial parks, protective wetlands, science centres, museum, zoos, grocery stores, fire stations, veterinary clinics and other relevant venues. Fieldtrips are also described by Tal and Morag (2009:56) as learners' experiences outside the classroom at interactive locations which are designed for educational purposes.

Field trips are of importance in the enhancement of understanding by learners. They are useful since they can be used in the introduction to a unit or comminatory actively. Fieldtrips serve as motivational measures to inspire learners in their learning of Physical Sciences. They excite learners to meet and interact with other learners (Nir & Avi, 1994:1097). The advantages of fieldtrips include the opportunity to offer real world experiences, enhancement of quality of education, proving teachers with opportunities for cooperative learning and encouraging socialisation among learners and teachers (Akrakowka, 2012:47).

Benherendt and Franklin (2014:235) identify some aspects that should be considered when designing field trips. The field trips are designed to provide firsthand experience and to stimulate interest and motivation in Physical Sciences. Trip fields stimulate interest and motivation in the learning of Physical Sciences. It is the purpose of

fieldtrips to strengthen observation and perception skills and to promote personal and social development (Benherendt & Franklin, 2014:237).

Educational excursion can also be done through Children Challenging Industry (CCI). This is a programme which is used to link learners of science at primary school with real science. It involves both primary school teachers and their learners (Porter, Parvin & Lee, 2010:10). The programme is run by the Chemical Industry Education Centre which is based at the University of York. It was launched in 1996. The programme allows teachers and learners to engage with science-based industries in real-life contexts. All the regions in England are engaged in this programme. Learners across regions study the effect of industry-based activities on the views of primary school learners and their teachers (Porter, Parvin & Lee, 2010:10). The CCI programme provides opportunities for primary school learners to experience science in an industrial context. Learners undertake to study a series scientific concepts before visiting local industrial partners to see how the scientific concepts are applied.

School excursions that are based on science education may assist to motivate the interest of learners in Physical Sciences. Teachers should also try to make close links between scientific and technological understanding. In that case, the use of the Children Challenging Industry programme seems to be the most relevant in this regard. The programme also provides teacher quality professional development to school teachers (Porter et al., 2010:12).

Nir and Avi (1994:1099) argue that field trips are the most neglected learning environment by teachers, curriculum developers and researchers. Teachers tend to shun field trips activities because they are unfamiliar with the philosophical techniques and organisation involved.

## 3.3 LEARNING METHODS THAT ENHANCE LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES

This section addresses the learning styles that are considered to enhance the performance of learners in the teaching and learning of Physical Sciences.

### 3.3.1 Learners' Learning Styles

Learners' learning styles refer to a range of competing and contesting theories that aim to account for differences in a way in which the individuals learn. These theories propose that learners can be classified according to their styles of learning. Kolb and Kolb (2005:3) indicate that individuals differ in the way in which they can learn effectively. Therefore, teachers should strive to understand the way in which learners master some concepts so that they can help them to maximize on concentration, attention for ultimate academic improvement (Kolb & Kolb, 2005:3).

Learning styles refer to the preferences for processing information in a particular way when carrying out a learning activity (Ellis, 2001:149). Learning styles are modes by which teachers become aware of different techniques which could be implemented on learners (Admin, 2016:1). This is an observable behaviour that arises from a person's underlying personality, motivation, cognitive style and ability. This is viewed as stable over a variety of situations. Learning styles entail the characteristics of learners which are reflected in their respective learning behaviours. According to Dybvig (2004:2), learning style is defined as a way in which a person processes, internalizes and study new challenging materials. These include the way in which learners are taught, learn and interact with the learning environment, peers and with teachers or instructors.

Rosewell (2005:3) postulates that it is helpful for a people to understand their own learning styles. Understanding one's own learning style helps a person to be more efficient and effective in learning. There are many methods of learning. Rosewell

(2005:3) further argues that for the learning style to work best, it depends on the learning activity, context and learners' personality.

To understand learning styles, it is critical that some tools to assess learning styles be understood first. Kolb (2005:4) indicates how various tools for assessing learning styles were created. The following are learning tools that were designed to assess learning styles: Learning Style Inventory (LSI), Silverman Learning Style Scale (LSS) and Solomon Style Questionnaire (Kolb & Kolb, 2005:5). Among these proposed tools for assessing learning styles, the Felder Silver learning style assessment model is said to be the most comprehensive and can generate in-depth findings on the effect of learning styles than other models (Kolb & Kolb, 2005:5).

Teachers should assess the learning styles preferred by learners so that they will be able to adjust their teaching methods to best fit each learner's learning style. The learning styles play a significant role in as far as learners' academic performance is concerned. The contribution of learning styles in learner performance may be understated. However, learning styles enhance the performance of learners through encouraging self-directed learning (Vali, Balakrishnan, Siokching, Latif & Nasiruden, 2014:752).

Vali et al. (2014:753) observe that learners always have preferences about how they wish to learn and understand a subject. In this case, it is advisable that learners should tailor their learning styles to suit their own learning needs. However, teachers, the institution managers and the subject heads should play a major role for the learners to realise and to develop their effective learning styles. Teachers, the subject heads and school principals should understand learners' learning styles in order to know when and how to assist them. It is important for teachers to understand the learning styles of learners in their classes in order to make relevant adjustments of the pedagogic approaches they employ (Vali et al., 2014:753).

There are several learning styles that are important in teaching and learning (Xiaojie & Xianmin, 2016:4). Xiaojie & Xianmin (2016:4) indicate that learning styles fall into four distinct learning types or learning preferences. Kolb and Kolb (2005:55) observe that different learning styles may suit different learning activities. When learners are aware of their learning styles, this assists them to judge the helpfulness of the activity to them (Xiaojie & Xianmin, 2016:4). Learning Styles are put into two groups which are Honey-Mumford Learning styles, as developed by Honey and Mumford and the Kolb Learning styles.

#### 3.3.1.2 Honey-Mumford learning styles

Honey and Mumford developed four learning styles which are activists, theorists, pragmatics and reflectors.

**(a) Activist learning style**

According to Kolb and Kolb (2005:55), activist learners prefer to learn something new. They like immediate involvement in activities, and they enjoy challenges of problem solving. Jawahitha (2003:1) concurs that in the activist learning style, activist people learn comfortably when they are exposed to new experiences. Such people are open minded and enthusiastic. They are creative, innovative and always ready to do things (Jawahitha, 2003:1). Activist learners are impulsive, and they tend to act first and consider the consequences of their actions afterwards (Kolb & Kolb, 2005:4). The activist learning styles also encourage team work. Activist learners can work better in collaborative teaching environments which encourage interaction (Rosewell, 2005:1).

Activist learning style functions better when people are engaged in new experiences and it works optimally where there is interaction among learners and learners and between learners and teachers. This learning style promotes the full application of collaborative methods in which learners work together and share knowledge, skills and concepts (Jawahitha, 2003:1).

**(b) Theorist learning style**

Kolb and Kolb (2005:4) state that theorists like exploring complex ideas and concepts and prefer to use their observations and experiences to build their models and theories. These learners like to understand the theory behind their actions. Jawahitha (2003:1) posts that theorist learners need models, concepts and facts to engage in the learning process. They prefer to analyse, synthesize and to draw new information into systematic and logical theory. Theorist learners learn by adapting, integrating, observations, logically sounding theories, thinking problems and applying a step by step methodology (Kolb & Kolb, 2005:4). Theorist learners are objective and analytical as opposed to being subjective or emotive. They learn better in a situation where they should use their skills and knowledge with a clear purpose. They also work better in a situation where they are exposed to interesting ideas and concepts (Jawahitha, 2003:2).

**(i) Pragmatist learning style**

Pragmatists are keen to try things. They need concepts that are relevant to their learning. They do not enjoy lengthy abstract discussions. Such people are practical and down to earth. Pragmatists learn better when there is a link between phenomena (Robert & Yaw, 2005:85). Kolb and Kolb (2005:5) postulate that pragmatist learners prefer to learn through techniques, practices and experiments. They also prefer to address real world problems.

**(ii) Reflectors' learning style**

Reflectors prefer to stand back and look at a situation from different perspectives. Reflectors like to collect information and views and consider everything thoroughly before they come to conclusions or making decisions. Reflectors learn by observing others and listening to their different views before joining in and offering their own views (Rosewell, 2005:3). They learn better through observations, as individuals or groups and thereafter have an opportunity to review what has happened. Reflectors like to gather and assimilate as much information as possible from as many sources as possible. They need enough time to consider the information they are dealing with.

Reflectors do not like to commit themselves to course of actions before they are ready (Rosewell, 2005:3).

#### 3.3.1.3 Kolb's learning styles

Kolb's learning styles are categorised into four learning styles as follows: Diverging learning style, assimilating learning style, converging learning style and accommodating learning style (Jawahitha, 2003:2).

**(a) Diverging learning style**

According to Kolb and Kolb (2005:4), individuals with diverging learning styles have Concrete Experience (CE) and Reflecting Observation (RO) as dominant learning abilities. Learners with diverging learning styles are best at viewing concrete situations from various points of view. This learning style has broad cultural interests and its practitioners like gathering information (Jawahitha, 2003:2). Kolb and Kolb (2005:4) postulate that individuals with diverging learning styles are interested in people, tend to be imaginative and emotional, have cultural interests and specialise in arts. Robert and Yaw (2005:185) observe that learners with diverging learning style prefer group work and listen to different viewpoints and receiving personalised feed- backs.

**(b) Assimilating learning style**

Individuals with assimilating learning style have Abstract Conceptualisation (AC) and Reflective Observation as dominant learning abilities (Kolb & Kolb, 2005:4). Such individuals are best at understanding information and put it into concise and logical form (Kolb & Kolb, 2005:4). People with assimilating learning style are less fond of people (Rosewell, 2005:4). Kolb and Kolb (2005:5) postulate that assimilating learning style is important for conveying effective information and for science careers. People with assimilating learning style prefer reading, lectures, exploring and analytical models and they have time to analyse and take decisions (Kolb & Kolb, 2005:4).

### (c) Converging learning style

Individuals with converging learning style have Abstract Conceptual (AC) and Active Experimentation (AE) as dominant abilities. These people are best at finding practical uses for ideas and theories (Kolb & Kolb, 2005:4). Such people make decisions based on finding a solution to problems. According to Desmedt and Valcke (2004:1), individuals with convergence learning styles prefer to deal with technical tasks and problems. They do not prefer to deal with social and interpersonal issues. The converging learning style is effective in the specialist and technical careers. Glonek (2013:1) points out that people with converging learning styles prefer to experiment with new ideas, simulations, laboratory assignments and practical applications.

### (d) Accommodation learning style

Kolb and Kolb (2005:4) state that people with accommodating learning styles have Concrete Experience (CE) and Active Experimentation (AE). These individuals have a tendency of learning from first-hand experience. Desmedt and Valcke (2004:1) indicate that individuals with accommodation learning style enjoy carrying on plans and getting involved in new and challenging experiences. Such people rely on people for information to solve problems than relying on their own technical analysis. Glonek (2013:1) points out that the accommodating learning style is important for action-oriented careers like marketing and sales. According to Kolb and Kolb (2005:4), people with accommodating learning style prefer testing out different approaches and to complete projects.

## 3.3.2 Factors that Shape a Learners' Learning Styles

Kolb and Kolb (2005:5) posit that four basic learning styles are shaped by transactions between people and their environment at different levels. Robert and Yaw (2005:185) postulate that factors that influence learning styles include personality, educational specialisation, professional career, current job role and adaptive competencies.

#### 3.3.2.1 Learners' personality type

The type of personalities displayed by people shape and influence their learning styles (Robert & Yaw, 2005:185). Learners are unique, as such they learn differently. Diverging style learners work better with learners with introverted feelings. The assimilating type works with learners with introverted intuition. Converging type of learners are learners who belong to the extroverted thinking. Accommodating style works better with extraverted sensation (Robert & Yaw, 2005:185).

#### 3.3.2.2 Educational specialisation

Early educational experiences also help to shape individual learning styles by instilling a positive attitude towards specific sets of learning skills and by teaching learners how to learn (Caspo & Hayen, 2013:130).

#### 3.2.2.3 Professional career

The professional choice of an individual does not only expose specialized learning environment but also involves a commitment to generic professional problems such as social services as well as professions which require a specialised adaptive orientation. A person becomes a member of a reference group which gives value to peers that share a professional mentality and a common set of beliefs about the way a person should behave professionally. Professional orientation shapes learning styles through habits acquired during professional training and through the normal pressure involved in being a competent professional.

- Social services and arts professions attract people with diverging learning styles.

- Professions in science, information and research have people with assimilating learning styles.

- Technology and intensive fields such as medicine and engineering are dominated by the converging learning styles.

- Careers in fields such as sales, social services and education are dominated by the accommodating learning styles (Aseweed, 2013:65).

#### 3.3.2.4 Current job roles

- The demands of tasks and pressure of the job shape a person and his/her adaptive orientation (Kolb & Kolb, 2005:6). Executive jobs such as general management need strong orientation to task accomplishment and decision making and certain emergent circumstances require an accommodating learning style.

- Personnel jobs such as counselling and personal administration require establishment of personal relationships and effective communication with other people. Such demanding jobs need the diverging learning style.

- Information jobs such planning and research, require data gathering and analysis as well as conceptual modelling. Such jobs require an assimilating learning style.

- Technical Jobs such as bench engineering and production require technical and problem-solving skills. Such demands need convergence learning orientation (Csaspo & Hayen, 2006:130).

#### 3.2.3.5 Adaptive competencies

This refers to the specific task or problems that the person is currently working on. Each task people face requires a specific set of skills for effective performance. Effective matching of task demands, and personal skills result in adaptive competence. The accommodating learning style encompasses a set of competencies that can be termed acting skills, leadership, initiative and action (Alseweed, 2013:65).

- The diverging style is associated with valuing skills, relationships, helping others and sense making.

- The converging learning style is associated with decision making skills like quantitative analysis and goal setting.

#### 3.3.2.6 The impact of learning styles on learner' performance

Xiaojie and Xianmin (2016:922) state that learning styles have an impact on learner concentration. Mobile learning (m-Learning) can serve as a good measure to motivate learners to learn through enhancement of their interests and attitudes in Physical Sciences. This is the type of learning in which mobile technologies like cellphones, tablets and others are used. The use of mobile technology for educational purposes is playing a vital role in the enhancement of learners' concentration (Rosewell, 2005:1).

M-Learning is very effective than the traditional ways of learning. Such type of learning promotes collaborative inquiry process. Caspo and Hayen (2006:130) argue that this method provokes interest in the engagement of the learners in learning since it fosters attention and concentration (Piaget, 2010:99). M-Learning also strengthens the interaction among the learners themselves during their study and ultimately improves the learning performance (Xiaojie & Xianmin, 2016:922).

To understand the learning styles of the individuals better, people should be able to distinguish between attention and concentration. According to Xiaojie and Xianmin (2016:922), attention refers to the focused concentration in learning whereas concentration refers to the ability of individuals to direct their thinking towards an intended direction (Paget, 2010:99).

Learners who have a positive attitude, high achievement motive, high self-esteem and high self-efficacy generally have high concentration in learning (Xiaojie & Xianmin, 2016:922). The learners' concentration levels should be enhanced to acquire these attributes. There are factors that are responsible for the improvement of learner concentration. Such factors include a conducive environment which is significant for learner concentration. A noisy surrounding, for example, may distract the attention of learners. The use of teaching aids is also effective in the cultivation of learning. In

addition, learning times need to be fragmented so that instruction on a concept can be completed while the concentration levels of learning are still high.

## 3.4 ENHANCEMENT OF LEARNERS' PERFORMANCE IN PHSICAL SCIENCES IN KENYA, JAPAN AND UNITED KINGDOMS

Studies were conducted in three international countries (Kenya, Japan and the United Kingdom) with the purpose to understand their experiences in delivering Physical Sciences curriculum. The focus was also on the challenges they encounter in the teaching of Physical Sciences. Focus was also paid on the strategies they apply to address such challenges.

### 3.4.1 Teaching of Physical Sciences in Kenya

The following factors that enhance the performance of learners in Physical Sciences were discussed. This was done to establish an understanding on the way in which the performance of learners was improved in Kenya. It was imperative to appreciate the intervention strategies which were used to mitigate the challenges.

#### 3.4.1.1 Appropriate teaching approaches

Teaching approaches are the main factors that influence the effectiveness of teaching Physical Sciences in Kenya. In Kenya, there is a need for teachers to be trained on teaching approaches to improve instructional delivery in Physical Sciences. Mudulia 2012:533). Various teaching approaches are used to teach Physical Sciences in Kenya. The government of Kenya through the Department of Education identified the project method as the best option to adopt in teaching Physical Sciences.

According to Mudulia (2012:534) the project method encourages the development of scientific skills and knowledge to address daily problems. The use of project method is trusted to produce better results than the traditional teaching methods such as group discussion. This method is based on the conviction that learning by doing raises

learners' mastery of Physical Sciences concepts. Kleinmann et al. (2013:90) posit that project method provides a good example where learners are actively engaged in the learning process. It also involves an in-depth investigation on topics which culminates in the making of scientific devices through the application to the knowledge learned.

The classroom interactions between learners and teachers are most important in as far as learning is concerned. The class arrangement, discipline and teachers' teaching approaches play an important role. Wachanga and Wangi (2004:26) express that teachers should get training on teaching approaches to understand the best ones to use in teaching Physical Sciences. The government of Kenya through the Ministry of Education, Science and Technology, with the assistance of the government of Japan through the Japan International Cooperation Agency, started a programme to commit themselves to strengthening Mathematics and Physical Sciences teaching in secondary schools in Kenya. This was done to improve the mastery of teaching methods among teachers and to encourage hands on activities for Physical Sciences learning (Wachanga & Wangi, 2004:26).

The use of inappropriate approaches is the main factor that hinders the effectiveness of teaching and learning of Physical Sciences in Kenya (Muriithi, Odundo, Origa & Katumu (2013:1). A variety of teaching approaches are used to teach Physical Sciences in Kenya. The government of Kenya, through the Ministry of Education identified project method as the best method for the teaching of Physical Sciences.

Larmer and Ravits (2003:4) observe the project method as a systematic teaching method that engages learners in mastering knowledge and skills through an extended inquiry process. Project method is built around complex authentic questions and carefully designed products and tasks. Pecore (2015:161) concurs that project method is a teacher -facilitated collaborative approach in which learners acquire and apply knowledge and skills to define and solve realistic problems using a process of extended inquiry. Project method is also known as Project Based Learning because it involves the making of actual projects by the learners.

Howel and Mardini (2003:15) postulate that Physical Sciences teachers in Kenya use project methods as a means of teaching skills and problem solving. The project-based learning realizes learner participation in the learning process. In this method, the focus is put on learners than on content and teachers. Teachers play a dominate role in the class to guide and to facilitate the learning process.

Bidabadi, Isfahani, Rouhollahi and Khalili (2016:180) observe that project method has its systematic way of teaching Physical Sciences. It also influences the quality of teaching. The method helps to evaluate and determine the learners' competence formation as well as future development opportunities.

Sears (2016:15), supports the above notion when postulating that the project methods encourage the development of self-directed learning, build research skills and determine their own needs. These methods are based on John Dewey's philosophical assumptions that education begins with curiosity by learners. Learners arrive at an understanding of concepts by themselves. The responsibility of learning rests on learners themselves.

The use of laboratory investigation is also considered most important in Kenya. In Kenya, they use the so-called Cooperative Class Experiment Teaching Method. Kenyan Education Ministry also identified this method as being effective in teaching Physical Sciences. This method encourages small group teaching through experiments and projects. Physical Sciences Curriculum developers in Kenya prefer learners to be taught through learner-based approaches. Such approaches include class experiment teaching which also involves supervised learning activities with learners doing practical work, individually or as groups. According to Wachanga and Mwangi (2005:27), cooperative class experiment teaching method incorporates cooperative learning into class experiments.

The use of experiments as a teaching method of Physical Sciences in secondary schools is crucial for concept delivery by the teachers. It is also important in as far as

the subject mastery is concerned. The delivery of quality content in Physical Sciences is faced with challenges like inadequate supply of qualified teachers, lack of Physical Sciences infrastructure such as Physical Sciences laboratory, laboratory apparatus and lack of laboratory assistants.

#### 3.4.1.2 Teaching and learning resources

Kenya, like many African countries, has serious challenges in as far as resources for the teaching of Physical Sciences are concerned. This affects effective teaching of Physical Sciences concepts in schools. Mosotho (2017:159) argues that challenges like the ones that confront South Africa are common in Kenya. According to Hofstein & Lunette (1982:208) lack of laboratory facilities, lack of motivation on both learners and teachers, inability of teachers to communicate ideas well to learners as well as inadequate learning facilities in schools with large classes create challenges.

**(a) Provisioning of Physical Sciences text books**

Physical Sciences curricula in Kenya is dominated by a variety of challenges. There is also a serious shortage of appropriate text books. Rono, Koros and Kosgel (2016:937) express that lack of Physical Sciences learning facilities and provisioning of adequate learning materials like text books are the main challenges in the state schools of Kenya. Lack of Physical Sciences apparatus is also a cause for concern. Lack of Physical Sciences resources affect delivery of Physical Sciences curriculum. This leads to learners developing a negative attitude towards the subject and this results in learners performing badly in the subject. The average performance of learners in Physical Sciences in Kenya is between 20% and 40% (Machio, 2013:11). Ruhama and Olsher (2014:21) contend that textbooks and other learning materials are highly cost-effective complementary inputs. The government and the Ministry of Education encounter difficulties to provide schools with adequate text books (Hofstein & Lunette, 1982:210).

Caillods et al. (1997:77) postulate that in Kenya, a significant proportion of learners cannot afford to buy Physical Sciences textbooks. This is because textbooks are very costly. Consequently, teachers resort to writing the subject content on the chalkboards

for learners to copy and this results in learners spending most of their learning time copying notes instead of engaging in meaningful learning.

**(b) Laboratory facilities in Physical Sciences**

Lack of adequate physical infrastructure is also a challenge in secondary schools of Kenya. There is a tremendous shortage of classes and laboratory facilities. Orodho (2013:1) reveals that there are insufficient physical resources in Kenya including lack of laboratories. The shortage of laboratory facilities makes it difficult for teachers and learners to conduct laboratory investigations. The application of inquiry-based teaching approach is also very difficult when laboratory facilities are not available. Learners would find it difficult to engage in collaborative learning through laboratory investigation.

The shortage of laboratory equipment in Kenya hampers the delivery of quality teaching and learning in Physical Sciences. As such, the teaching of Physical Sciences is done theoretically with teaching characterised by the lecture method (Caillods et al., 1997:64). Hoftein and Lunetta (1982:211) observe that even places where laboratories are available, there is a problem of laboratory maintenance since teachers who are available are not well equipped with laboratory knowledge and skills.

**(c) Provision of qualified teachers**

Okono, Sati and Awuor (2015:447) express that the main challenge faced by the Ministry of Education in Kenya is lack of qualified teachers. Provisioning of inadequate qualified Physical Sciences teachers is common in most countries in Africa. Availability of adequate qualified teachers is a major determinant of quality teaching and learning. The World Bank Development Report (2004:99) empresses that there is a serious shortage of qualified teachers in Kenya. The report reflects that teacher-learner ratio in Kenya is supposed to be 1:30 but in actual fact, it is 1:58. This is because qualified teachers are not enough to cover the expected teacher learner ratio.

Ntsi and Maphosa (2016:61) postulate that the shortage of qualified Physical Sciences teachers in Kenya, emanated from the overcrowding of classes since the implementation of Compulsory Free Education (CFE) in Kenya. This brought the

number of learners far more than the available qualified teachers. Consequently, the teaching of Physical Sciences is compromised by larger classes and the provisioning of inadequate qualified teachers. This is supported by Orodho, Waweru, Ndichu and Nthinguri (2013:01) who express that inadequate supply of teachers' results in high teaching load for Physical Sciences teachers. Teachers are not able to give individualised attention, especially to slow learners and those learners with special needs

**(d) The use of technology**

Curriculum implementation in Kenya is complemented using technological devices like videos, games and quizzes. Teachers also use some teaching technology to complement the teaching of Physical Sciences. However, technology in Kenya's education system is still far behind. Few schools in Kenya are making use of technologies in the teaching of Physical Sciences. But still, schools that have technology equipment are still faced with a mammoth challenge of computer illiteracy on the side of teachers. Furthermore, technology in Kenya is also affected by lack of infrastructure (Gaal & Afrahsan, 2017:54).

### 3.4.2 Teaching of Physical Sciences in Japan

This section discussed teaching and learning of Physical Sciences as applied in Japan to enhance the performance of learners.

#### 3.4.2.1 Appropriate teaching approaches

Inquiry-based teaching is the recommended approach for teaching Physical Sciences in Japan (Ogawa et al., 2013:08). According to Ogawa et al. (2013:09), Physical Sciences gives learners an opportunity to learn concepts and processes in Physical Sciences. To achieve this in Japan, the 1996 Science Education (SES) document expects teachers to plan and incorporate inquiry-based approach into the science curriculum. The SES also listed the most important learner out-comes as being the ability to design and conduct

scientific investigations, formulate scientific explanations using experimental evidence and effectively communicating the results of scientific investigations.

Akani (2015:206) postulates that learners who use laboratory investigative approach show remarkable achievements in formulating hypotheses, making scientific assumptions, designing and executing investigations, understanding variables, making careful observations, recording data, analysing and interpreting results, synthesizing new knowledge and the development of curiosity, openness, responsibility and satisfaction.

#### 3.4.2.2 Laboratory Investigations in Physical Sciences

Japan believes in practicals for learners to learn effectively in Physical Sciences. Tetsuo (2016:1), concurs that experiments that demonstrate the principles of Physical Sciences are mostly used. Tetsuo (2016:2) also expresses that practical work which is done in laboratories improves the interests of learners in the subjects. The ensuing interests also serve as a source of motivation to learners in Physical Sciences. The other challenge is on the shortage of qualified teachers in Physical Sciences who could facilitate laboratory investigations. To prepare and conduct proper Physical Sciences experiments, teachers should attend workshops that prepare them for such activities. According to Yoshisuke (2005:6), the Japanese Ministry of Education always intervenes through holding some workshops on the preparation of materials and kits for the experiments.

#### 3.4.2.3 Provisioning of qualified teachers

According to Akani (2015:207), teachers in Japan are not conversant with appropriate and effective methods of instruction. The Ministry of Education in Japan introduced the so-called Practice-based Inquiry Cycles. Practice-based Inquiry Cycles revolve around planning, observation and analysis of live instruction.

Programmes are established in Japan to improve instructional approaches to teaching Physical Sciences in schools. These programmes are organized and sponsored at

different levels. Japan National-Based Lesson Study, Association–Sponsored Lesson Study and Independent Association Study sponsor various programmes to keep teachers in touch with effective instructional methods (Toshiko, 2010:8). Japan has a variety of National subject matter organizations for pre-primary through to university. Learners who are interested in teaching a subject matter are included in these programmes. This is referred to as communal activity where subject teachers plan together and identify long-term goals for learners' development. They plan, observe and reflect on both instructional and extra curricula activities (Tsuneyoshi, 2001:26).

The Japanese government through the Ministry of Education encourages the use of National networks across the country. Teachers are not only entitled to be teachers at schools where they are stationed. Teachers are supposed to improve the current curriculum and instructional methods. It is in these cycles that teachers could talk and debate on how best they could teach Physical Sciences. The Ministry of Education, Culture, Sports, Science and Technology is set to improve teaching and enhancement of pre-service teacher training courses around the universities.

#### 3.4.2.4 The use of technology

Technology is used to enhance the teaching of Physical Sciences in Japan (Yoshisuke, 2005:6). Teachers use different technologies to teach Physical Sciences in classes. Learners also use many technologies to learn concepts in Physical Sciences. According to Yoshisuke (2005:6), the performance of teachers who use Science Technologies remains predominantly very good. Technologies are very much important to make sure that Physical Sciences are effectively taught and learned. The use of videos, televisions, audio devices, computers, advanced microscopes, magnifiers make the learning of Physical Sciences well understood. Technologies also provide practical learning activities for citizens to prepare for lifelong learning (Yoshisuke, 2005:7).

### 3.4.3 Teaching of Physical Sciences in the United Kingdom

This section discussed some strategies that are used in the United Kingdom to enhance the performance of learners in Physical Sciences.

#### 3.4.3.1 Appropriate teaching approaches

There are different teaching approaches that are used to teach Physical Sciences in the United Kingdom. The most recommended teaching approach to teach Physical Sciences in the United Kingdom is the Problem-Based Learning Approach. Problem-Based Learning is an instructional approach where students learn by solving challenging, open ended problems. The problems are authentic tasks and are solved in socially and contextually based teams of students (Stanford University, 2001:6). In Problem-Based learning, learners work in groups to identify and acquire knowledge required to solve the identified problems. Barell (2007:175) expresses that in problem-based, teachers shift from their standard based curriculum from direct instruction of passive students to active engagement of solvers and question askers.

#### 3.4.3.2 Provision of textbooks

For the past 50 years, the United Kingdom has been making attempts to reform the education system for it to be productive. These attempts bore fruits, particularly in England and Wales where the standard of education grew to cutting edge levels. The government in partnership with the private business and industries is committed to improving the standard of education. The education system was reformed to the extent that all elements that enhance learner performance were attended to and made effective (Hansen & Vignoles, 2005:4).

Education in the United Kingdom is comprised of private and public education systems. The two education systems work together to make sure that the standard of education is upheld. They make sure the required resources are provided to improve the content mastery by learners. In this regard, text books are considered a priority.

#### 3.4.3.3 Availability Physical Sciences laboratories

Levitt (2002:16) expresses that most developed countries like the United Kingdom and Wales have good school infrastructure such as class rooms and Physical Sciences laboratories. The laboratories in the United Kingdom are more advanced compared to those in the secondary schools in Kenya and South Africa. The United Kingdom has well equipped laboratories with laboratory assistant technicians. They are also characterised by teachers who are qualified to run laboratories and conduct laboratory activities.

In the United Kingdom, the teaching of Physical Sciences is dominated by Problem-solving learning approach which is based on the experiments and more of laboratory investigations. Learners are always hands-on in their laboratory activities. This has an impact on the performance of learners because learners in Physical Sciences operate through practical work (Levitt, 2002:18).

#### 3.4.3.4 Provision of teachers

Teachers are a precious requirement for the normal implementation of the curriculum. In as far as teacher supply is concerned, the state education is doing enough to provide teachers in the system. However, there is a huge gap between the private sector and the state schools in terms of teacher supply (Hansen & Vignoles, 2005:6). The huge growth of resources in the private sector contrasts strongly with fiscal limitation faced by the state education system. The two education systems differ markedly in both the inputs and the outputs. Such differences are caused by the contrasts regarding the provision of teachers. In 2000, the learner-teacher ratio was at 10:1 in the private sectors compared to 23:1 in state schools (Hansen & Vignoles, 2005:06). In the UK, the provision of qualified teachers is very good compared to what is happening in South Africa and Kenya, where the teacher-learner ratio is at 1:50 and 1:58 respectively.

## 3.5 CONCLUSION

There are various strategies that could be used to enhance learners' performance in Physical Sciences. In this chapter, strategies that enhance learners' performance in Physical Sciences were discussed in detail. Learning styles also play a crucial role in the mastering of concepts by learners in schools. Since learners are unique, they also prefer to learn in different ways. Discussion on Honey-Mumford and Kolb learning styles were discussed in detail as they contribute towards learners' performance.in this chapter, discussion on the performance of learners in Physical Sciences in Kenya, Japan and the United Kingdom was detailed. The focus was on the delivery of Physical Sciences curriculum inclusive of challenges they encounter and the strategies they apply to address such challenges.

# CHAPTER FOUR

# RESEARCH DESIGN AND METHODOLOGY

## 4.1 INTRODUCTION

This chapter presents the research paradigm, research design and research methodology of the study.

## 4.2 RESEARCH PARADIGM

The study is guided by the pragmatic philosophy. Creswell and Clark (2007:802), contend that pragmatism advocates for the use of different research methods, processes and procedures. This is done to obtain both objective and subjective knowledge. Pragmatism advocates for the adoption of mixed methods of research within a single study. In this study, quantitative and qualitative research methods are viewed as a continuum which work to complementary. Quantitative methods measure objective aspects of the phenomenon in question while the qualitative methods focus on the subjective aspects. In this case, the phenomenon of interest is the performance of learners in Physical Sciences. Pragmatism acknowledges the interplay between knowledge and action. Morgan (2014:048) contends that knowledge of the individuals is unique as it would be obtained from unique individuals and their experiences, but such knowledge can also be common because individuals come from socially shared experiences.

## 4.3 RESEARCH DESIGN

Research design refers to the plan and strategy through which the entire research is managed until the results are reported (Taylor, 2005:13). This study adopted the mixed methods research design. Mixed methods research design involves the use of both quantitative and qualitative methodologies. Creswell (2005:510) postulates that mixed

methods research design is a procedure for collecting, analysing and mixing both quantitative and qualitative data in a single study to understand a research problem. In this design, findings from quantitative and qualitative techniques complement each other. Punch (2005:290) points out that mixed methods research design strengthens the results of the study and avoids overlapping of weaknesses. In this study, the researcher used the mixed methods research design because it provides a better understanding of the research problem than when either design is used by itself (Creswell, 2009:510). Through the use of the chosen research design, research methods were effectively integrated. Research techniques, procedures and perspectives employed could also satisfactorily enhance the efficacy of strategies adopted.

## 4.4 RESEARCH METHODOLOGY

The study used the mixed methods. Mixed methods research involves the use of both quantitative and qualitative methods of data collections. Punch (2009:290) posits that mixed research methods is an empirical research approach that involves the collection and analysis of both quantitative and qualitative data as delineated below:

### 4.4.1 Quantitative Research Methods

The study employed surveys in the form of questionnaires to collect quantitative data from the Grade 12 Physical Sciences learners. The researcher used questionnaires because they are more useful in collecting data and opinions from a larger number of participants (Burton & Bartlett, 2009:82). Questionnaires are also reliable since they promote anonymity, encourage greater honesty, they are more economical and time saving (Cohen, Manion & Morrison, 2000:129).

### 4.4.2 Qualitative Research Methods

Qualitative research methods are techniques for gathering data based on the views of the participants in the form of words or texts (Creswell, 2005:39). In this research, interviews were used to generate qualitative research as follows.

#### 4.4.2.1 Interviews

According to Fox (2009:04), interviews are data collection methods in which the researcher asks participants open-ended questions and record their answers. An interview is a dialogue between two people for gathering information about a phenomenon of study (Boyce & Neale, 2005:3). Interviews allow probing and clarification of ideas to collect complete information. In this study, interviews were conducted with Physical Sciences teachers. Through conducting interviews with various participants, the researcher managed to collect large amounts of data which related to teacher knowledge or expertise, effective teaching methods, preferred learning styles of learners, availability of suitable support and challenges encountered in the teaching and learning of physical sciences.

## 4.5 SAMPLING

Sampling is defined by McMillan & Schumacher (2006:121) as a process in which subjects are drawn from a larger population in such a way that the probability of selecting each member of the population is known. In this section, the following aspects were addressed: the population of the study, sampling procedures and sample.

### 4.5.1 Population

Cooper and Schindler (2003:69) define population as a group of interest to the researcher or the group to which the results of the study may ideally be generalised. In addition, McMillan and Schumacher (2001:129) define population as individuals that conform to specific criteria which is used to generalise the results of the research. The population of this research comprised all Grade 12 Physical Sciences learners,

teachers, heads of departments and the principals who are in the Mopani District of Limpopo Province.

### 4.5.2 Sampling Procedures

Both quantitative and Qualitative sampling procedures were used to select the two types of samples as outlined below:

#### 4.5.2.1 Quantitative sampling

Quantitative sampling methods; systematic sampling method, stratified sampling method and simple random sample method were employed to reduce the number of circuits, schools and of learners in the district.

Mopani district has 24 circuits with 253 secondary schools. To reduce the number of the circuits, the researcher made use of Systematic Sampling Method to select 10 circuits from 24 circuits in the districts). As far as Systematic Sampling Method is concerned, every – nth element is selected from a list of all elements in the population (Mc Millan & Schumacher,2006:121). In this case, circuits were allocated numbers from 1 to 24 and have them written on the piece of paper. The first even numbers were considered for selection.

Stratified Sampling Method (SSM) was used to select schools from 253 schools of Mopani district. Schools that are doing Physical Sciences in the district were divided or grouped into the subgroups called the strata. Each school was randomly selected from each of the 10 strata/ subgroups.

100 learners were selected from 10 secondary schools using simple random sampling procedure. In each school, learners converged in the class. The researcher randomly selected 10 learners from each school. The issue of gender was considered to ensure satisfactory representation of each group.

#### 4.5.2.2 Qualitative Sampling

Purposive Sampling Procedure was used to select Physical Sciences teachers. McMillan and Schumacher (2006:475) posit that purposive sampling procedure is a way of sampling that allows the researcher to choose small groups or individuals who are informative about the teaching of Physical Sciences. In this research, Physical Sciences teachers were purposively selected based on whether their schools were selected for research purpose quantitative sampling. This means that teachers in schools selected in quantitative sampling were all selected.

### 4.5.3 Samples

A sample is a group of units which is selected from the population and is thus less than the population, while remaining as representative as possible (Mulder, 2000:55). Both quantitative and qualitative samples were presented as indicated below.

#### 4.5.3.1 Quantitative sample

Quantitative sample comprised 100 Grade 12 learners

#### 4.5.3.2 Qualitative Sample

The qualitative sample was made of 10 teachers.

The total sample was made up of 110 participants.

## 4.6 INSTRUMENTATION

Instrumentation refers to the tools used by a researcher or an investigator to measure variables or items of interest in data collection. It is not only related to instrument design, selection, and assessment, but also to the conditions under which the designated instruments are administered (Hsu & Sandford, 2012:2). This section detailed how quantitative and Qualitative data instruments were developed.

### 4.6.1 Quantitative Data Collecting Instrument

The research employed the use of survey wherein questionnaire was adapted to collect quantitative data from Grade 12 Physical Sciences learners. Questionnaire was designed and developed by the researcher. The instrument was divided into two sections: Section1 focused on collecting biographical data from Physical Sciences learners. Section 2 of the questionnaire had 24 questions that were designed to collect data related to the performance of Grade 12 learners in Physical Sciences. The section was designed Linkert scale where respondents were expected to indicate by an **X** the appropriate space that best suit their answers from A = Agree, SA = Strongly Agree, UD = Undecided, D = Disagree and SD = Strongly Disagree.

### 4.6.2 Qualitative Data Collecting Instrument

Interview schedules were developed to collect data from Physical Sciences teachers.

#### 4.6.2.1 Appendix B: Interview Schedule: Physical Sciences Teachers Views on the enhancement of learners' performance.

The interview schedule used to collect data from the Physical Sciences teachers was made of two sections. Section 1 sought to gather the participants' bibliographical information that included gender, age, experience as Physical Sciences teachers and qualifications. Section 2 had Six questions that sought to gather information related to the participants' views concerning effective teaching of Physical Sciences.

## 4.7 PILOTING THE RESEARCH INSTRUMENTS

Piloting of the research instruments was conducted in two secondary schools which were not part of the study in Mopani District. Piloting was conducted in order to check the validity and reliability of the instruments. (Cohen, 2008:234) posits that for the validity and reliability of data collection instruments to prevail, the instruments should be

verified to make sure that they measure what they are meant to measure and to ensure that there is consistency in the data collection instruments.

To achieve this, pilot-testing had been administered before the instruments were used in the actual investigation. This was to ensure that errors of whatever nature were noticed and rectified before the actual data could have been collected. Piloting the instruments enabled the researcher to eliminate ambiguous, biased and vague questions.

Both questionnaire and the interview schedules were piloted. During piloting of instruments, the following errors were discovered;

- Some questions in the instruments were repeated
- Same questions were asked more than once in different ways.
- Some of the questions were ambiguous, biased and vague.
- The research instruments contained many questions causing the interview to take a long period to administer.

## 4.8 ADAPTION OF RESEARCH INSTRUMENTS

The researcher discussed the errors that were discovered through piloting of the instruments with the promoter. Identified errors were rectified and the final research instruments were adapted.

## 4.9 DATA ANALYSIS

Two types of data analyses were employed; quantitative data analysis and qualitative data analysis as outlined below:

### 4.9.1 Quantitative Data

Quantitative data were analysed through the Statistical Package for Social Sciences (SPSS) Software Version 25.

### 4.9.2 Qualitative Data

Qualitative data were analyzed thematically. The tape-recorded interviews were transcribed, and the transcripts were analysed using codes and themes.

## 4.10 CONCLUSION

The following issues were discussed in detail in this chapter: Pragmatism was employed in this study to guide the research endeavour. Mixed methods research design which allows for the complementary use of quantitative and qualitative methods, processes and procedures was discussed as the design that was used in the research. Simple random sampling techniques was employed to generate a quantitative sample whereas purposive sampling technique was adopted to select a quantitative sample for the study. The research used questionnaires to collect numerical research data and a structured interview to generate qualitative data. Quantitative data were analysed through the statistical Package for the Social sciences (SPSS) version 25. Qualitative data were analysed thematically. Research instrumentation and adaptions of the instruments were included in the discussion.

# CHAPTER FIVE

# DATA ANALYSIS AND INTERPRETATION

## 5.1 INTRODUCTION

This chapter presents, data analysis and interpretation on how learners' performance can be enhanced. Two sets of data, namely quantitative and qualitative were analysed.

## 5.2 ANALYSIS AND INTERPRETATION OF QUANTITATIVE DATA

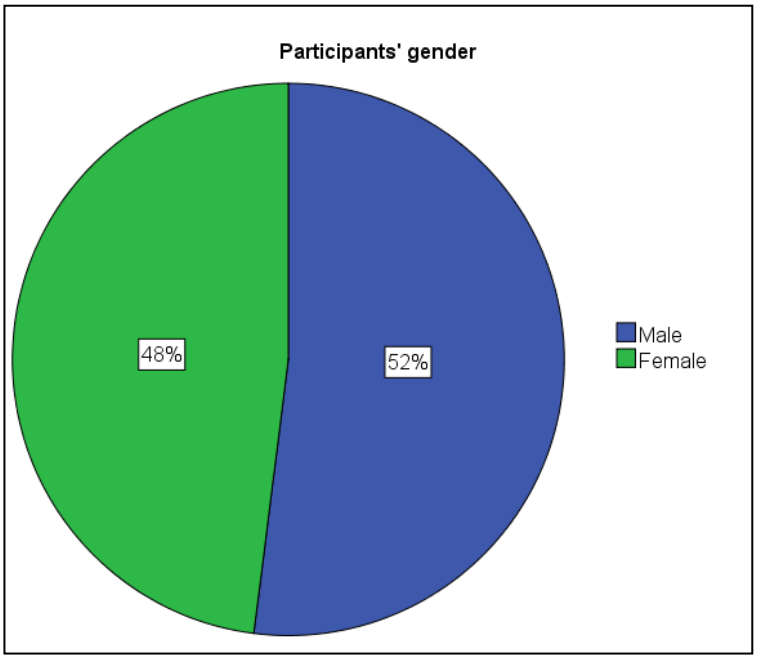
Questionnaires were administered to Grade 12 Physical Sciences learners to solicit their views about how the learners' performance in Physical Sciences can be enhanced. Questionnaires were comprised of two sections: Section 1 solicited information pertaining to the demographical data of participants. Section 2 focused on contextual information relating to the enhancement of learners' performance in Physical Sciences. In Section 2, the participants had to decide on whether each given statement defines how they view themselves in the teaching and learning of Physical Sciences by making a choice on the Five Point Likert Scale consisting of the Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree.

### 5.2.1 Section 1: Demographical Data

This section analysed the demographical information of participants.

#### 5.2.1.1 Distribution of Learners by Gender

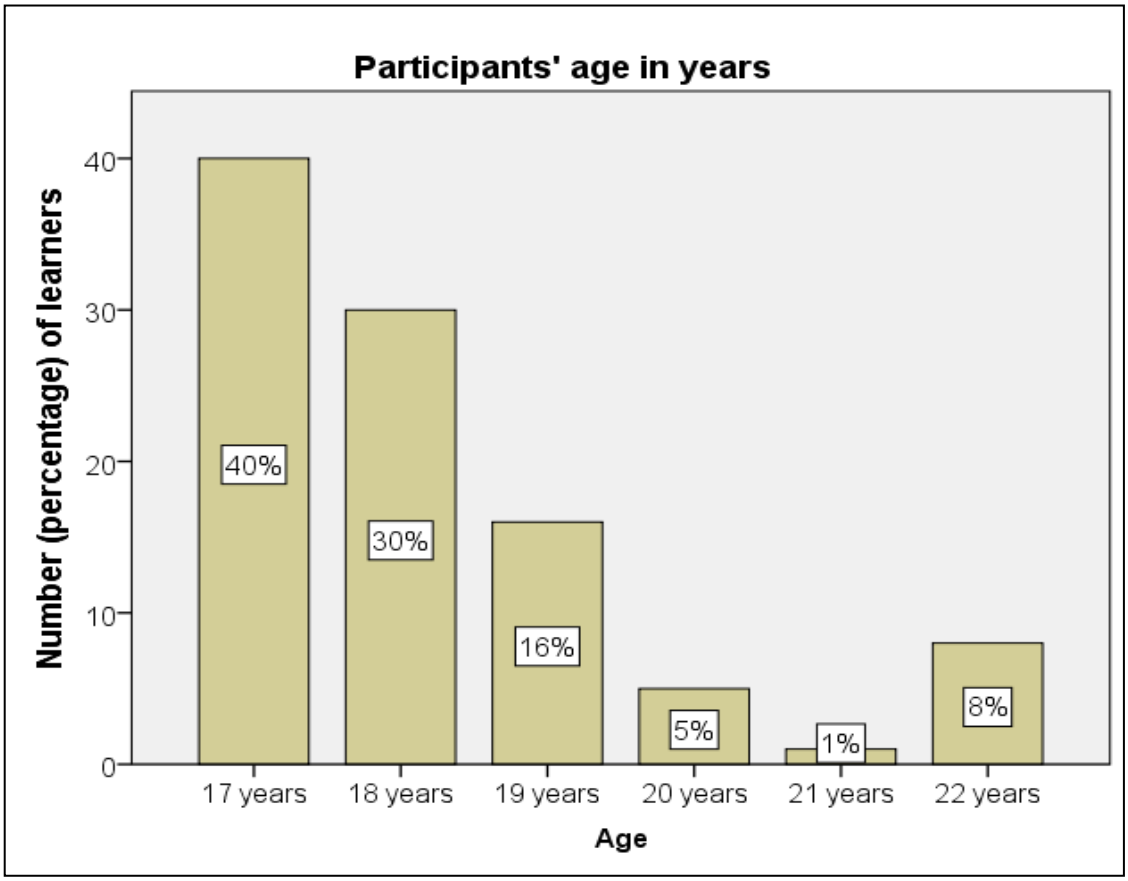
100 learners participated in the study. 48 (48%) of the learners who participated in the study were females and 52 (52%) of them were males. The high number of male participants by 52% indicates that most male learners take Physical Sciences as their major subject.




**Graph 5.1 Distribution of Learners by Gender**

#### 5.2.1.2 Distribution of Learners by Age

Graph 5.2. shows the age difference of learners who participated in the study. 100 participants responded to questionnaire items. 40% of the participants were 17 years, 30% were aged 18, 16% were 19 years old, 5% were 20 years and 1% was aged 21. 8% of the participants were aged 22 years. This indicates that the number of learners who were doing Grade 12 Physical Sciences at the recommended age were 40%. Probably 60% of learners repeated a grade or grades during study. This also indicates that some learners find the learning of Physical Sciences difficult which prevents them from completing Grade 12 in the recommended time. Participants' responses are presented in Graph 5.2.




**Graph 5.2: Distribution of Learners by Age**

## 5.3 AN INVENTORY OF GRADE 12 LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES

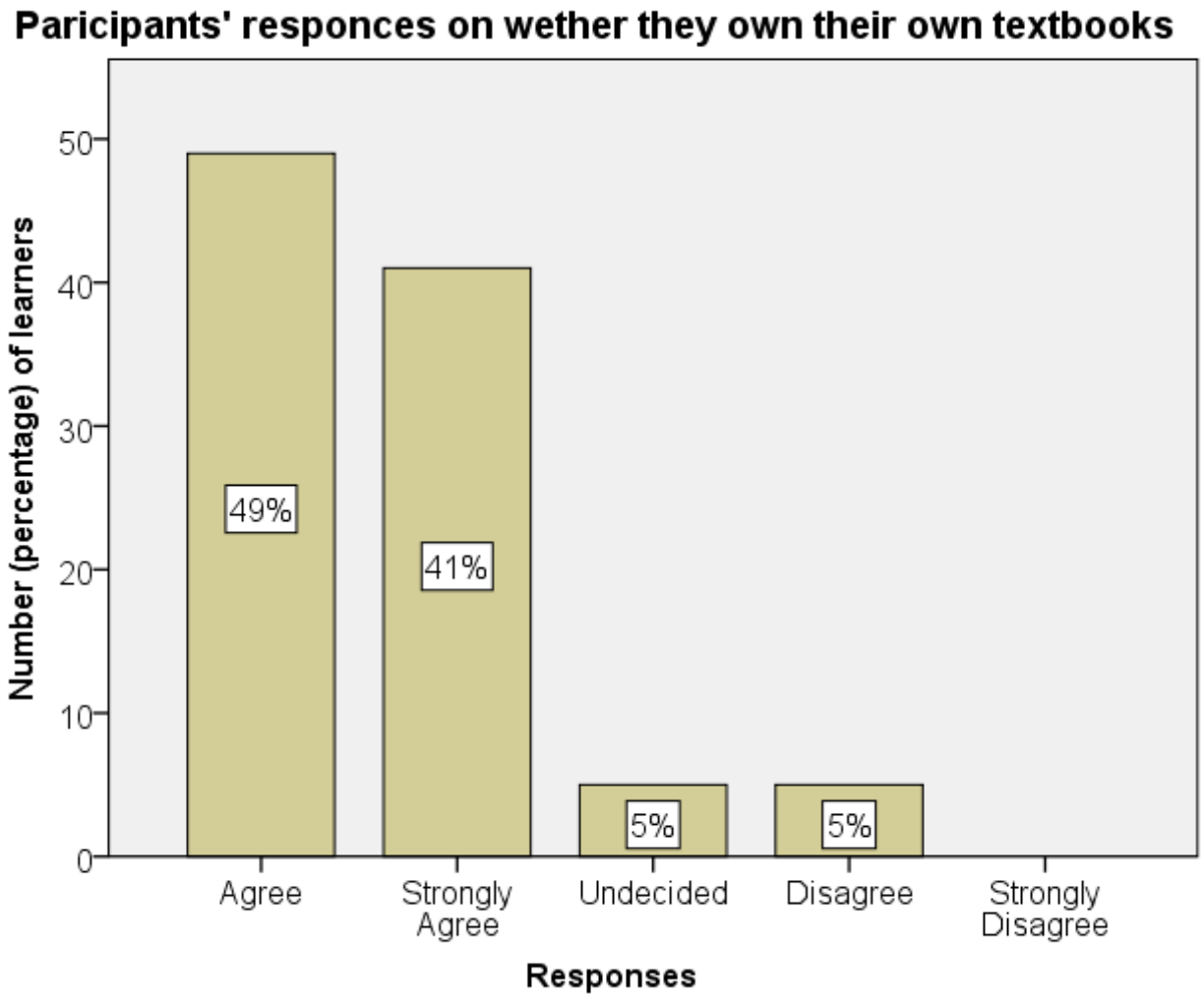
The section, analysed and interpreted quantitative data regarding the enhancement of learners' performance in Physical Sciences. Data was analysed based on the availability of text books, laboratory investigations, the use of technology, educational fieldtrips, measures to enhance content mastery, learning styles and parental involvement.

### 5.3.1 Learners use their own Physical Sciences Text Books

Participants generally indicated the importance of textbooks in the learning of Physical Sciences. 49 (49%) agreed that they have their own Physical Sciences text books. On

the same note, 41 (41%) strongly agreed, 5 (5%) were undecided whereas 5 (5%) disagreed with the statement. This shows that most participants had their own text books. It also means that the participants did not share text books. The adequacy and the use of text books helps learners to easily understand the subject.

Studies confirm that text books play a significant role in learning. Studies showed that a classroom that is well-resourced with adequate suitable text books is conducive for positive facilitation of lessons in schools. Physical Sciences teachers and learners can finish their syllabus well ahead of time when text books are adequate (See Sub-section 3.3.3.2.1). This is because with textbooks, learners can study and revise at any time at home and at school. Literature also indicates that adequate text books enable teachers to utilise the text book teaching method. This method improves teachers' flexibility and it also provides learners with new information direct from the source (See Sub-section 3.3.3.2.1). The participants' views are presented in Graph 5.3.

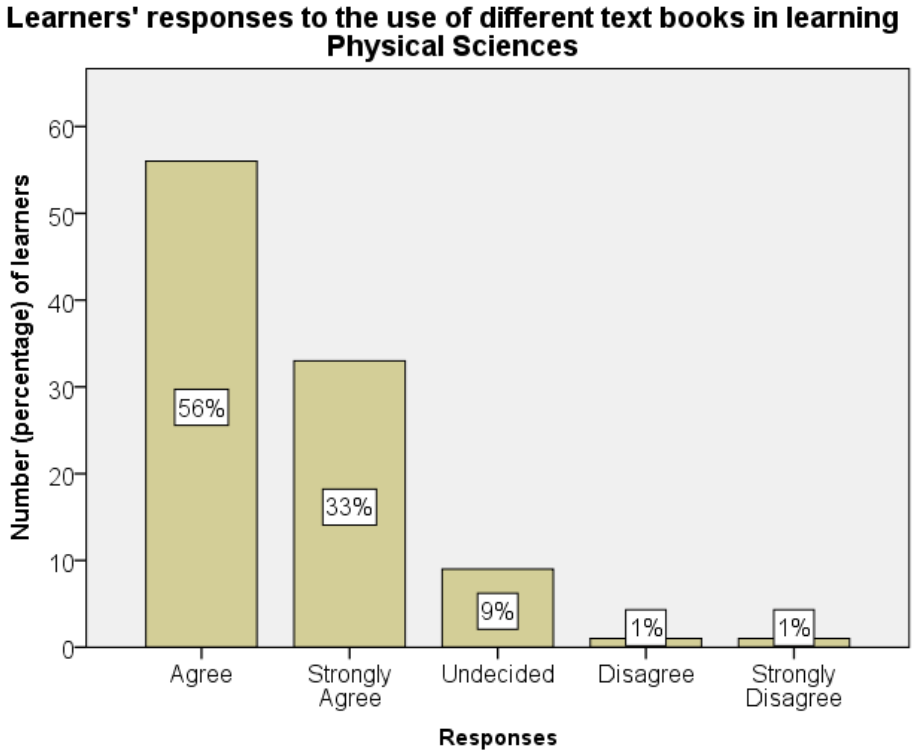



**Graph 5.3: Learners have their own Physical Sciences Text Books**

### 5.3.2 There are Other Text Books for Use to study Physical Sciences

Participants were requested to indicate whether they used different types of text books to understand Physical Sciences concepts. 56 (56%) agreed that they used different types of text books in their Physical Sciences lessons. 33 (33%) strongly agreed, 9 (9%) were undecided and 1 (1%) disagreed. Only 1 (1%) participant strongly disagreed that different text books are used in Physical Sciences lessons. The responses reveal that most participants (89%) use different text books to enhance their understanding in

the subject. Literature indicates that the use of different textbooks is important. Learners value the use of different text books and they use them more frequently and intensively to prepare for their lessons. The use of different text books assists learners to do their class activities and home activities (Sub-section 2.3.1.2.1). The responses of participants are presented in Graph 5.4.

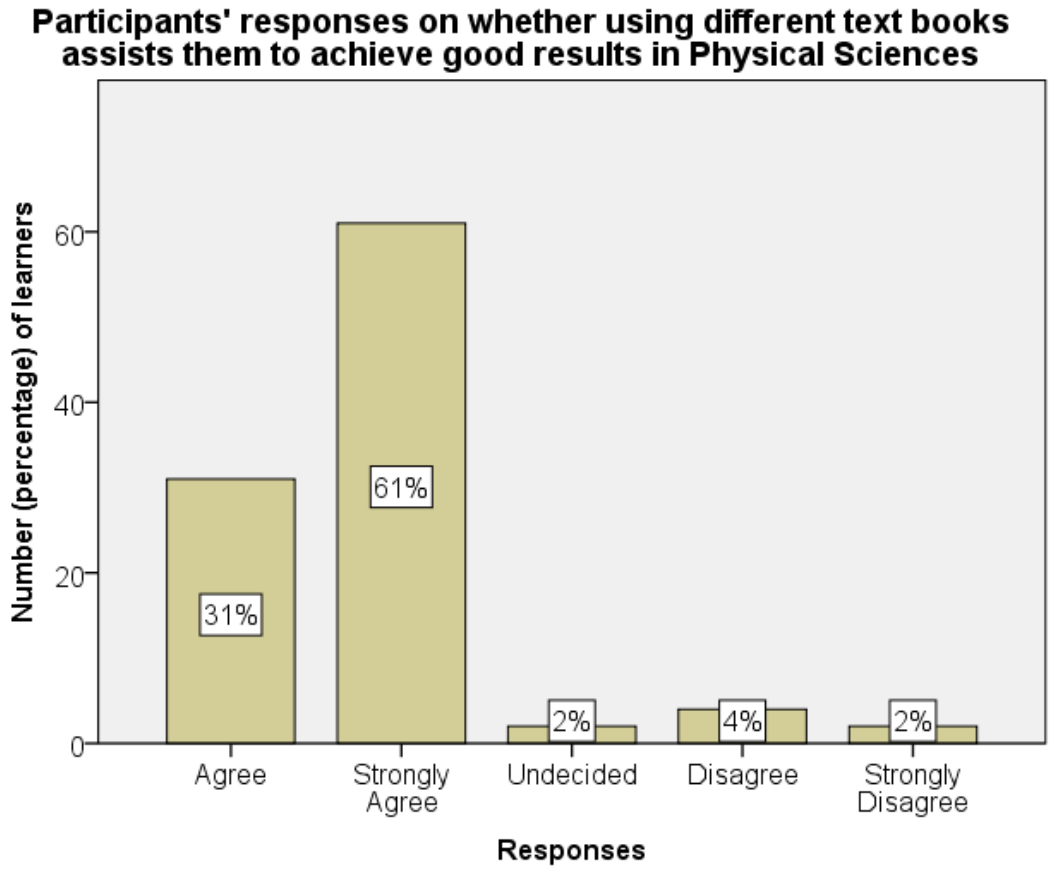



**Graph 5.4: Availability of Other Text Books in Physical Sciences**

### 5.3.3 Different Text Books Assist Learners to Achieve Good Results in Physical Sciences

Participants generally agreed that they use different textbooks in the teaching and learning of Physical Sciences. 31 (31%) participants agreed, 61 (61%) strongly agreed, and 2 (2%) were undecided. On the same note, 2 (4%) participants disagreed that they use different textbooks in learning Physical Sciences. The remaining 2 (2%) strongly disagreed. This shows that most participants (92%) were assisted by using different text books in the learning of Physical Sciences. Literature reveals that the use of

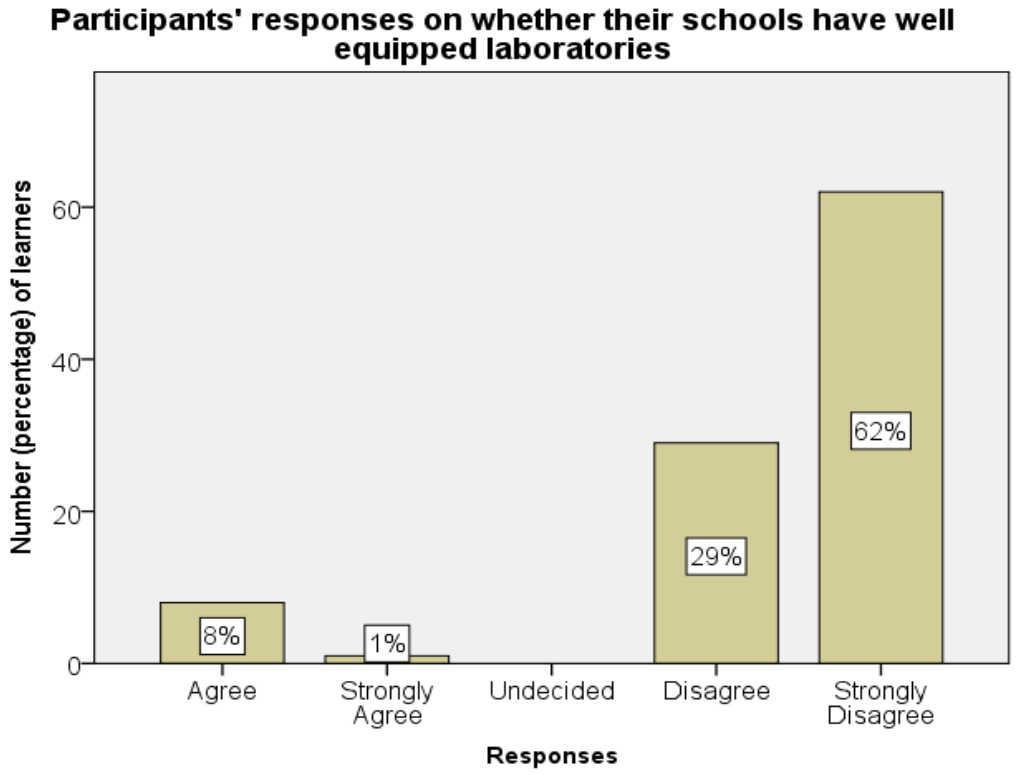
different textbooks is very important as it has the potential to improve learners' experiences in Physical Sciences. The use of various text books helps learners to obtain adequate information from many sources (Sub-section 3.2.9 p.70). The responses of participants on this questionnaire item are shown in Graph 5.5.




**Graph 5.5: The use of Different Text Books Assist Learners to Achieve Good Results in Physical Sciences**

### 5.3.4 Availability of Well-equipped Laboratories

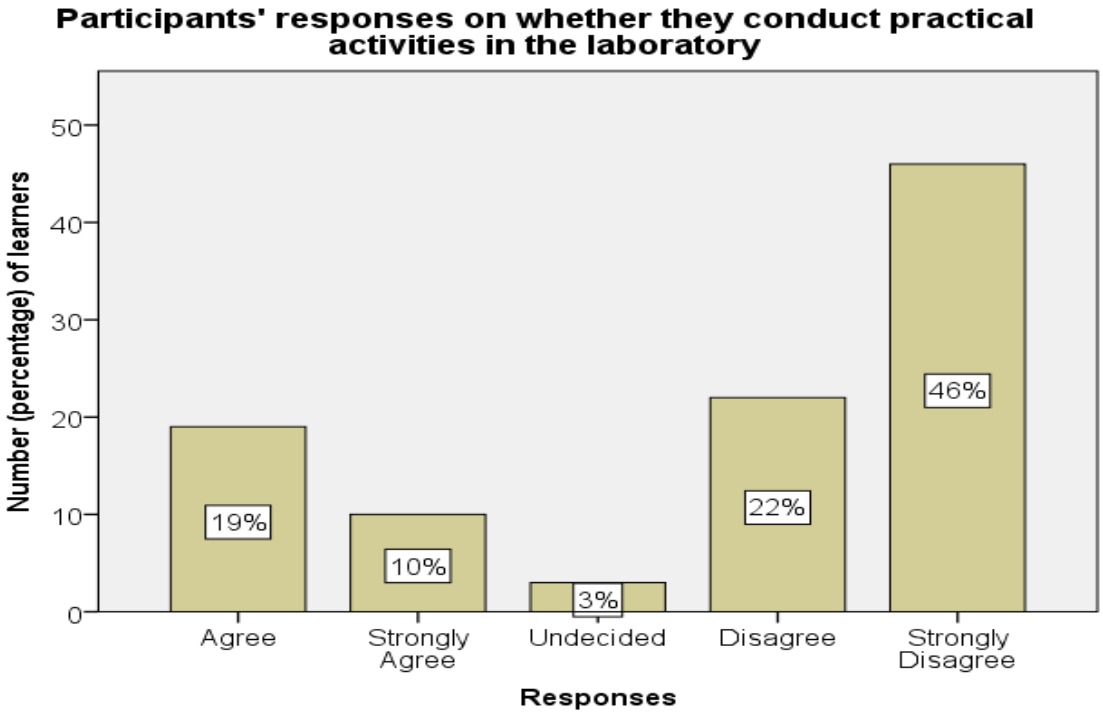
Participants were requested to provide their views on the extent to which they agree or disagree whether their schools have well equipped Physical Sciences laboratories. 8 (8%) participants agreed that they have well equipped laboratories, 1 (1%) strongly agreed, 29 (29%) disagreed and 62 (62%) strongly disagreed. In responding to this statement, 29 (29%) disagreed and 62 (62%) strongly disagreed, making a total of 91 (91%) participants who denied the existence of well-equipped laboratories in their schools. This implies that there are challenges to effective teaching and learning of Physical Sciences owing to ill equipped laboratories in schools. The findings contradict literature which states that laboratory activities give learners an opportunity to explore in Physical Sciences and help learners to have a good understanding of content knowledge, skills to use the laboratory as well as conduct investigations (Sub-section 3.2.7). The participants' views are presented in Graph 5.6 below:




**Graph 5.6: Availability of Well-equipped Physical Sciences Laboratory**

### 5.3.5 Conducting Practical Activities in the Laboratory

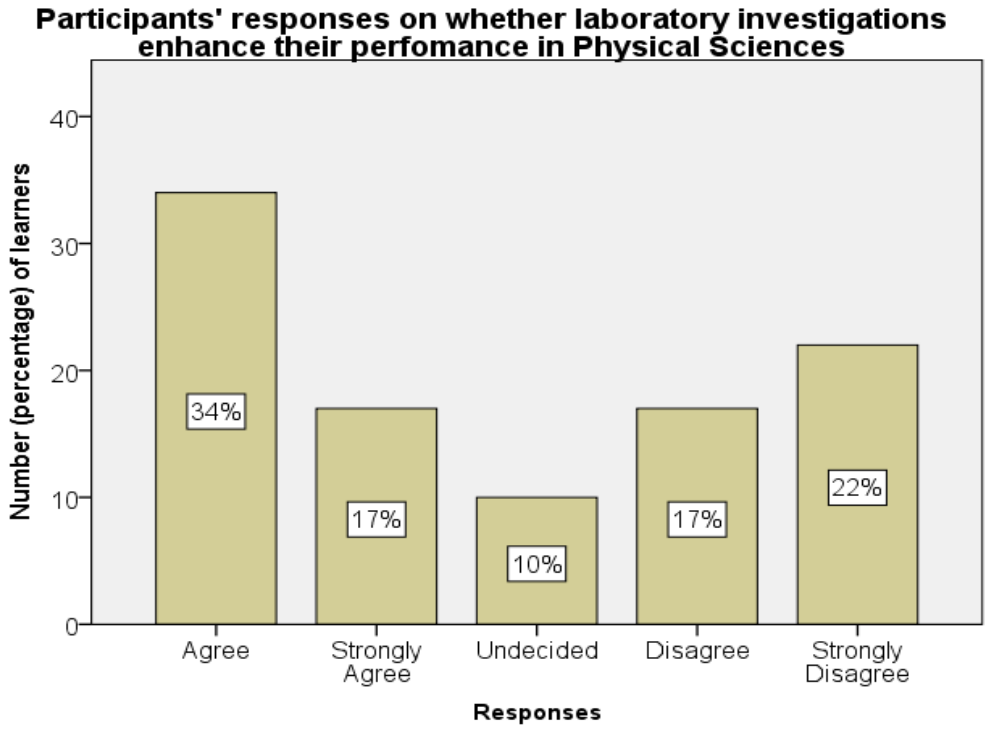
Participants were requested to provide their views on whether they conduct practical activities in Physical Sciences laboratory. In this regard, 19 (19%) participants agreed, 10 (10%) strongly agreed and 3 (3%) were undecided. 22 (22%) participants disagreed that they conduct Physical Sciences practical activities in the laboratory. The remaining 46 (46%) strongly disagreed. In total 68 (68%) confirmed that they were not conducting Physical Sciences activities in the laboratory. This contradicts literature which asserts that laboratory activities provide learners with content knowledge and skills to use the laboratory and conduct scientific investigations. Learners benefit through interactions, hands on activities and applications which foster creativity in Physical Sciences. Teachers' knowledge and expertise in Physical Sciences is important for learners to diligently understand and perform laboratory activities (See Sub-section 3.2.8). Studies also confirm that laboratory activities play a role in the effective teaching and learning of Physical Sciences (See Sub-section 3.2.7). The views of the participants are presented in Graph 5.8 below:




**Graph 5.7: Conducting Practical Activities in the Laboratory**

### 5.3.6 Laboratory Activities Enhance Performance of Learners

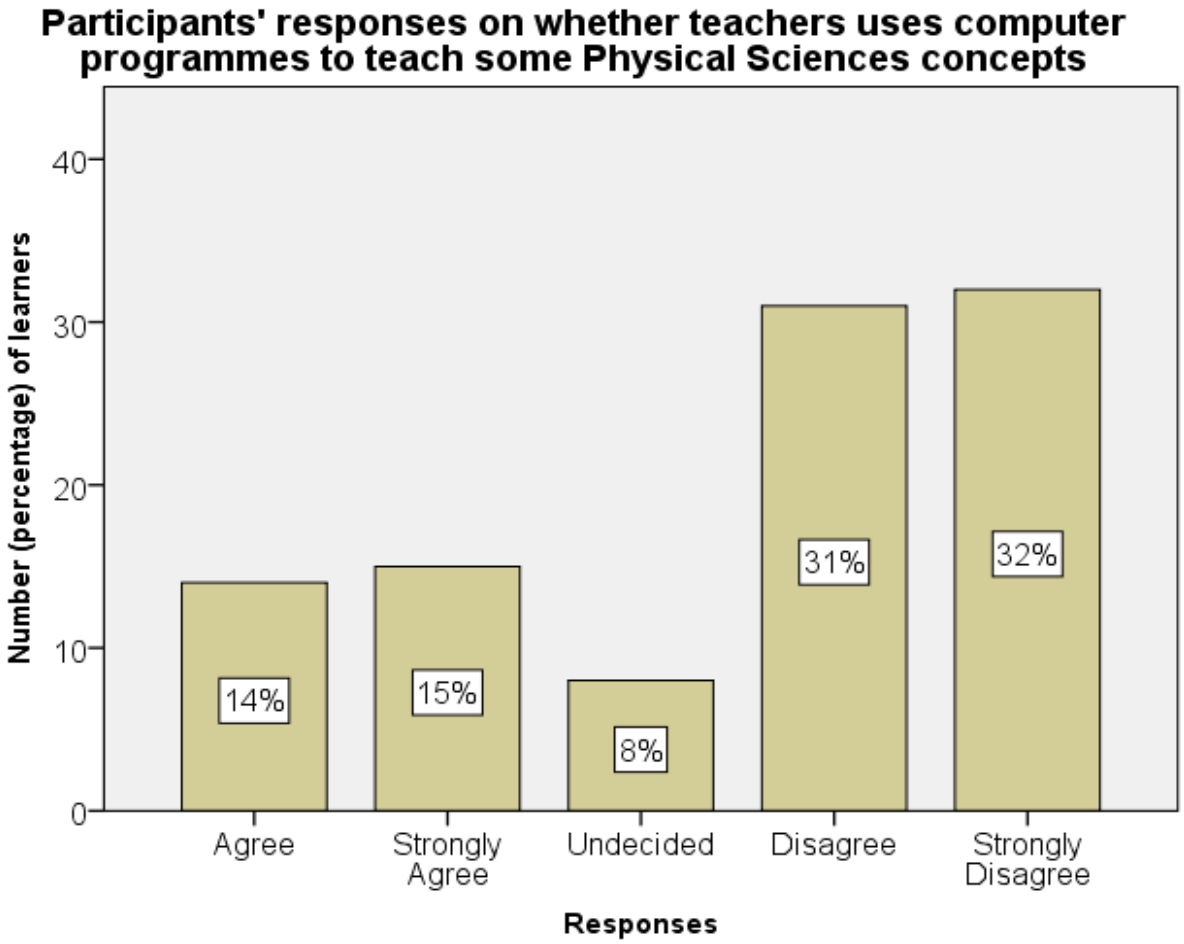
Participants were requested to provide their views on whether laboratory investigations enhance learners' performance in Physical Sciences. 34 (34%) participants agreed, 17 (17%) strongly agreed. 10 (10%) were undecided. 17 (17%) participants disagreed and the remaining 22 (22%) strongly disagreed. The results show that most participants (51%) view laboratory investigations as of crucial importance in the enhancement of their performance in Physical Sciences. Laboratory activities provide learners with the understanding of the content knowledge, skills to use the laboratory and to conduct scientific investigations (Sub-section 3.2.7). Literature states that laboratory activities provide learners with the understanding of the content knowledge, skills to use the laboratory and to conduct scientific investigations (Sub-section 3.2.7). The views of the participants are presented in Graph 5.8.




**Graph 5.8: Laboratory Investigations Enhance Learners' Performance**

### 5.3.7 Use of Computer Programmes to Teach Concepts

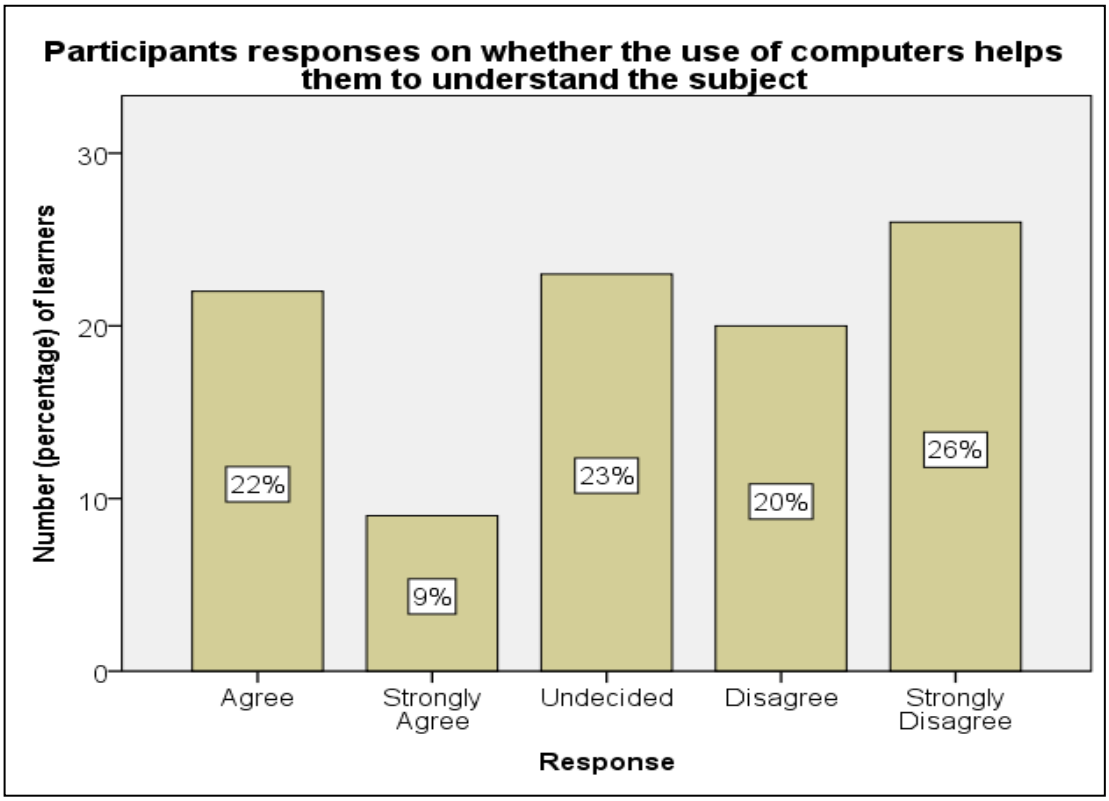
Participants were requested to provide their views on whether their teachers use computer programmes to teach them some Physical Sciences concepts. 14 (14%) participants agreed that teachers use computer programmes, 15 (15%) strongly agreed whereas 8 (8%) were undecided. On the same note 31 (31%) participants disagreed to this questionnaire item and 32 (32%) strongly disagreed. These results showed that most learners (64%) are not exposed to the use of computer programmes by their teachers to assist them in understanding concepts in Physical Sciences. This contradicts literature which contends that computers expose learners to some research tools and datasets that are used by scientists in the field (Sub-section 3.2.4). Learners cooperate in certain computer environments like Computer Based Instruction (CBI) which also give teachers the potential to individualise instruction according to the demands of learning tasks, processing requirements and to monitor the ongoing performance of learners (See Sub-section 2.2.4). The responses of participants in this regard are presented in Graph 5.9.




**Graph 5.9: Teachers use Computer Programmes to teach Physical Sciences**

### 5.3.8 The Use of Computers Helps Learners to Understand

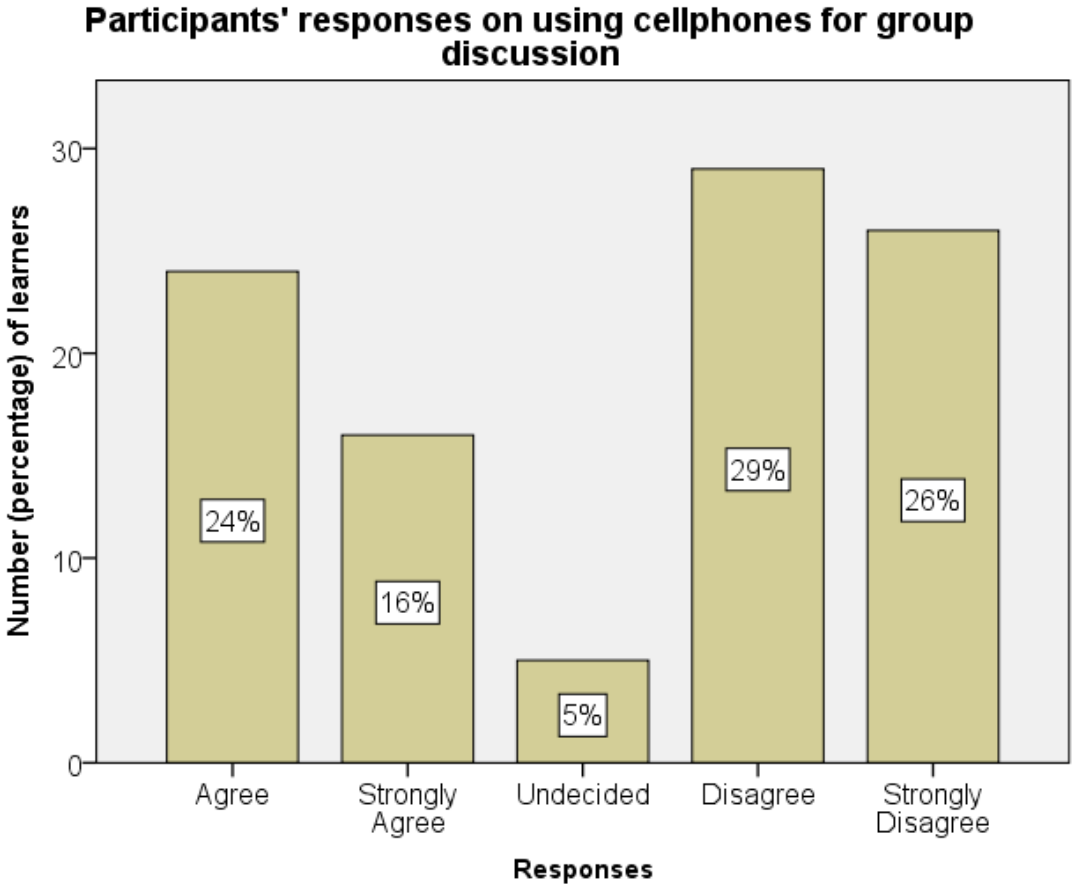
In responding to this questionnaire item, 22 (22%) participants agreed, 9 (9%) strongly agreed whereas 23 (23%) were undecided. 20 (20%) disagreed and 26 (26%) strongly disagreed. Altogether, 46 (46%) participants rejected the view that computers help learners to understand Physical Sciences. This contradicts literature which states that computer–supported learning uses instructional methods that are designed to encourage learners to work together on learning tasks (See Sub-section 3.2.4). The use of computers enables both learners and teachers to access information and other learning materials through google searches and other internet connections to enhance learning (Sub-section 3.2.4). The participants' views are presented in Graph 5.10.




**Graph 5.10: The use of Computers Helps Learners to Understand**

### 5.3.9 The Use of Social Networks for Group Discussions

The participants were requested to provide their views as to whether they use cellphones' social networks for group discussions with their classmates. In responding to the questionnaire item, 24 (24%) participants agreed that they use social networks for group discussions, 16 (16%) strongly agreed and 5 (5%) were undecided. 29 (29%) participants disagreed whereas 26 (26%) strongly disagreed. This shows that majority of 55 (55%) participants denied using cell phones to engage in group discussions with their classmates. To enhance learners' interest and attitude in learning of Physical Sciences, mobile learning (m-Learning) serves as a good measure to motivate learners to learn. Participants' views are presented on Graph 5.11.

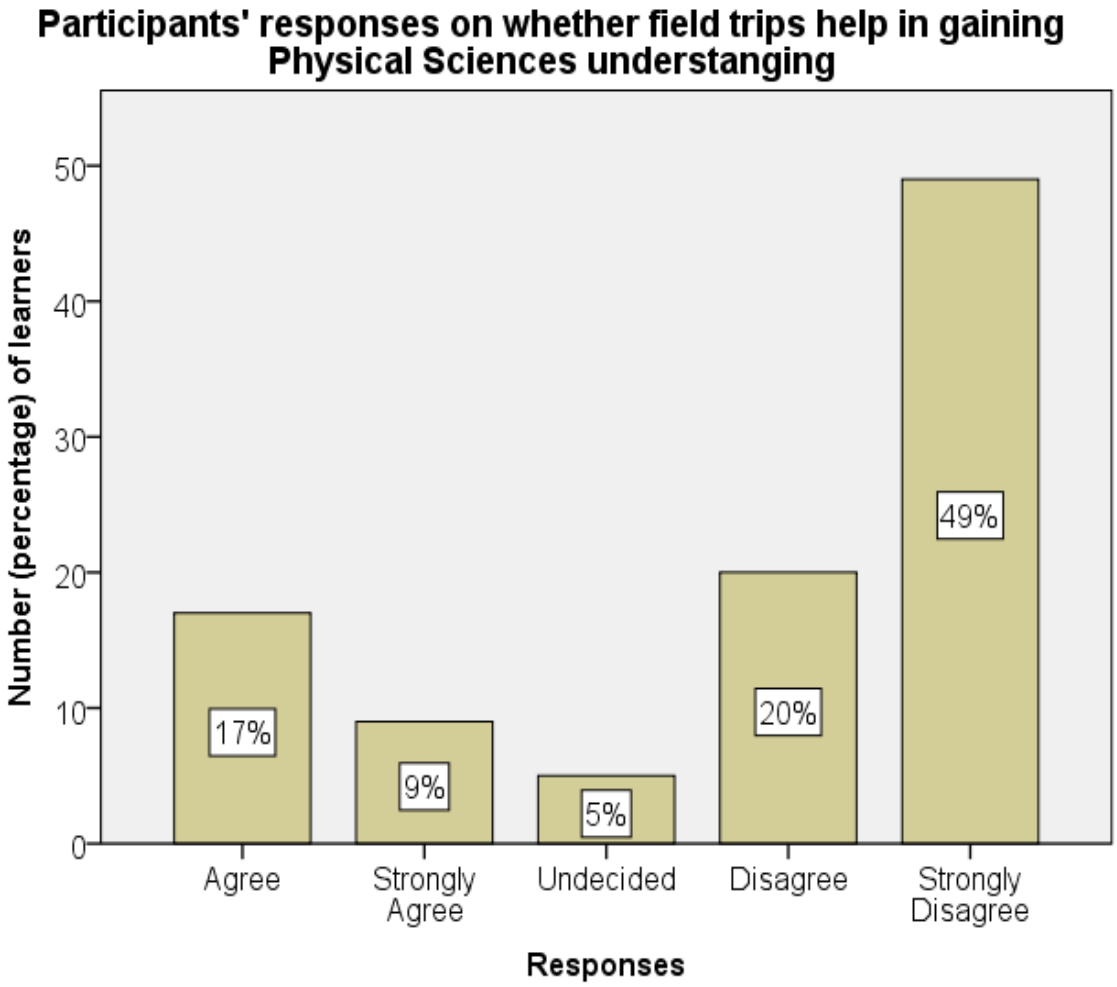



**Graph 5.11: Learners' Use Cell Phones for Group Discussions**

### 5.3.10 Fieldtrips help Learners to Understand Physical Sciences

The participants were requested to respond on whether fieldtrips help them to gain an understanding of Physical Sciences. 17 (17%) participants agreed, 9 (9%) strongly agreed and 5 (5%) were undecided. On the same note, 20 (20%) of participants disagreed whereas 49 (49%) strongly disagreed that fieldtrips improve their understanding of Physical Sciences. In total, 69 (69%) participants showed that fieldtrips do not assist learners to understand Physical Science subject content. This is partly consistent with literature which indicates that some teachers are not able to organise fieldtrips to effectively benefit learners. In the same vein, literature also states that educational fieldtrips are useful as sources of excitement, allow learners to interact

with one another outside the classroom environment to discuss, debate and share common understanding. Participants' views are presented in Graph 5.12.

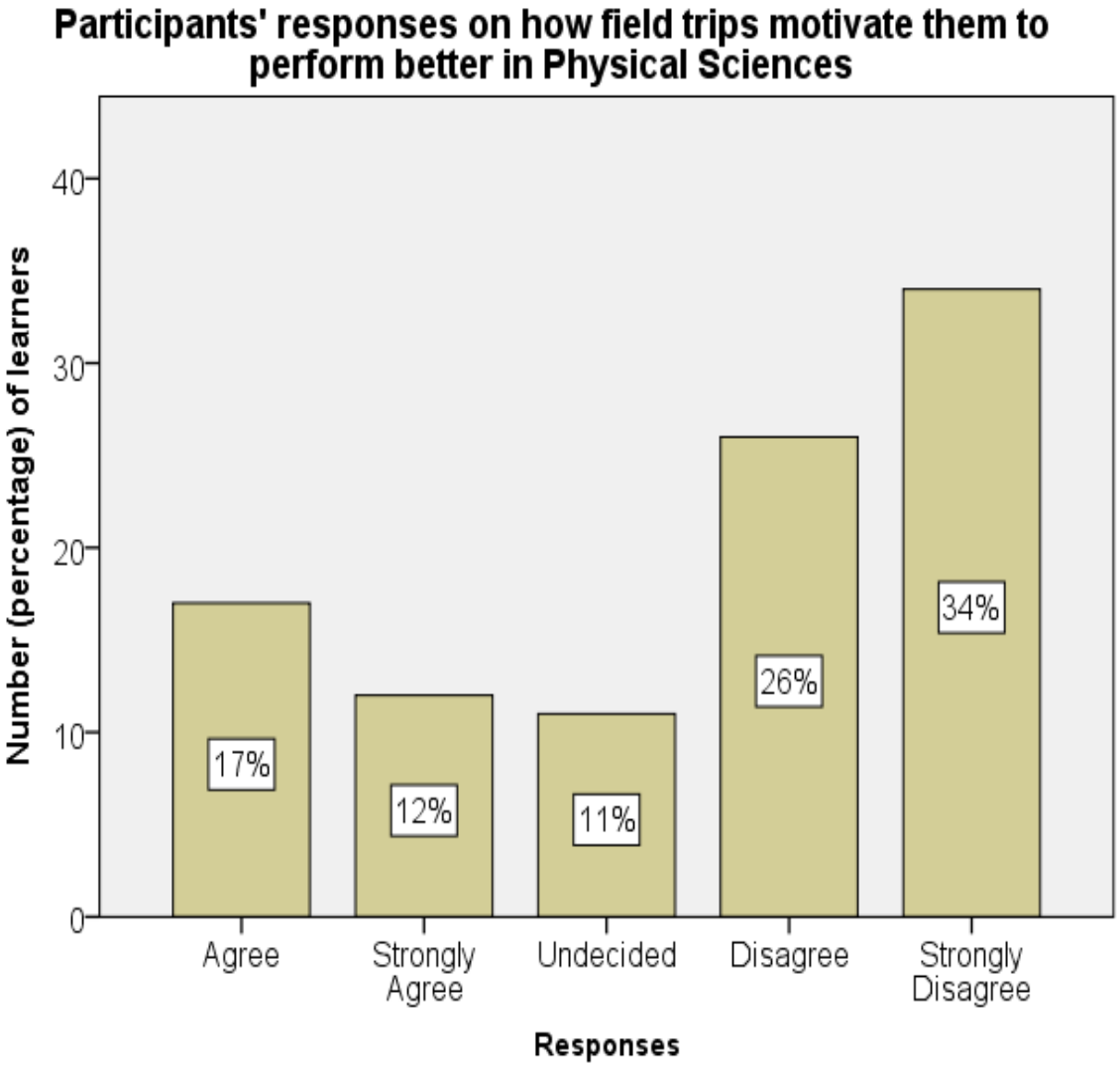



**Graph 5.12: Field Trips Help Learners to Understand Physical Sciences**

### 5.3.11 Field Trips Help Learners to Perform Better

The views of participants were solicited on whether fieldtrips help them to perform better in Physical Sciences. 17 (17%) participants agreed, 12 (12%) strongly agreed and 11 (11%) were undecided. 26 (26%) of participants disagreed and 34% strongly disagreed. This indicates that majority of 60 (60%) participants were generally not helped by fieldtrips to perform better in Physical Sciences. This contradicts literature

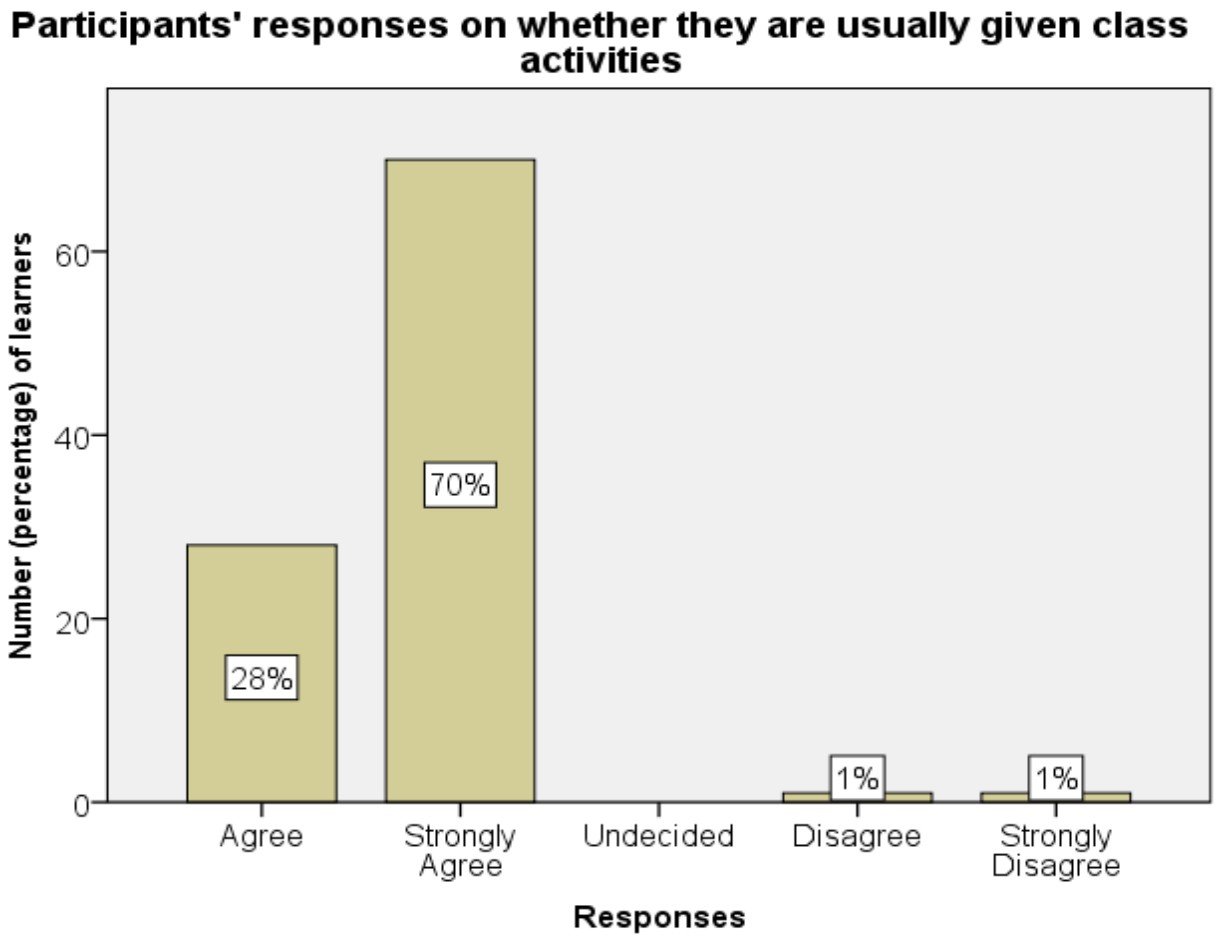
which states that excursions or fieldtrips help learners to engage in Physical Sciences programmes in real contexts (See Sub-section 3.2.1). In schools, learners learn a series of scientific concepts before visiting local industrial partners to see how the scientific concepts are applied in life (See Sub-section 3.2.10).




**Graph 5.13: Fields Trips Help Learners to Perform Better in Physical Sciences**

### 5.3.12 Teachers Regularly Give Learners Class Activities

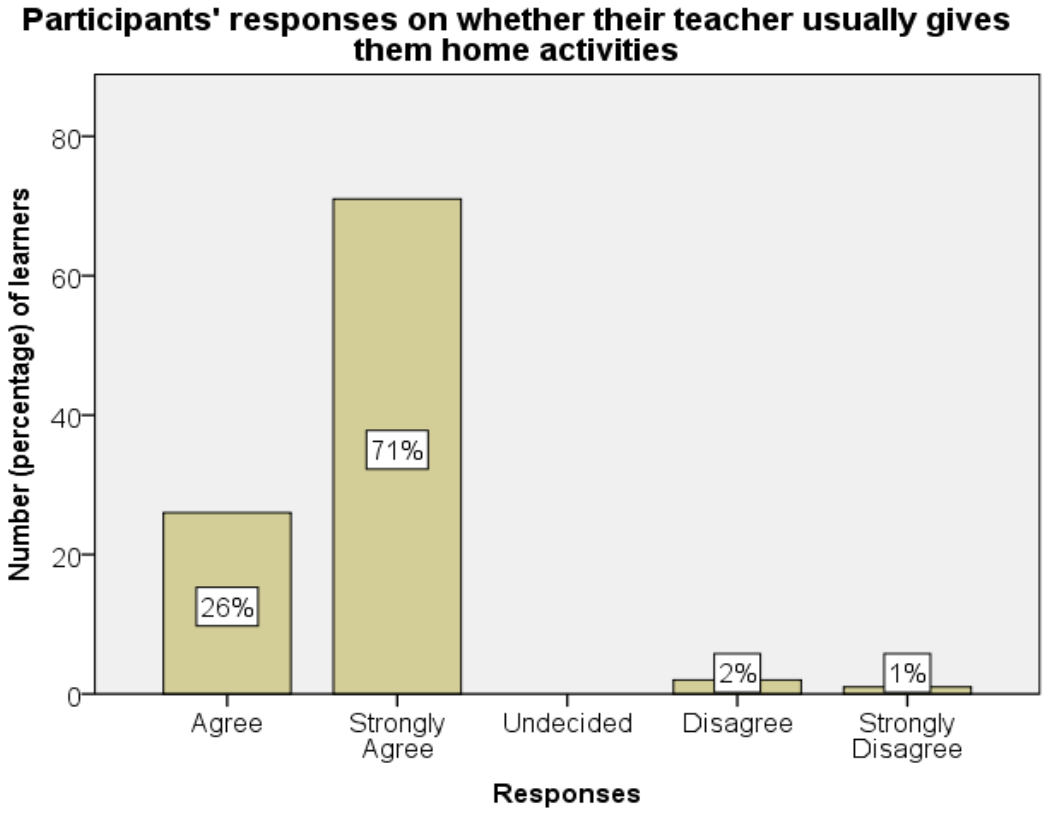
In response to this questionnaire item, 28 (28%) participants agreed that their teachers usually gave them class activities that enhance their understanding of Physical Sciences. 70 (70%) strongly agreed, 1% disagreed and the remaining 1% strongly disagreed. Most participants, that is, 98%, confirmed being regularly given class activities that enhance their understanding by their teachers. The literature contends giving learners activities that enhance understanding in the subject is crucial for learner performance. Assessment assists to ensure that teaching and learning are effective in class (Sub-section 3.2.9.2.3). Participants' views are presented in Graph 5:14.




**Graph 5.14: Teachers Regularly Give Learners Class Activities**

### 5.3.13 Teachers Usually Give Learners Home Activities

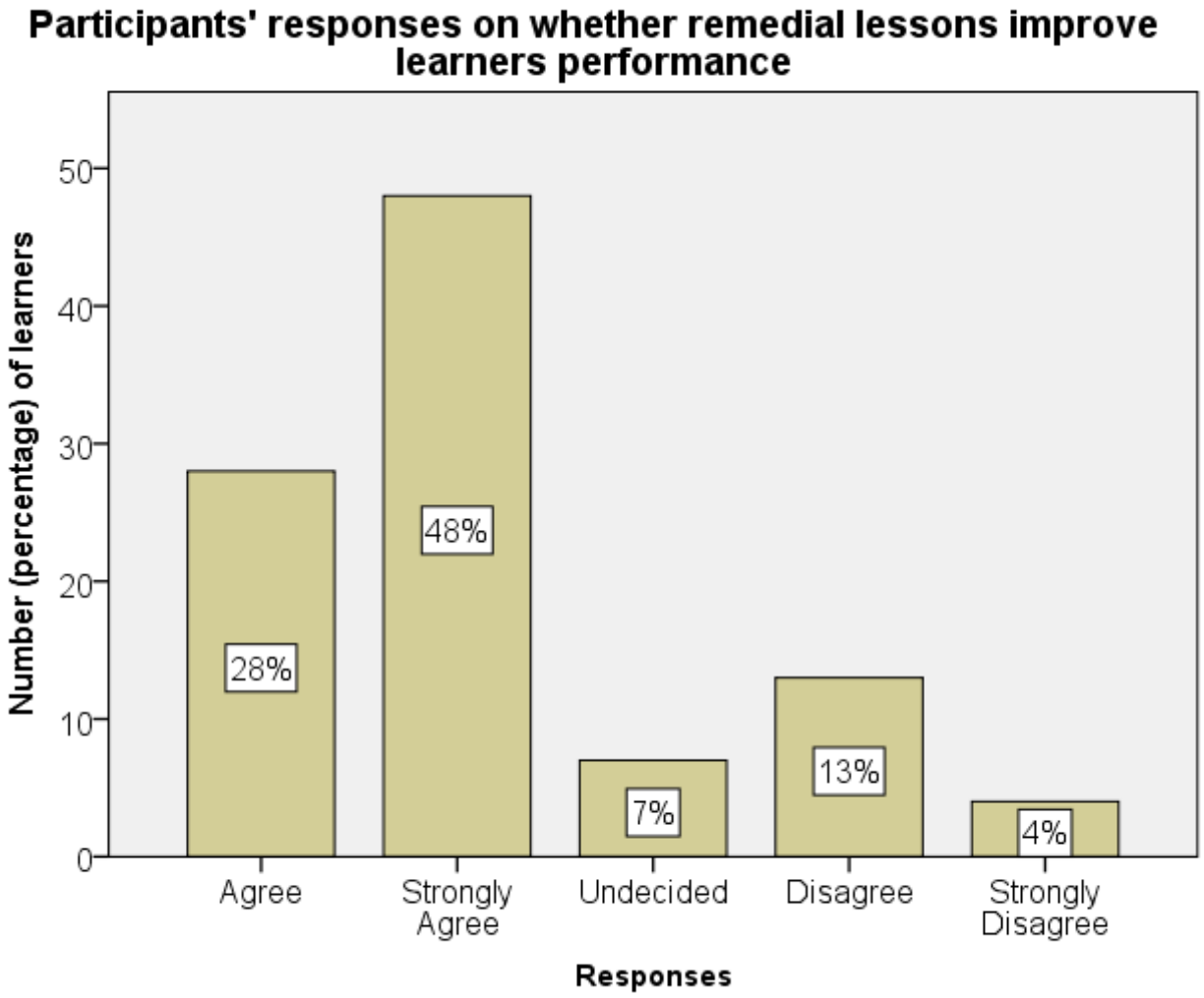
Participants were requested to provide responses on whether teachers give them home activities that enhance their understanding of Physical Sciences. In response to this statement, 26 (26%) participants agreed, 71 (71%) strongly agreed 2 (2%) participants disagreed and only 1 (1%) strongly disagreed. The outcome reflects that majority of 97 (97%) participants confirmed being given home activities to enhance performance in Physical Sciences. This is consistent with literature which shows that assessment is imperative because it is a diagnostic means of providing feed-back to teachers and learners over the course of instruction (3.2.9.2.3). Participants' views are presented in Graph 5.15.




**Graph 5.15: Teachers Usually Give Learners Home Activities**

### 5.3.14 Extra Lessons Improve Learner Performance

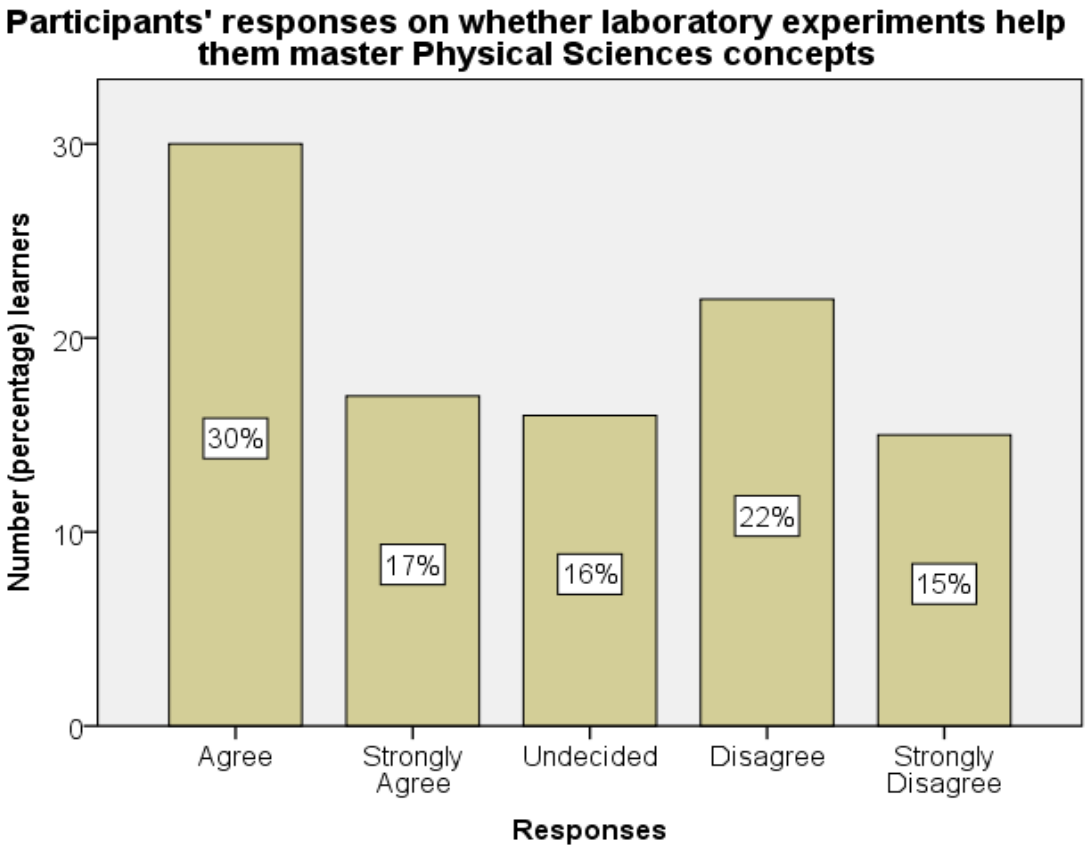
In responding to this item, 28 (28%) participants agreed that remedial lessons improve their performance in Physical Sciences, 48 (48%) strongly agreed and 7 (7%) were undecided. 13 (13%) participants disagreed and the remaining 4 (4%) strongly disagreed. The results show that majority of 98 (98%) participants confirmed the benefit of remedial lessons in improving the performance of learners. This shows that remedial lessons are crucial in the enhancement of learners' performance. Participants' views are presented in Graph 5.16.




**Graph: 5.16: Extra Lessons Improve Learners' Performance**

### 5.3.15 Laboratory Activities Help Learners to Master Concepts

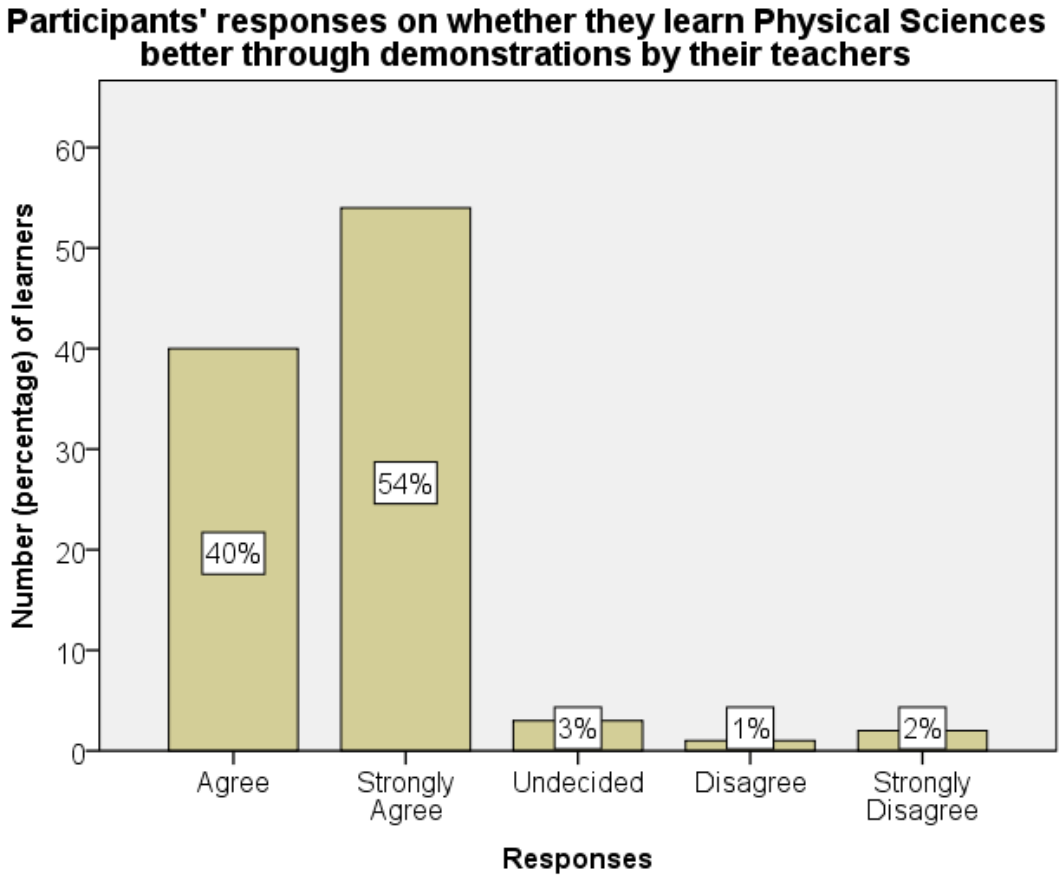
The responses of participants were solicited on whether laboratory activities help them to master Physical Sciences concepts. 30 (30%) participants agreed, 17 (17%) strongly agreed and 16 (16%) were undecided. On the other hand, 22 (22%) disagreed and 15 (15%) strongly disagreed. majority of 47 (47%) participants generally agreed that they are being assisted by laboratory experiments to master Physical Sciences concepts. Literature concurs that laboratory activities are important in catering for the learners' development of practical skills. Through laboratory activities, learners can state hypotheses, observe experimental developments, draw conclusions and explain the use of some materials to develop problem solving skills (See Sub-section 3.2.7). The views of participants are presented in Graph 5.17.




**Graph 5.17: Laboratory Activities Help Learners to Master Concepts**

### 5.3.16 Learners Learn Better through Teacher Demonstrations

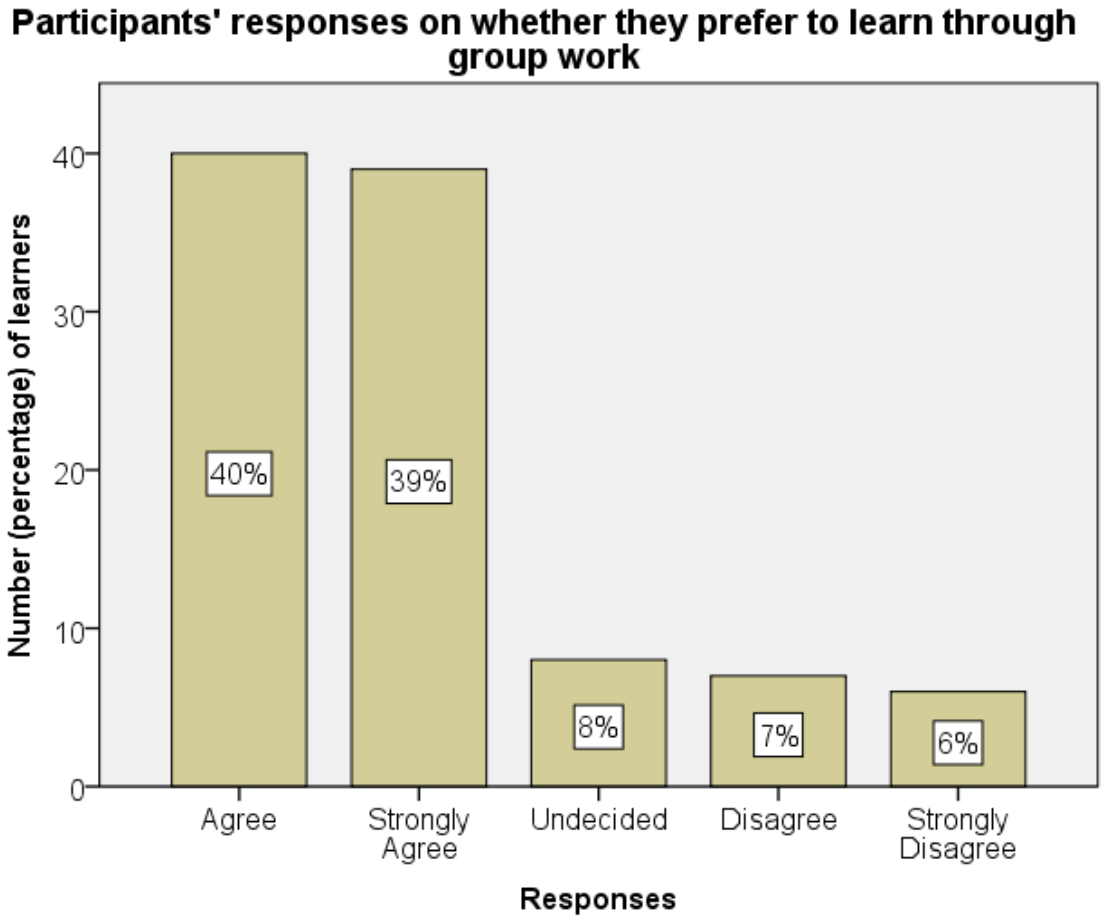
Participants were requested to provide their views on whether they learn Physical Sciences better through teachers' demonstrations. 40 (40% participants agreed, 54 (54%) strongly agreed and 3 (3%) were undecided. On the other hand, 1(1%) participant disagreed and the remaining 2 (2%) strongly disagreed. This shows that most participants (94%) confirm that they learn Physical Sciences better through demonstrations from their teachers. The participants' views are presented in Graph 5.18.




**Graph 5.18: Learners Learn Better through Demonstrations**

### 5.3.17 Learning Physical Sciences through Group Work

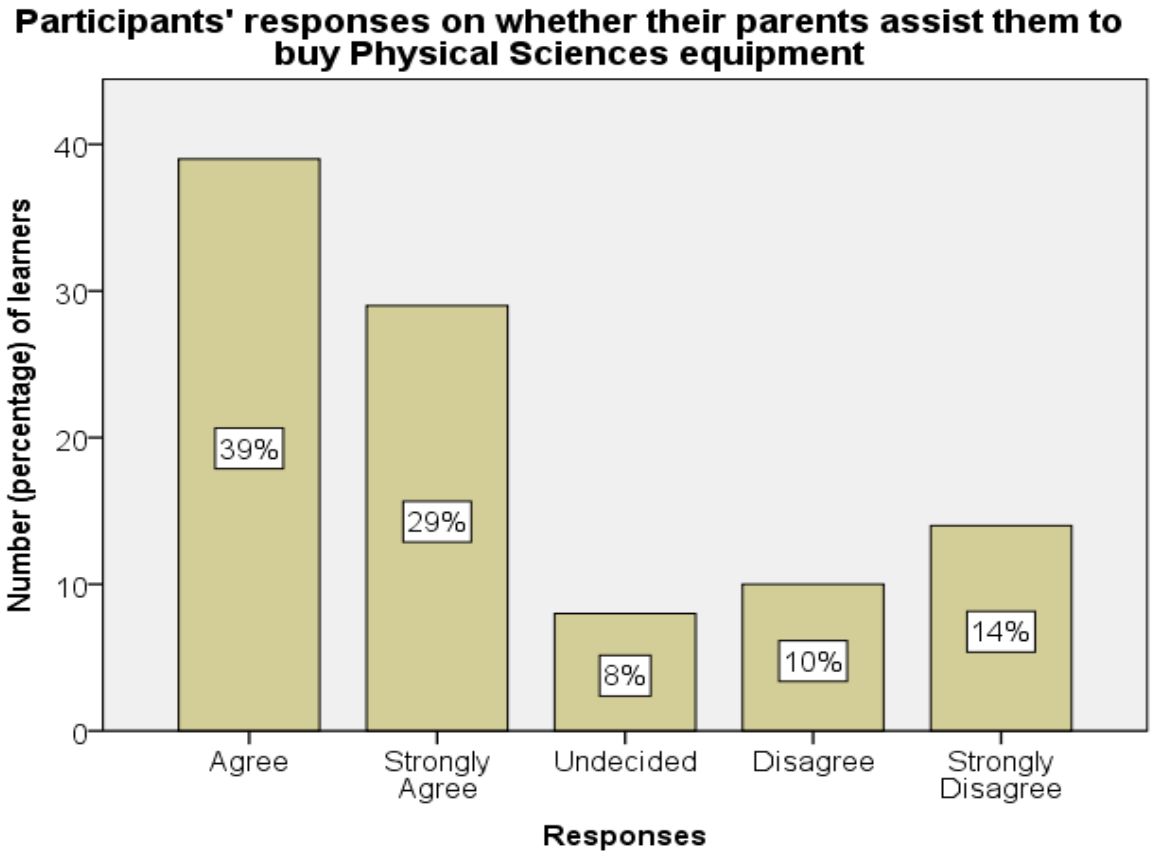
The participants were requested to provide their views on whether they prefer to learn through group work. In response to the question item, 40 (40%) participants agreed that they prefer to learn through group work, 39 (39%) strongly agreed and 8 (8%) participants were undecided. However, 7 (7%) disagreed and the remaining 6 (6%) strongly disagreed. This shows that most participants at (79%) prefer to learn through group work. This is supported by literature which advances that group learning promotes active learning as it allows learners to actively participate in the learning process (Sub-section 3.2.2.2). Participants' views are presented in Graph 5.19.




**Graph 5.19: Learning Physical Sciences Through Group Work**

### 5.3.18 Parents Buy Physical Sciences Equipment for their Children

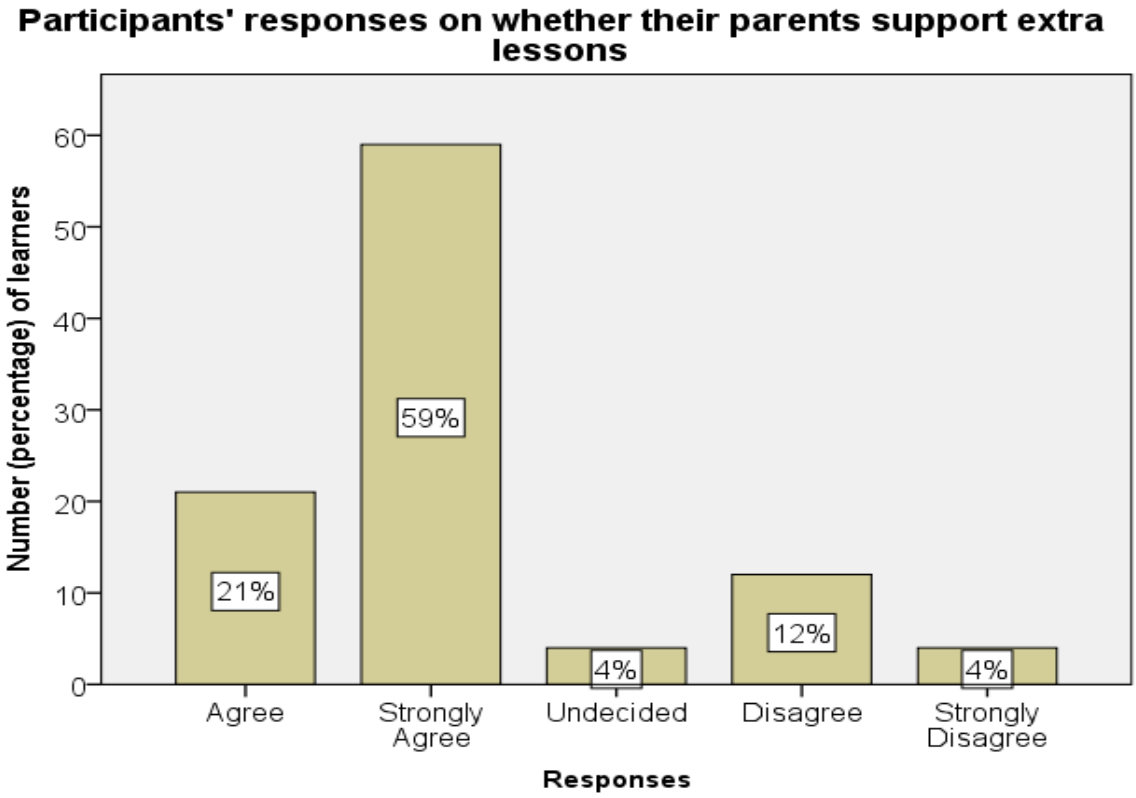
In response to this questionnaire item, 39 (39%) participants agreed that their parents buy them Physical Sciences equipment, 29 (29%) strongly agreed, 8 (8%) were undecided. On the other hand, 10 (10%) participants disagreed and the remaining 14 (14%) strongly disagreed. In total, (68%) participants consented that their parents buy them Physical Sciences equipment. Parents' involvement in their children's education assist learners to achieve better academically (Sub-section 3.2.3). Parents make their homes conducive places for study and encourage their children to learn by providing them with learning equipments (See Sub-section 3.2.3). Participants' views are presented in Graph 5.20.




**Graph 5.20: Parents Buy Physical Sciences Equipment for their Children**

### 5.3.19 Parents Pay for their Children's Extra Lessons

In responding to this questionnaire item, 21 (21%) participants agreed that their parents support them on extra lessons, 59 (59%) strongly agreed and 4 (4%) were undecided. On the other hand, 12 (12%) participants disagreed and the remaining 4 (4%) strongly disagreed that their parents support them on extra lessons. In total, 80 (80%) participants affirmed the support they receive from parents regarding extra lessons. Literature corroborates this finding, noting that the support which parents give to children through offering extra lessons makes a difference in learning (Sub-section 3.2.3). Parents' support for children's school programmes in and outside school has a significant impact in enhancing the quality of learning, creating a positive learning climate and the overall learners' performance (See Sub-section 3.2.3). Participants' views are presented in Graph 5.21.




**Graph 5.21: Parents Pay for their Children's Extra Lessons**

## 5.4 TEST OF SIGNIFICANCE: CHI-SQUARE CROSS TABULATION

### Table 5.1: Statements Based on Textbooks used in Physical Sciences

**Crosstab (I have my own Physical Sciences textbook*Using text books to study assists us to achieve good results in Physical Sciences)**

| | | | Using text books to study assists us to achieve good results in Physical Science | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| I have my own Physical Science textbook | Agree | Count | 30 | 19 | 0 | 0 | 0 | 49 |
| | | Standardized Residual | 3.8 | -2.0 | -1.0 | -1.4 | -1.0 | |
| | Strongly Agree | Count | 1 | 40 | 0 | 0 | 0 | 41 |
| | | Standardized Residual | -3.3 | 3.0 | -.9 | -1.3 | -.9 | |
| | Undecided | Count | 0 | 2 | 2 | 1 | 0 | 5 |
| | | Standardized Residual | -1.2 | -.6 | 6.0 | 1.8 | -.3 | |
| | Disagree | Count | 0 | 0 | 0 | 3 | 2 | 5 |
| | | Standardized Residual | -1.2 | -1.7 | -.3 | 6.3 | 6.0 | |
| Total | | Count | 31 | 61 | 2 | 4 | 2 | 100 |

Table 5.3 shows that learners using their own Physical Sciences text books to study consider them useful in achieving good results in Physical Sciences.

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson's Chi-Square | 166.692[a] | 12 | .000 |
| Likelihood Ratio | 97.845 | 12 | .000 |
| Linear-by-Linear Association | 68.524 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(12) = 166.692$, p=0.001. This shows that there is a statistically significant association between owning a text book and achieving good results in Physical Sciences.

**Crosstab (We use different text books in learning Physical Sciences * Using text books to study assists us to achieve good results in Physical Sciences)**

| | | | Using text books to study assists us to achieve good results in Physical Science | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| We use different text books in learning Physical Sciences | Agree | Count | 31 | 25 | 0 | 0 | 0 | 56 |
| | | Standardized Residual | 3.3 | -1.6 | -1.1 | -1.5 | -1.1 | |
| | Strongly Agree | Count | 0 | 33 | 0 | 0 | 0 | 33 |
| | | Standardized Residual | -3.2 | 2.9 | -.8 | -1.1 | -.8 | |
| | Undecided | Count | 0 | 3 | 2 | 4 | 0 | 9 |
| | | Standardized Residual | -1.7 | -1.1 | 4.3 | 6.1 | -.4 | |
| | Disagree | Count | 0 | 0 | 0 | 0 | 1 | 1 |
| | | Standardized Residual | -.6 | -.8 | -.1 | -.2 | 6.9 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 1 | 1 |
| | | Standardized Residual | -.6 | -.8 | -.1 | -.2 | 6.9 | |
| Total | | Count | 31 | 61 | 2 | 4 | 2 | 100 |

The table shows that learners view using different text books in learning Physical Sciences as assisting them in achieving good results.

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 196.058[a] | 16 | .000 |
| Likelihood Ratio | 93.881 | 16 | .000 |
| Linear-by-Linear Association | 62.569 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 196.058$, p=0.001. This shows that there is a statistically significant association between using different Physical Sciences text books and achieving good results in Physical Sciences.

**Table 5.2: Statements Based on Laboratory Investigations**

**Crosstab (Our school has a well-equipped Physical Sciences laboratory * Conducting laboratory investigations enhances our performance in Physical Sciences)**

| | | | Conducting laboratory investigations enhances our performance in Physical Sciences | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| Our school has a well-equipped Physical Sciences laboratory | Agree | Count | 8 | 0 | 0 | 0 | 0 | 8 |
| | | Standardized Residual | 3.2 | -1.2 | -.9 | -1.2 | -1.3 | |
| | Strongly Agree | Count | 1 | 0 | 0 | 0 | 0 | 1 |
| | | Standardized Residual | 1.1 | -.4 | -.3 | -.4 | -.5 | |
| | Disagree | Count | 25 | 4 | 0 | 0 | 0 | 29 |
| | | Standardized Residual | 4.8 | -.4 | -1.7 | -2.2 | -2.5 | |
| | Strongly Disagree | Count | 0 | 13 | 10 | 17 | 22 | 62 |
| | | Standardized Residual | -4.6 | .8 | 1.5 | 2.0 | 2.3 | |
| Total | | Count | 34 | 17 | 10 | 17 | 22 | 100 |

This table shows how a well-equipped Physical Sciences laboratory and conducting laboratory investigations enhance performance.

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 88.170[a] | 12 | .000 |
| Likelihood Ratio | 116.567 | 12 | .000 |
| Linear-by-Linear Association | 37.047 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(12) = 88.170$, p=0.001. This shows that there is a statistically significant association between a well-equipped Physical Sciences laboratory and enhanced performance in Physical Science.

**Crosstab (We conduct Physical Sciences practical activities in the laboratory * Conducting laboratory investigations enhances our performance in Physical Sciences)**

| | | | Conducting laboratory investigations enhances our performance in Physical Sciences | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| We conduct Physical Sciences practical activities in the laboratory | Agree | Count | 19 | 0 | 0 | 0 | 0 | 19 |
| | | Standardized Residual | 4.9 | -1.8 | -1.4 | -1.8 | -2.0 | |
| | Strongly Agree | Count | 10 | 0 | 0 | 0 | 0 | 10 |
| | | Standardized Residual | 3.6 | -1.3 | -1.0 | -1.3 | -1.5 | |
| | Undecided | Count | 3 | 0 | 0 | 0 | 0 | 3 |
| | | Standardized Residual | 2.0 | -.7 | -.5 | -.7 | -.8 | |
| | Disagree | Count | 2 | 17 | 3 | 0 | 0 | 22 |
| | | Standardized Residual | -2.0 | 6.9 | .5 | -1.9 | -2.2 | |
| | Strongly Disagree | Count | 0 | 0 | 7 | 17 | 22 | 46 |
| | | Standardized Residual | -4.0 | -2.8 | 1.1 | 3.3 | 3.7 | |
| Total | | Count | 34 | 17 | 10 | 17 | 22 | 100 |

This table indicates that if learners conduct Physical Sciences practical activities in the laboratory, their performance could be enhanced.

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 171.451[a] | 16 | .000 |
| Likelihood Ratio | 183.556 | 16 | .000 |
| Linear-by-Linear Association | 71.566 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 171.451$, p=0.001. This shows that there is a statistically significant association between having Physical Sciences practical activities in the laboratory and enhanced performance in Physical Sciences.

**Table 5.3: Statements Based on Technology**

**Crosstab (Our Physical Sciences teacher uses computer programmes to teach some Physical Sciences concepts * The use of computer programmes in learnin Physical Sciences helps me to understand the subject better)**

| | | | The use of computer programmes in learning Physical Sciences helps me to understand the subject better | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| Our Physical Sciences teacher uses computer programmes to teach some Physical Sciences concepts | Agree | Count | 14 | 0 | 0 | 0 | 0 | 14 |
| | | Standardized Residual | 6.2 | -1.1 | -1.8 | -1.7 | -1.9 | |
| | Strongly Agree | Count | 8 | 7 | 0 | 0 | 0 | 15 |
| | | Standardized Residual | 2.6 | 4.9 | -1.9 | -1.7 | -2.0 | |
| | Undecided | Count | 0 | 2 | 6 | 0 | 0 | 8 |
| | | Standardized Residual | -1.3 | 1.5 | 3.1 | -1.3 | -1.4 | |
| | Disagree | Count | 0 | 0 | 17 | 14 | 0 | 31 |
| | | Standardized Residual | -2.6 | -1.7 | 3.7 | 3.1 | -2.8 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 6 | 26 | 32 |
| | | Standardized Residual | -2.7 | -1.7 | -2.7 | -.2 | 6.1 | |
| Total | | Count | 22 | 9 | 23 | 20 | 26 | 100 |

This table shows that learners understand Physical Sciences subject better when teachers use computer programmes to teach concepts.

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 203.468[a] | 16 | .000 |
| Likelihood Ratio | 208.701 | 16 | .000 |
| Linear-by-Linear Association | 88.964 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 203.468$, p=0.001. This shows that there is a statistically significant association between the use of computer programmes by Physical Sciences teachers and the level of learners' understanding of the subject.

**Crosstab (I use cell social networks for group discussions with my class mates * The use of social networks in learning Physical Sciences helps me to understand the subject better)**

| | | | The use of social network in learning Physical Sciences helps me to understand the subject better | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| I use social networks for group discussions with my class mates | Agree | Count | 22 | 2 | 0 | 0 | 0 | 24 |
| | | Standardized Residual | 7.3 | -.1 | -2.3 | -2.2 | -2.5 | |
| | Strongly Agree | Count | 0 | 7 | 9 | 0 | 0 | 16 |
| | | Standardized Residual | -1.9 | 4.6 | 2.8 | -1.8 | -2.0 | |
| | Undecided | Count | 0 | 0 | 5 | 0 | 0 | 5 |
| | | Standardized Residual | -1.0 | -.7 | 3.6 | -1.0 | -1.1 | |
| | Disagree | Count | 0 | 0 | 9 | 20 | 0 | 29 |
| | | Standardized Residual | -2.5 | -1.6 | .9 | 5.9 | -2.7 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 26 | 26 |
| | | Standardized Residual | -2.4 | -1.5 | -2.4 | -2.3 | 7.4 | |
| Total | Count | | 22 | 9 | 23 | 20 | 26 | 100 |

This table indicates that the use of social networks for group discussions with classmates and the use of technology in learning Physical Sciences help them to understand the subject better.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 252.406[a] | 16 | .000 |
| Likelihood Ratio | 240.373 | 16 | .000 |
| Linear-by-Linear Association | 90.849 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 252.406$, p=0.001. This shows that there is a statistically significant association between the use of cell phone social networks for group discussions with classmates and the level of learners' understanding of the subject.

**Crosstab (My Physical Sciences teacher uses videos to help us understand some concepts in Physical Sciences * The use of computers in learning Physical Sciences helps me to understand the subject better)**

| | | | The use of computers in learning Physical Sciences helps me to understand the subject better | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| My Physical Sciences teacher uses videos to help us understand some concepts in the subject | Agree | Count | 8 | 0 | 0 | 0 | 0 | 8 |
| | | Standardized Residual | 4.7 | -.8 | -1.4 | -1.3 | -1.4 | |
| | Strongly Agree | Count | 14 | 1 | 0 | 0 | 0 | 15 |
| | | Standardized Residual | 5.9 | -.3 | -1.9 | -1.7 | -2.0 | |
| | Undecided | Count | 0 | 3 | 0 | 0 | 0 | 3 |
| | | Standardized Residual | -.8 | 5.3 | -.8 | -.8 | -.9 | |
| | Disagree | Count | 0 | 5 | 23 | 5 | 0 | 33 |
| | | Standardized Residual | -2.7 | 1.2 | 5.6 | -.6 | -2.9 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 15 | 26 | 41 |
| | | Standardized Residual | -3.0 | -1.9 | -3.1 | 2.4 | 4.7 | |
| Total | | Count | 22 | 9 | 23 | 20 | 26 | 100 |

This table shows that the use of videos by Physical Sciences' teachers helps learners to understand the subject better.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 202.588[a] | 16 | .000 |
| Likelihood Ratio | 196.449 | 16 | .000 |
| Linear-by-Linear Association | 84.168 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 202.588$, p=0.001. This shows that there is a statistically significant association between the use of videos by Physical Sciences teachers and the level of learners' understanding of the subject.

### Table 5.4: Statements on Educational Excursions

| Crosstab (We do fieldtrips to gain a better understanding of Physical Sciences aspects * I feel these fieldtrips helps me to gain better understanding in Physical Sciences) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Fieldtrips helps me to gain a better understanding in Physical Sciences | | | | | |
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| Fieldtrips help to gain a better understanding of Physical Sciences aspects | Agree | Count | 17 | 0 | 0 | 0 | 0 | 17 |
| | | Standardized Residual | 8.3 | -1.4 | -1.4 | -2.1 | -2.4 | |
| | Strongly Agree | Count | 0 | 9 | 0 | 0 | 0 | 9 |
| | | Standardized Residual | -1.2 | 7.6 | -1.0 | -1.5 | -1.7 | |
| | Undecided | Count | 0 | 3 | 2 | 0 | 0 | 5 |
| | | Standardized Residual | -.9 | 3.1 | 2.0 | -1.1 | -1.3 | |
| | Disagree | Count | 0 | 0 | 9 | 11 | 0 | 20 |
| | | Standardized Residual | -1.8 | -1.5 | 4.6 | 2.5 | -2.6 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 15 | 34 | 49 |
| | | Standardized Residual | -2.9 | -2.4 | -2.3 | .6 | 4.2 | |
| Total | | Count | 17 | 12 | 11 | 26 | 34 | 100 |

This table shows that learners engage in fieldtrips to gain better understanding of Physical Sciences aspects and that these fieldtrips helps them to perform better in Physical Sciences.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 244.409[a] | 16 | .000 |
| Likelihood Ratio | 208.480 | 16 | .000 |
| Linear-by-Linear Association | 90.760 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 244.409$, p=0.001. This shows that there is a statistically significant association between doing field trips to gain better understanding of Physical Sciences aspects and to improve learners' performance in Physical Sciences.

**Crosstab (The fieldtrips organised in our school are adequate * I feel these fieldtrips motivate me to perform better in Physical Sciences)**

| | | | I feel these fieldtrips help me to perform better in Physical Sciences | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| The fieldtrips help me to perform better in Physical Sciences | Agree | Count | 13 | 0 | 0 | 0 | 0 | 13 |
| | | Standardized Residual | 7.3 | -1.2 | -1.2 | -1.8 | -2.1 | |
| | Strongly Agree | Count | 4 | 1 | 0 | 0 | 0 | 5 |
| | | Standardized Residual | 3.4 | .5 | -.7 | -1.1 | -1.3 | |
| | Undecided | Count | 0 | 11 | 3 | 0 | 0 | 14 |
| | | Standardized Residual | -1.5 | 7.2 | 1.2 | -1.9 | -2.2 | |
| | Disagree | Count | 0 | 0 | 8 | 21 | 0 | 29 |
| | | Standardized Residual | -2.2 | -1.9 | 2.7 | 4.9 | -3.1 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 5 | 34 | 39 |
| | | Standardized Residual | -2.6 | -2.2 | -2.1 | -1.6 | 5.7 | |
| Total | | Count | 17 | 12 | 11 | 26 | 34 | 100 |

This table shows that the fieldtrips helps learners to perform better in Physical Sciences.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 243.024[a] | 16 | .000 |
| Likelihood Ratio | 219.514 | 16 | .000 |
| Linear-by-Linear Association | 90.015 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 243.024$, p=0.001. This shows that there is a statistically significant association between the undertaking of fieldtrips and learners' improved performance in Physical Sciences.

**Table 5.5: Statements Based on Measures to Enhance Content Mastery**

| Crosstab (Our Physical Sciences teacher regularly gives class activities * Physical Sciences activities that enhance our understanding) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Physical Sciences class activities enhance our understanding | | | | |
| | | | Agree | Strongly Agree | Disagree | Strongly Disagree | Total |
| Physical Sciences teacher regularly gives class activities | Agree | Count | 26 | 2 | 0 | 0 | 28 |
| | | Standardized Residual | 6.9 | -4.0 | -.7 | -.5 | |
| | Strongly Agree | Count | 0 | 69 | 1 | 0 | 70 |
| | | Standardized Residual | -4.3 | 2.7 | -.3 | -.8 | |
| | Disagree | Count | 0 | 0 | 1 | 0 | 1 |
| | | Standardized Residual | -.5 | -.8 | 6.9 | -.1 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 1 | 1 |
| | | Standardized Residual | -.5 | -.8 | -.1 | 9.9 | |
| Total | | Count | 26 | 71 | 2 | 1 | 100 |

This table indicates that if Physical Sciences teachers regularly give class activities that enhance learners' understanding of the subject.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 239.567[a] | 9 | .000 |
| Likelihood Ratio | 118.647 | 9 | .000 |
| Linear-by-Linear Association | 84.404 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(9) = 239.567$, p=0.001. This shows that there is a statistically significant association between Physical Sciences teacher regular class activities and the learners' enhanced understanding of the subject.

**Crosstab (Extra lessons improve my performance in Physical Sciences * Physical Sciences extra lessons enhance our understanding in Physical Sciences**

| | | | Extra lessons enhance my understanding of Physical Sciences | | | | |
|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Disagree | Strongly Disagree | Total |
| Extra lessons improve my performance in Physical Sciences | Agree | Count | 26 | 2 | 0 | 0 | 28 |
| | | Standardized Residual | 6.9 | -4.0 | -.7 | -.5 | |
| | Strongly Agree | Count | 0 | 48 | 0 | 0 | 48 |
| | | Standardized Residual | -3.5 | 2.4 | -1.0 | -.7 | |
| | Undecided | Count | 0 | 7 | 0 | 0 | 7 |
| | | Standardized Residual | -1.3 | .9 | -.4 | -.3 | |
| | Disagree | Count | 0 | 13 | 0 | 0 | 13 |
| | | Standardized Residual | -1.8 | 1.2 | -.5 | -.4 | |
| | Strongly Disagree | Count | 0 | 1 | 2 | 1 | 4 |
| | | Standardized Residual | -1.0 | -1.1 | 6.8 | 4.8 | |
| Total | | Count | 26 | 71 | 2 | 1 | 100 |

This table shows that teachers' guidance in doing corrections enhances learners' understanding of Physical Sciences activities.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 164.185[a] | 12 | .000 |
| Likelihood Ratio | 120.812 | 12 | .000 |
| Linear-by-Linear Association | 52.795 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(12) = 239.567$, p=0.001. This shows that there is a statistically significant association between teachers' guidance when learners do corrections and their improved understanding of Physical Sciences activities.

**Table 5.6: Statements on Learning Styles**

| Crosstab (I learn best through teacher demonstrations * Teacher demonstrations help me to understand Physical Sciences concepts | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Practical work helps to understand concepts | | | | | |
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| I learn best through teacher demonstrations | Agree | Count | 30 | 10 | 0 | 0 | 0 | 40 |
| | | Standardized Residual | 5.2 | 1.2 | -2.5 | -3.0 | -2.4 | |
| | Strongly Agree | Count | 0 | 7 | 16 | 22 | 9 | 54 |
| | | Standardized Residual | -4.0 | -.7 | 2.5 | 2.9 | .3 | |
| | Undecided | Count | 0 | 0 | 0 | 0 | 3 | 3 |
| | | Standardized Residual | -.9 | -.7 | -.7 | -.8 | 3.8 | |
| | Disagree | Count | 0 | 0 | 0 | 0 | 1 | 1 |
| | | Standardized Residual | -.5 | -.4 | -.4 | -.5 | 2.2 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 2 | 2 |
| | | Standardized Residual | -.8 | -.6 | -.6 | -.7 | 3.1 | |
| Total | | Count | 30 | 17 | 16 | 22 | 15 | 100 |

This table indicates that learners learn best through teacher demonstrations and that experiments help learners to master Physical Sciences concepts.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 115.414[a] | 16 | .000 |
| Likelihood Ratio | 130.387 | 16 | .000 |
| Linear-by-Linear Association | 59.062 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 115.414$, p=0.001. This shows that there is a statistically significant association between the use of demonstrations and experiments by teachers and learners' mastering of Physical Sciences concepts.

**Crosstab (I prefer learning through group work with my peers * Experiments helps in mastering physical sciences concepts)**

| | | | Practical work help me in mastering Physical Sciences concepts | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| I prefer learning through group work with my peers | Agree | Count | 30 | 10 | 0 | 0 | 0 | 40 |
| | | Standardized Residual | 5.2 | 1.2 | -2.5 | -3.0 | -2.4 | |
| | Strongly Agree | Count | 0 | 7 | 16 | 16 | 0 | 39 |
| | | Standardized Residual | -3.4 | .1 | 3.9 | 2.5 | -2.4 | |
| | Undecided | Count | 0 | 0 | 0 | 6 | 2 | 8 |
| | | Standardized Residual | -1.5 | -1.2 | -1.1 | 3.2 | .7 | |
| | Disagree | Count | 0 | 0 | 0 | 0 | 7 | 7 |
| | | Standardized Residual | -1.4 | -1.1 | -1.1 | -1.2 | 5.8 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 6 | 6 |
| | | Standardized Residual | -1.3 | -1.0 | -1.0 | -1.1 | 5.4 | |
| Total | | Count | 30 | 17 | 16 | 22 | 15 | 100 |

This table shows that learners prefer learning through group work with peers and that experiments help them to master Physical Sciences concepts.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 178.414[a] | 16 | .000 |
| Likelihood Ratio | 179.609 | 16 | .000 |
| Linear-by-Linear Association | 74.224 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 178.414$, p=0.001. This shows that there is a statistically significant association between learners' preferences to learn through group work with peers and experiments and their mastering of Physical Sciences concepts.

**Table 5.7: Statements on Parental Involvement**

| Crosstab (My parents buy me Physical Sciences equipments * PI Physical Sciences equipments helps me to perform good in Physical Sciences | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Physical Sciences equipments helps me to perform good in Physical Sciences | | | | | |
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| My parents assist me by buying Physical Sciences equipments that are used in Physical Sciences lessons | Agree | Count | 17 | 5 | 4 | 12 | 1 | 39 |
| | | Standardized Residual | 4.0 | 2.2 | 2.0 | 3.4 | -4.7 | |
| | Strongly Agree | Count | 0 | 0 | 0 | 0 | 29 | 29 |
| | | Standardized Residual | -2.2 | -1.2 | -1.1 | -1.9 | 2.6 | |
| | Undecided | Count | 0 | 0 | 0 | 0 | 8 | 8 |
| | | Standardized Residual | -1.2 | -.6 | -.6 | -1.0 | 1.4 | |
| | Disagree | Count | 0 | 0 | 0 | 0 | 10 | 10 |
| | | Standardized Residual | -1.3 | -.7 | -.6 | -1.1 | 1.5 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 14 | 14 |
| | | Standardized Residual | -1.5 | -.8 | -.7 | -1.3 | 1.8 | |
| Total | | Count | 17 | 5 | 4 | 12 | 62 | 100 |

This table shows that parents buy their children Physical Sciences equipment and that this helps to perform good in Physical Sciences.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 95.864[a] | 16 | .000 |
| Likelihood Ratio | 123.512 | 16 | .000 |
| Linear-by-Linear Association | 37.093 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 95.864$, p=0.001. This shows that there is a statistically significant association between parents buying Physical Sciences equipment for their children and the ability of learners to perform good in Physical Sciences.

**Crosstab (My parents pay for my children's Physical Sciences extra lessons that I attend I attend Physical Sciences Extra lessons**

| | | | extra lessons help me to perform better in Physical Sciences | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Agree | Strongly Agree | Undecided | Disagree | Strongly Disagree | Total |
| My parents pay for my Physical Sciences extra lesson I attend | Agree | Count | 17 | 4 | 0 | 0 | 0 | 21 |
| | | Standardized Residual | 7.1 | 2.9 | -.9 | -1.6 | -3.6 | |
| | Strongly Agree | Count | 0 | 1 | 4 | 12 | 42 | 59 |
| | | Standardized Residual | -3.2 | -1.1 | 1.1 | 1.8 | .9 | |
| | Undecided | Count | 0 | 0 | 0 | 0 | 4 | 4 |
| | | Standardized Residual | -.8 | -.4 | -.4 | -.7 | 1.0 | |
| | Disagree | Count | 0 | 0 | 0 | 0 | 12 | 12 |
| | | Standardized Residual | -1.4 | -.8 | -.7 | -1.2 | 1.7 | |
| | Strongly Disagree | Count | 0 | 0 | 0 | 0 | 4 | 4 |
| | | Standardized Residual | -.8 | -.4 | -.4 | -.7 | 1.0 | |
| Total | | Count | 17 | 5 | 4 | 12 | 62 | 100 |

This table shows that parents pay for their children extra lessons in Physical Sciences and that extra lessons helps learners to perform good in Physical Sciences.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 104.129[a] | 16 | .000 |
| Likelihood Ratio | 109.210 | 16 | .000 |
| Linear-by-Linear Association | 38.981 | 1 | .000 |
| N of Valid Cases | 100 | | |

The Chi-Square table shows that $x^2(16) = 104.129$, p=0.001. This shows that there is a statistically significant association between the extra lessons that learners attend, learners' improved performance.

## 5.5 ANALYSIS AND INTERPTRETATION OF QUALITATIVE DATA

This section analysed and interpreted qualitative data. The analysed data was drawn from the interviews conducted with Grade 12 Physical Sciences teachers regarding strategies to enhance learners' performance in the subject. Data was analysed and interpreted thematically. Schools were coded from S1 - S8. 8 teachers took part in the research. Teachers were also coded T1- T8 according to their schools.

### 5.5.1 Demographic Information of Physical Sciences Teachers

8 teachers participated in the interviews based on the enhancement of Grade 12 learners' performance in Physical Sciences. This group of participants was composed of 6 males and 2 female teachers. Male teachers were 6 in number whereas female teachers were only 2. There were more male Physical Sciences teachers than their female counterparts. 2 participants were aged between 20 and 29, 2 were at the age between 30-39. 3 were at the age between 40-49. Only 1 participant was at the age of

50 years and above. This indicates the existence of Physical Sciences teachers of various age groups in the District.

The distribution of teachers by their professional qualifications was also the analysed. From the total of eight participants, 1 participant was in possession of BSc Honours, 2 participants had BEDFET degree, 1 BED (Hons), 1 STD, 1 HED, 1 (PGCE), and 1 had a Primary Teachers' Diploma (PTD). This shows that in the Mopani district, there were Physical Sciences teachers who were underqualified to teach Grade 12 Physical Sciences since they were holders of primary education qualifications. In terms of teaching experience, three participants had between 1 and 5 years teaching experience, 3 had 5-10 years, 1 had 10-15 years, and the remaining had between 20 and 25 years teaching experience. Most teachers had an experience of less than 10 years. Only 2 teachers taught Physical Sciences for more than 10 years.

### 5.5.2 Analysis and Interpretation of Contextual Data

This section presents data that was generated from interviews that were conducted with Grade 12 Physical Sciences teachers. The analysis was guided by the research questions, research purpose, literature review and the theoretical framework of the study on strategies to enhance learners' performance in Physical Sciences. Focus was given on the items of the interview schedule.

#### 5.5.2.1 In what ways do text books contribute to learners' academic performance in Physical Sciences?

The study established that teaching and text books are crucial in the teaching and learning of Physical Sciences. The study revealed that such teaching and learning resources provide the potential which is required to improve learners' performance. Teachers also tend to teach effectively when teaching in the institutions where resources are available. This environment, for example, should have different textbooks which are pivotal in improving teaching and learning of Physical Sciences in schools. Learners value their text books and use them more frequently and intensively

to prepare for class activities. The availability and use of different text books assist learners to do their home activities. The study found out that although most of the schools have adequate Physical Sciences textbooks, some few schools do not have adequate textbooks. This implies that some Physical Sciences teachers rely on sharing the few available textbooks amongst learners or resort to using notes to assist learners. One participant said:

> *T3: Yea, it is true, they are very much vital even though in our school we don't have much resources. We are lacking a lot. We can't perform some of the experiments because we don't have enough apparatus, we do them theoretically. Mm... Currently, we do not have resources.*

The participants revealed that lack of human resources in Physical Science stifles effective delivery of the subject curriculum. Some teachers were teaching Grade 12 Physical Sciences while in possession of the old Secondary Teachers' Diplomas which they acquired twenty or thirty years ago. These teachers have not upgraded their qualifications. This means that some Physical Sciences teachers do not qualify to teach Grade12 as they hold PTD and SPTD, which are primary teaching qualifications. The study also gathered that some teachers and the heads of departments hold STD 10 as their highest qualifications in Physical Sciences. On this regard, one participant said:

> T1: *We are trying our level best to make sure that the teaching of Physical Sciences is done, even if there are challenges. We used to invite some teachers from the neighboring schools to come and assist our learners, and we also take our learners to Giyani Science laboratory, but it is difficult to do that because it is far, and money is required for that.*

#### 5.5.2.2 Challenges that teachers encounter when conducting laboratory activities with learners

Participants indicated the importance of laboratory activities as processes which stimulate teaching and learning. Experiments help learners to engage both their hands and minds in academic work. Laboratory activities enable learners to work as groups

and at their own pace. Learners benefit a lot through engaging themselves with concepts, especially when they do practical activities through interactions and applications. As much as laboratories are important, schools are still facing serious challenges concerning the conduct of laboratory activities owing to inadequacy of buildings and equipment. It is apparent that, even though the challenges may differ from school to school, schools have a common challenge which is lack of laboratory investigations. This is supported by evidence from participants who said:

> *T2: The school is having limited resources. Usually when we want to perform some experiments we arrange with other schools for the use of their equipment. Learners cannot do the experiments hence we cannot expect them to answer related questions correctly.*
>
> *T1: Presently in our school, the challenges we have is of the laboratory which is of the olden style. Some apparatuses and chemicals have expired, and we don't have an option but to use them so that learners would understand what is needed in as far as science experiments are concerned.*

The responses of participants solicited on the availability laboratories. They revealed that most schools do not have laboratories for experimentation. Schools with mobile laboratories could not properly perform all the experiments as the equipment was not adequate for the nature of practical activities demanded in the curriculum. The tendency was that some schools resorted on the theoretical aspects of Physical Sciences at the expense of practical activities. There is no provision for hands-on activities in some schools. The shortage of equipment and chemicals hinders the effective conduct of Physical Sciences experiments. Some participants said:

> *T7: We do not have a laboratory. We just have a store room where we put our apparatuses. Sometimes we visit schools that are having laboratories to perform experiments, sometimes we borrow materials from Sekgosese Secondary school, but they also do not have enough. Most of the times we do theory by using text books and explaining experiments to learners.*
>
> T5: *Yea, our laboratory is not up to standard as you can see, we are using the mobile laboratory in the class as our laboratory. The serious*

*challenge is that we are unable to perform the experiments as required by the syllabus. As a result, we shelve it or arrange with other schools that have proper laboratories.*

*T3: We do not have a laboratory in our school. We only use Physical Sciences equipment. However, this imposes a great danger to learners. It means that we must carry whatever chemicals to the classroom and perform the experiments there with the learners, which is very dangerous.*

#### 5.5.2.3 How helpful is the use of ICT in the teaching of Physical Sciences

Participants indicated that they are not using ICT gadgets in teaching Physical Sciences because of several reasons. This is despite the general acceptance of the usefulness of such available technologies for teaching and learning. The use of technology helps learners to access more and current information which is not contained in textbooks. Learners also tend to be attentive during the instructional process compared to a situation where a teacher delivers a lesson using mainly the chalkboard. Some participants responded to this item as follows:

*T8: I understand that the use of ICT helps a teacher a lot. When we are using laptops and overhead projectors, we display the lesson on the overhead projectors. It arouses the learners' interests in such a way that when they listen, they give the teacher all the attention than if the teacher is using the chalkboard, and it is also time saving.*

*T5: Yes, it does help the learners to get more information, especially the information which is not in the text books. So, it is very important, maybe, as a school to have things like Wi-Fi where learners can access the internet and get information.*

Although the ICT gadgets play an important role in as far as the enhancement of learners' performance is concerned, teachers and learners are facing a variety of challenges concerning their use. In this regard, most participants indicated that they do not have these gadgets for use during teaching and learning. The participants showed that the only ICT technologies they used to improve learners' performance in Physical

Sciences are data projectors and the laptops. The full use of these tools is hampered by their expensive nature and the absence of related internet connectivity to access and download needed information. To indicate their frustration, some participants said:

> *T3: We only have overhead projectors. We have only two computers in the office. I can only look for the information and print it for learners.*

> *T4: It is very difficult for us to use gadgets. In the first place, it has to do with the network that we are not having in our area. We have gadgets that were donated to our school by the MTN. Those gadgets are not working, the Wi-Fi that they provided is not working because of poor network around the school itself. So, we find it difficult to use those gadgets.*

> *T5: The ICT gadgets are very expensive. It is difficult for our school to purchase gadgets like laptops and tablets which are enough for learners.*

Cell phones seem to be the most portable gadgets and simple devices that most learners have. However, the main challenge facing most of the teachers and leaners is that in most schools, learners are not allowed to bring cell phones to class.

> *T6: Some learners have modern cellphones which can be used profitably in the teaching and learning of Physical Sciences. Unfortunately, those phones are not allowed to be brought to some schools as a precautionary measure against indiscipline and diverted attention of learners.*

#### 5.5.2.4 How teachers utilise the fieldtrips to teach Physical Sciences?

Some participants revealed that they undertake field trips but to a lesser extent. There are instances where learners are transported to Science centres where they are exposed to relevant equipment and processes which are crucial in understanding Physical Sciences. Learners can also be taken to mining areas where they observe mining activities. This includes visits to experience Iron Ore mining in Phalaborwa and gold mining in Johannesburg. Fieldtrips can be very essential in influencing learners to choose and follow certain careers in life. On this regard, participants said:

*T1: In most cases, these fieldtrips are done twice a year, in the first quarter and third quarter. Sometimes we take our Science learners to Sciences centres at Giyani. We also used to visit centres at Soekmansdaal and Mastech where learners are shown what is happening there. At the end of the day, they improve the knowledge they would have obtained from class.*

*T4: Yea, it is helpful because at one time, we arrange fieldtrips to Phalaborwa mine where learners experience how Iron Ore is mined and how copper is being processed, and how iron sheets are made. Another year we went to Johannesburg Gold mines, they saw how gold was processed. So, I think excursions like are helpful even to grab the minds of learners and to encourage them to follow some careers.*

On the other hand, some of the participants revealed that they do not undertake educational excursions and fieldtrips. This arises mainly from the shortage of funds or lack of funding. Most learners come from poor backgrounds which makes them unable to pay for organised fieldtrips. At times parents show interest to have their children participate in educational tours but financial challenges dissipate the motive. Some schools are also located far away from factories and industries, which are areas of educational interests and this renders educational trips very expensive to organise. In addition, some teachers lack expertise to organise such trips, making their schools very rare candidates for practical experiences for learners. Some participants said:

*T7: Mm, field trips are very much helpful but expensive because places that need to be visited are far from our school. We always have challenges since we do not have money.*

*T8: That one is limited because we don't have kind of needed support. Learners would be excited to go to the industries to see, for example, the manufacturing of fertilizers so that they link what they learn and what is happening in the work and factories*.

*T6: Excursions, I don't do that, but we are having teachers who are responsible for that. We just move around within nearby schools.*

Some participants also revealed that their schools are situated far from the factories and industries that are relevant for learners to visit or engage in educational fieldtrips. They

indicated that it was very hard for them to take learners for fieldtrips or excursions because of financial challenges. A very limited number of schools engage in fieldtrips which are crucial in the realization of learner academic achievement. The poor backgrounds of most learners discourage participation in field trips as they do not have the needed financial resources to support such activities. Parents would opt to pay school fees for their children rather than channel their meagre finances to touring places. The absence of educational trips in some schools militates against improved academic achievement in Physical Sciences. Some participants sad:

> *T8: Yes, we do utilize it but we always find it difficult because of the conditions in which we are living. You find that learners do not have money to pay for transport. You find that only three or five learners manage to pay but you can't take five learners for fieldtrips.*
>
> *T7: Mm, fieldtrips or educational excursions are very helpful but very expensive because places that we should touch for this purpose are very far. We always have financial challenges since we do not have money.*
>
> *T3: Yea! From the way things are, we never did that before and even if I propose that, there is that issue that we don't have funds. Asking learners who do not pay school fees to pay for fieldtrips, I don't think is y schools.*

#### 5.5.2.5 Use of various teaching approaches

Participants were requested to give their responses pertaining to the use of various and appropriate teaching approaches on learner performance. Most participants revealed that appropriate teaching approaches influence learners' academic performance. Learners may not be able to learn in the same way and as such, teachers need to be cognisance of diverse paths through which knowledge is imparted to learners. Teachers should use a variety of teaching approaches in class. The knowledge of learners' styles of learning can help teachers to know the best teaching method that can be utilised. Some participants said:

> *T3: I use appropriate methods of teaching Physical Sciences. I can't use the narrative approach while teaching Physical Sciences. I prefer*

*to engage learners in solving problems and encourage them to work on their own. I also encourage them to work in groups in doing laboratory activities.*

*T6: It is important to come up with the best teaching approach to use in lesson delivery to aid learners' understanding in class. Most of the time, I prepare everything which they need to learn using different approaches.*

*T7: In terms of teaching approaches, learners prefer different teaching styles. To encourage these learners, we normally use lecture methods and complement them with visual aids to deepen their grasp of taught concepts. We can also make use of visual laboratory in the internet.*

The study established that various teaching approaches are equally important. No approach is better than the other, but they should be applied in a way that they could complement one another. These include group work, lecture method, experimentation, and demonstration. Teachers should be familiar with most teaching approaches to enhance learners' understanding of concepts in the subject (See Sub-section 3.2.2)., Teachers should always adjust their teaching approaches to accommodate learners' learning styles (See Sub-section 3.2). some teachers added and said the following:

*T2: The method that I prefer is one which is learner centred. No one method can be used to teach Physical Sciences. I think the inquiry teaching method is appropriate because learners are assisted to understand concepts by themselves, but this learning approach can be combined with the collaborative teaching approach to improve learners' performance.*

*T3: In teaching, Physical sciences, I can say cooperative teaching method is the most important one. We group learners according to their level of performance, then give them the chance to discover concepts on their own. If they do not find enough information, I give them feedback and add on the information that they discovered.*

*T4: In teaching, Physical Sciences myself, I think the discovery method is appropriate to create learners' understanding of concepts. I use what I call flat classroom. I give them problems to solve by themselves collaboratively.*

The inquiry-based method is considered as one of the most effective method in the teaching of Physical Sciences. The approach enables learners to engage in enquiries and discover knowledge on their own. This approach improves learners' problem-solving skills and enhances critical thinking (See Sub-section 3.2.2.1). The cooperative learning approach also emerged as equally important and effective. Literature states that the method includes team building, positive interdependence, group interaction, structured activities and individual accountability. Cooperative learning strategies promote greater learner academic gain (See Sub-section 3.2.2).

#### 5.5.2.6 Learning styles in which learners perform better in Physical Sciences activities

Some participants suggested learning styles that they believe are effective in the teaching of Physical Sciences. The participants had different preferences of learning styles regarding active learners, pragmatists, theorists and reflectors. Generally, effective learning styles appeared to concern individuals who prefer participation, discussion and collaboration to tackle learning activities. One participant said:

> *T4: I prefer that groups should be constituted to promote learner participation. Even those who cannot work by themselves, while in the group, they are not afraid to contribute as they know each other. They are not afraid to ask questions. Even those who are elected leaders feel honoured when assisting those who need assistance.*

The study established that active learners learn better in collaborative teaching environment and they prefer an interactive situation where they interact with other learners and teachers (3.2.1.1). Pragmatic learners prefer to learn through techniques, practical work and experiments. They prefer to learn through attending to real problems prevailing in the real world (See Sub-section 3.2.1.3). Theorists learners learn through observation and logical sounding theories, thinking through problems and applying step by step methodology (See Sub-section 3.2.1.4). Literature posit that reflectors like to gather and assimilate as much information as possible from a variety of sources before they are ready to make conclusions or judgements (See Sub-section 3.2.1.1).

### 5.5.3 Triangulation of Findings from Question Survey Using Individual Interviews

This section integrated findings which were obtained from the collection of quantitative and qualitative data. According to Bryman (2007:8), integration is a technique which involves an analysis, interpretation and reporting of quantitative and qualitative parts of a study to achieve an outcome that is mutually enlightening. The two data sets were combined to yield a product that is greater than the sum of each individual method (Guetterman, Fetters & Cresswell, 2015:555). The strategy of integration concerns merging or linking qualitative and quantitative components of information to bring fresh insight into the results of the investigation. The study integrated findings that were collected from the survey instrument with learners and interviews with teachers.

#### 5.5.3. 1 Textbooks contribute to teachers' academic performance in Physical Sciences.

The availability of relevant textbooks is primary in improving the performance of both teachers and learners in schools. Quantitative results showed that learners generally use different textbooks in the teaching and learning of Physical Sciences. Most participants 92 (92%) confirmed using different text books in the learning of Physical Sciences. This implies that most learners had their own text books which they used to complement those which were provided in schools. It also means that some of the participants did not share text books, which is a preferred condition for effective teaching and learning. 90 (90) participants indicated that they did not share reading materials for their Science lessons. This corroborated the qualitative findings which established that most schools had adequate Physical Sciences textbooks. There were however, few schools that did not have adequate textbooks for use in Physical Sciences. This implies that some Physical Sciences teachers rely on sharing the few available textbooks amongst learners or resort to using notes to assist learners. One participant said:

*T3: Yea, it is true, textbooks are very much vital even though in our school we don't have much resources. We are lacking a lot.*

Literature reveals that the use of different textbooks is very important as it has the potential to improve learners' experiences in Physical Sciences. The use of various text books helps learners to obtain adequate information from many sources (Sub-section 3.2.9). Learners should use different and relevant text books more frequently and intensively to prepare for their lessons. The use of different text books assists learners to do their class activities and home activities (Sub-section 2.3.1.2.1).

#### 5.5.3.2 The use of various teaching methods enhances the teaching of Physical Sciences.

The study indicated that teachers need to employ various teaching approaches to assist learners to master Physical Sciences concepts. Most learners (98%) attested to being given regular class activities that enhance their understanding by their teachers. 97 (97%) participants also confirmed that they are provided with home activities to improve their performance in the subject. This is consistent with literature which states that it is crucial to give learners assessment activities to increase their understanding of the content of the subject under study. Assessment is imperative because it is a diagnostic means of providing feed-back to teachers and learners over the course of instruction (3.2.9.2.3).

It also emerged that remedial lessons contribute immensely in the teaching and learning of Physical Sciences lessons. The results showed that a majority (98%) of participants confirmed the benefit of remedial lessons in improving the performance of learners. In the same vein, 40 (40% participants agreed, 54 (54%) strongly agreed that they learn Physical Sciences better through teachers' demonstrations. The use of group work as a preferred teaching method was confirmed by 79% of the participants. These views were confirmed by the findings of the qualitative study which highlighted that the knowledge of learners' styles of learning can help teachers to know the best teaching methods that they can utilize, inclusive of group work, lecture method, experimentation and

demonstration. Group learning, like demonstration and experimentation, promotes active learning as it allows learners to actively participate in the learning process (Sub-section 3.2.2.2). The inquiry-based method was also considered as one of the most effective methods in the teaching of Physical Sciences. The approach enables learners to engage in enquiries and to discover knowledge on their own, but under the guidance of teachers. This approach improves learners' problem-solving skills and enhances critical thinking (See Sub-section 3.2.2.1). Regarding the teaching methods, one participant said:

*T2: The method that I prefer is one which is learner centred. No one method can be used to teach Physical Sciences. I think the inquiry teaching method is appropriate*

**5.5.3.3 The use of computers helps learners to understand Physical Sciences**

The study indicated that learners were not conversant with the benefits of using computers in the teaching of Physical Sciences. 46 (46%) participants rejected the view that computers help learners to understand Physical Sciences. These results showed that most learners (64%) are not exposed to the use of computer programmes by their teachers to assist them to understand concepts in Physical Sciences. This corroborated the views of teachers who indicated that they are not using ICT gadgets in teaching Physical Sciences, owing to several reasons which they enlisted. This contradicts literature which contends that computers enable both learners and teachers to access information and other learning materials through google searches and other internet connections to enhance learning (Sub-section 3.2.4).

Many participants (55%) denied using cell phones to engage in group discussions with their classmates. The use of mobile learning (m-Learning) serves as a good measure to motivate learners in the teaching and learning of Physical Sciences. Computers and the related ICT services allow teachers and learners to access new and current information which is not available in textbooks. Laptops, overhead projectors, cellphones can be used during lessons to facilitate teaching. Two participants said:

*T8: ICT arouses learners' interests in such a way that they give the teacher all the attention than if the teacher is using the chalkboard, and it is also time saving.*

*T5: Yes, it does help the learners to get more information, especially the information which is not in the text books.*

#### 5.5.3.4 Use of fieldtrips to teach Physical Sciences

Participants (69%) showed that fieldtrips do not assist learners to understand Physical Science subject content. This resulted in most (60%) participants confirming that they were not helped by fieldtrips to perform better in Physical Sciences. It is generally assumed that field trips play a pivotal role in the learning progress of learners as they can consolidate information received theoretically in class or through lectures. The responses of participants contradict literature which states that fieldtrips help learners to engage in Physical Sciences programmes in real contexts (See Sub-section 3.2.1; See Sub-section 3.2.10).

Some participants revealed that they undertake field trips, but to a lesser extent as they are critical in their learning in Physical Sciences. T4 said: *I think fieldtrips are helpful even to grab the minds of learners and to encourage them to follow some careers.* Failure to engage in field trips was associated mainly with the shortage of funds or lack of funding. Most learners come from poor backgrounds which make them unable to pay for organised fieldtrips. In addition, some teachers lack expertise to organise such trips, making their schools very rare candidates for practical experiences for learners. One participant said:

*T7: Mm, field trips are very much helpful but expensive because places that need to be visited are far from our school. We always have challenges since we do not have money.*

#### 5.5.3.5 Conducting laboratory activities to improve learner understanding

The study revealed that most participants (47%) agreed that they are being assisted by laboratory experiments to master Physical Sciences concepts. 51 (51%) participants also viewed laboratory investigations as of crucial importance in the enhancement of their performance in the subject. It is however, significant that 68 (68%) participants confirmed that they were not conducting Physical Sciences activities in the laboratory, despite acknowledging their importance in their learning. Participant T5 said: *The serious challenge is that we are unable to perform the experiments as required by the syllabus.* This contradicts literature reiterates that laboratory activities are important in catering for the learners' development of practical skills. Learners benefit through interactions, hands on activities and applications which foster creativity in Physical Sciences (3.2.7). Teachers' knowledge and expertise in Physical Sciences is also important for learners to diligently understand and perform laboratory activities (See Sub-section 3.2.8).

The results of the qualitative study revealed that although, laboratory activities are vital in enhancing teaching and learning, there are challenges which hamper this endeavour. Schools are still facing serious challenges owing to inadequacy of buildings and equipment. Schools encounter lack of laboratory equipment and chemicals. The use of mobile laboratories and outdated laboratory facilities militates against effective experimentation in schools. One participant said: *T7: We do not have a laboratory. We just have a store room where we put our apparatuses.* This situation contradicts literature which states that laboratory activities have borne good results through improving learners' performance in Physical Sciences.

## 5.6 DISCUSSION OF FINDINGS

The major findings of the study generally revealed factors that are crucial in Grade 12 learners 'performance of Physical Sciences. These factors included the availability of textbooks, use of various teaching methods, availability and increased use of ICT gadgets and computers, use of fieldtrips and conduction of laboratory activities to improve learners' understanding. In relation to textbooks, it seemed that their availability

in schools was core in enhancing the performance of both teachers in their delivery of concepts and grasping of taught concepts by learners. The availability issue further seemed to go hand in hand with adequacy. This relates to the number of learners and the number of textbooks availed or provided in schools. Most schools had adequate textbooks such that, most learners were not sharing. In addition to adequacy, the study resonated that textbooks need to vary. This is important in the understanding of learners because the way authors or textbook writers explain concepts differs from one individual to the other. One may be able to simplify difficult concepts more than the other. It is important to consider variety so that all learners are included in the learning process. In this regard, results obtained through quantitative means revealed that schools generally used different textbooks in the teaching and learning of Physical Sciences and this was confirmed by most participants.

It also emerged that learners had their own personal textbooks which they used when at home. This was regarded as noble as it ensured continued learning from home to school. Literature substantiates that the use of different textbooks is very important as it has the potential to improve learners' experiences in Physical Sciences as well as obtaining adequate information from many sources (Sub-section 3.2.9). Learners should use different and relevant text books more frequently and intensively to prepare for their lessons. Also, Ausubel's theory of meaningful learning, which guided this study confirms that the use of different text books assists learners to do their class activities and home activities (Sub-section 2.3.1.2.1). Results gathered through quantitative methods corroborated with those obtained through qualitative means. It was observed however that, there were few schools that did not have adequate textbooks for use in Physical Sciences. This implies that some Physical Sciences teachers had to rely on sharing the few available textbooks amongst learners or resort to using notes in their delivery of relevant concepts.

Furthermore, the study showed that teachers need to employ various teaching approaches to assist learners to master Physical Sciences concepts. In this regard, most learners who took part in the investigation indicated that they were exposed to

regular class activities that enhanced their understanding of the taught subject. Furthermore, they also revealed that there were provided with home activities to improve their performance in the subject. This is consistent with literature which states that it is crucial to give learners assessment activities to increase their understanding of the content of the subject under study. Assessment is imperative because it is a diagnostic means of providing feed-back to teachers and learners over the course of instruction (3.2.9.2.3).

Quantitative data also revealed that remedial lessons contributed immensely in the teaching and learning of Physical Sciences lessons. The majority of participants felt that such lessons helped them to fully grasp the concepts that in most cases they would have failed to in the normal teaching-learning process. Furthermore, the study confirmed that teacher demonstrations as an approach in teaching assisted learners do imitations and, in the process, improve their understanding of what there were taught. Cooperative learning also proved to be useful in Physical Sciences as it helped learners to learn from their peers, share ideas and corroborate meaningfully. The findings of qualitative study further substantiated that the knowledge of learners' styles of learning assist teachers to adopt teaching methods that are relevant and inclusive. These encompass group work, lecture method, experimentation and demonstration. Group learning, like demonstration and experimentation, promotes active learning as it allows learners to actively participate in the learning process (Sub-section 3.2.2.2). The inquiry-based method was also considered as one of the most effective methods in the teaching of Physical Sciences. The approach enables learners to engage in enquiries and to discover knowledge on their own, but under the guidance of teachers. This approach improves learners' problem-solving skills and enhances critical thinking (See Sub-section 3.2.2.1).

Furthermore, it emerged that despite the crucial role that computers play in current educational trends, most learners were not fully aware of the benefits of using these gadgets in the learning of Physical Sciences. This owed to their limited exposure to computers and the programmes they offer. This corroborated the views of teachers who

indicated that they were not using ICT gadgets in teaching Physical Sciences, mainly because most of them had limited knowledge of relating certain computer programmes with certain concepts in Physical Sciences. This finding did not resonate well with literature which maintains that computers enable both learners and teachers to access information and other learning materials through google searches and other internet connections to enhance learning (Sub-section 3.2.4).

The results of the study further indicated that a significant number of participants could not acknowledge that field trips were vital in the enhancement of the understanding of Physical Sciences' concepts. This contradicted literature which states that fieldtrips help learners to engage in Physical Sciences programmes in real contexts (See Sub-section 3.2.1; See Sub-section 3.2.10). It was further revealed that some schools could hardly ensure that learners engaged in field trips and was mainly caused by shortage of funds to support this noble cause.

Above all, the study confirmed that laboratory experiments were important in the mastery of physical sciences concepts because these actually involved learners fully in their learning. However, it was revealed that some schools did not ensure adequate conduction of laboratory experiments by learners owing to inadequacy of buildings, laboratory equipment and chemicals. This contradicts literature which substantiates that laboratory activities are important in catering for the learners' development of practical skills. Learners benefit through interactions, hands on activities and applications which foster creativity in Physical Sciences (3.2.7). Teachers' knowledge and expertise in Physical Sciences is also important for learners to diligently understand and perform laboratory activities (See Sub-section 3.2.8).

## 5.7 CONCLUSION

This chapter analysed and interpreted data pertaining to enhancement Grade 12 learners' performance. Data analysis was based on the aim and objectives, literature review, of the study as infused in the design of questionnaire items and the interview

schedule. Quantitative data from 100 learners were analysed through the Statistical Package for Social Sciences (SPSS) version 25. Tests of significance were presented after quantitative data analysis. Qualitative data collected from 8 Physical Sciences teachers were presented and analysed thematically.

# CHAPTER 6

# SUMMARY, CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDIES

## 6.1 INTRODUCTION

This chapter presents the summary, conclusions, recommendations, limitations and suggestions for further studies. All these were guided by the research questions, literature review and the empirical investigations. Conclusions drawn from the findings of the study enabled the recommendations to be made the enhancement of learners' performance in Physical Sciences. The limitations of the study were also discussed. Suggestions for future studies were captured to offer fertile ground for prospective investigations in the field. The suggested model to enhance learners' performance was finally developed and presented.

## 6.2 SUMMARY OF FINDINGS OF THE STUDY

The summary of findings of the study was informed by the research questions, literature review and empirical investigations. The study was guided by the following main research question: How effective are strategies which are being used to enhance the performance of Grade 12 learners in Physical Sciences?

The following subsidiary questions were developed to address the main aim of the research question stated above:

### 6.2.1 Research Question 1: What Strategies are Employed to Enhance Learners' Performance in Physical Sciences?

The study established that there are different types of strategies that may be employed to enhance the performance of Grade 12 learners in Physical Sciences. The provision

of appropriate and adequate text books is a key strategy to improve the quality of teaching and learning. Learners value the use of different text books and use them frequently and intensively to prepare for classroom instruction. Text books enable learners to do their class and home activities. While most schools have adequate Physical Sciences textbooks, few have inadequate textbooks. Some teachers share few available textbooks with learners or resort to the use of notes to assist their leaners in Physical Sciences.

The study revealed that lack of qualified teachers in Physical Sciences is the main challenge at the schools that were selected. Some Physical Sciences teachers were teaching Grade 12 classes without requisite qualifications such as PTD, SPTD and outdated Secondary Teachers' Diplomas.

Laboratory activities were viewed as significant in the enhancing teaching and learning of Physical Sciences. They promote cooperative study, development of practical skills and understanding of concepts in Physical Sciences. Laboratory activities foster interactions, hands on activities, applications and learner creativity. Most of the schools under study did not have Physical Sciences laboratories and adequate chemicals. Teachers' knowledge and expertise in Physical Sciences is also important for learners to diligently understand and perform laboratory activities. Some teachers were not adequately qualified to deliver instruction in Grade 12 Physical Sciences. At times schools outsourced human resources to assist teachers in conducting Physical Sciences laboratory experiments.

The use of ICT gadgets like computers, tablets, cell phones, internet and other computer software is important in the learning of Physical Sciences, but teachers are unable to use such technologies as schools do not have funds to purchase them. Computer based and computer supported learning makes learning interesting and stimulating. Learners cooperate in certain technological environments such as in Computer Based Instruction (CBI). However, unreliability of networks for internet-based operations present a challenge in the teaching of Physical Sciences.

The study established that fieldtrips are important as they enhance learners' understanding. Fieldtrips motivate learners and enable them to interact outside the classroom environments through discussions, debates and collaborations. These enable learners to share common understanding of concepts and scientific phenomena. However, the study revealed that fieldtrips were not adequately undertaken in some schools, while in others they were not undertaken at all. Teachers found it difficult to organise fieldtrips because of financial challenges. Some schools were situated far from factories and industries making it very difficult for learners to engage in field trips due to financial constraints.

### 6.2.2 Research Question 2: What Teaching Styles are Used by Teachers to Enhance Learners' Performance in Physical Sciences?

The study established that teachers should use a variety of teaching approaches to improve the teaching of Physical Sciences. All teaching approaches are equally important. There is no teaching approach which is more important than others, but they are more effective when used together in a complementary manner. Therefore, teachers should familiarise themselves with different teaching approaches to enhance learners' understanding of concepts in the subject. The study also gathered that for effective teaching of Physical Sciences and learners' best performance, teachers should adjust their teaching approaches to accommodate different individual learning styles.

The study identified some teaching methods that are considered more effective in the teaching and learning of Physical sciences. The inquiry-based method and the cooperative learning approaches are effective methods in the teaching of Physical Sciences. These methods promote team building, positive interdependence, group interaction, structured activities and individual accountability. Cooperative learning strategies also promote greater learner academic gain during lessons.

The study established that it is the duty of the heads of departments to influence teachers to use a variety of teaching methods in the teaching of Physical Sciences to

enhance learners' performance. Heads of departments should influence teachers in their subject areas by monitoring them through class visits to establish a true picture of what happens in those classrooms. The study also established the subject committee meetings as another platform to address the issue of monitoring teachers. In such meetings, teachers discuss their challenges, frustrations and exchange fruitful ideas to improve their teaching skills.

### 6.2.3 Research Question 3: What Appropriate Learning Styles are Used by Learners to Enhance their Performance in Physical Sciences?

Learners prefer different learning styles. The study found out that learners learnt differently as unique beings. Activist learners learn better in collaborative teaching and they prefer interactive situations where they interact with other learners and teachers. Pragmatic learners prefer to learn through techniques, practicals and experiments. They also prefer to learn through attending real problems prevailing in the real world. Theorists learn by adopting observations, logical sounding theories, thinking problems and applying a step by step methodology. Reflectors like to gather and assimilate as much information as possible from a variety of sources before they are ready for assessment. It was also established that some learners learn better through observation of demonstrations by their teachers.

The study established that other learners learn effectively through group work. In this type of learning, a learning style commonly known as peer to peer learning is dominant. Group learning promotes active learning and allows learners to participate in the learning process. Teachers have a duty to make sure that learners discover their learning styles. They should also consider individual learning styles in their teaching processes to accommodate learners with diverse learning styles.

## 6.3 SUMMARY OF LITERATURE REVIEW

Literature review showed that teacher competency is important for effective curriculum delivery. Teacher competency refers to the ability of a teacher to deal adequately with the demand of the teaching profession using an integrated set of knowledge, skills and attitudes. These are manifested in both the performance of teachers and the reflections on their performance (See Sub-section, 2.2.1). The pedagogical content knowledge of teachers is critical in the teaching of Physical Sciences. This involves understanding of Physical Sciences topics and the way teachers should explain such topics to make them meaningful to learners. Pedagogical content knowledge relates to teachers who have a thorough knowledge of their subjects (See Sub-section 2.2.1).

Teaching approaches are ways that are used by teachers to facilitate teaching and learning in class. This stems from the realisation that learners do not learn in the same way. Therefore, for effective teaching to take place, various teaching methods should be employed (See Sub-section, 2.2.2). Inquiry-based learning and cooperative teaching methods are effective teaching methods, but they need to be complemented by other methods to enhance learners' performance (See Sub-section, 2.2.2.2). It is very important for parents to be involved in their learners' educational matters. Parents have a variety of roles which include being a legal guardian or a *loco-parentis,* such as a grandparent with whom a child lives or a person who is legally responsible for the child's welfare (See Sub-section 2.2.3). Parents' involvement has a significant effect on the quality of learning of their children, creating a positive school climate and enhancing overall learners' performance (See Sub-section 2.2.3). The parent-teacher cooperative relationship should be developed since they are both important stakeholders in the mission of educating the society.

Education Technology entails the use of technological devices that may be used in the classroom to enhance teaching and learning (See Sub-section, 2.2.4). This relates to the hardware, software and other digital technologies that are used to advance teaching, learning and administration. Two categories of technology involve the use of

technology in teaching and the use of technology in learning (See Sub-section, 2.2.4.2.1).

Motivation also plays an important role in the individuals' performance. For quality teaching and learning to prevail, both learners, and teachers need to get motivated (See Sub-section, 2.2.4). Sources of motivation can be categorised as either extrinsic (external of the person) or intrinsic (internal of the person). Intrinsic sources can further be sub-categorised as either cognitive, affective, conative or transpersonal, physical and mental. Motivation is also hinged on the needs of learners. Needs are viewed as dispositions toward action (See Sub-section, 2.2.4). This means that needs create a condition that is predisposed towards acting. Behaviour may be initiated by either positive or negative incentives or a combination of both. Behaviour may be more related to emotions and the affective area whereas persistence may be more related to conation (volition) or goal-orientation. Studies also established that salary or remuneration is one of the factors in motivating teachers (See Sub-section 2.2.4). The availability of material resources also serves as a source of motivation for both learners and teachers (See Sub-section, 2.2.2.4.2).

Human resources form the basis of the development of education. Literature suggests that for positive education development to prevail within a country, quality teacher resource receives the priority. Teacher qualifications and the level of teacher development in the subject play a significant role in enhancing learners' performance in Physical Sciences (See Sub-section 2.2.5). Teacher qualification involves a planned combination of learning outcomes which provides learners with applied competence and a basis for further learning (See Sub-section 2.3.3.2.1). This ensures that teachers have the required knowledge and skills in their discipline coupled with broad understanding of instructional skills for effective teaching and learning.

Teacher qualifications can be in the form of degrees, diplomas, certificates and other qualifications as recognised by the Minister of Education as criteria of appointment as a teacher (See Sub-section 2.3.2.1.2). However, the provision of adequate qualified Physical Sciences teachers is a challenge in most countries in Africa. This emanates

from the overcrowding of classes (See Sub-section 2.3.2.1.2). Teachers are also not able to give individualised attention, especially to slow learners and to learners with special needs (See Sub- section 2.3.3.2.3).

The use of adequate relevant text books enhances learners' performance in Physical Sciences (See Sub-section 2.3.3.2.1). The reviewed literature established that under-resourced classes are very much impersonal, and they are overpowering and result in poor performance of learners. Teachers can only teach effectively when they work in well-resourced classes (See Sub-section 2.3.1.2.1). Text books are important in supporting effective teaching and learning of Physical Sciences (See Sub-section 2.2.9). The provision of adequate text books is a strategy for achieving effective teaching and learning (See Sub-section 2.2.9).

## 6.4 SUMMARY OF THE EMPIRICAL FINDINGS

This section presents a summary of empirical findings.

### 6.4.1 Research Question 1: What Strategies are Employed to Enhance Learners' Performance in Physical Sciences?

Research question 1 sought to establish strategies that were adopted by schools to enhance learners' performance in Physical Sciences. Focus was given on the availability of teaching and learning resources, use of laboratory experiments, availability and use of ICT gadgets, educational excursion and assessment of learners' work.

The study established that teaching and learning resources are crucial in the teaching and learning of Physical Sciences. Teaching and learning resources provide the potentials required to improve individual learning experience. Moreover, teachers teach effectively in well-resourced environments. The use of different textbooks is important in the teaching and learning of Physical Sciences. The study indicated that learners value text books and use them more frequently and intensively to prepare for lessons.

Textbooks are the most effective teaching aid and the availability and use of different text books enable learners to do their class and home activities more successfully. It emerged that although most schools have adequate Physical Sciences textbooks, some teachers resort to asking their learners to share the few available textbooks. Other teachers use their notes to counter the shortages of Physical Sciences textbooks.

The study further established that lack of human resources in Physical Sciences posed a challenge at Grade 12 and some teachers were teaching the subject while still holding the old Secondary Teachers' Diploma. These teachers had not upgraded their qualifications. Moreover, some Physical Sciences teachers did not qualify to teach Grade12 because they held primary teaching qualifications such as PTD and SPTD.

The study found that laboratory activities or experiments stimulate teaching and learning. Experiments encourage learners to use both their hands and minds. Laboratory activities also enable learners to work in groups and at their own pace. Learners benefit a lot through engaging themselves with concepts when they do practical work which involves interactions, hands on activities and applications. Although laboratories are very important, schools are still facing a serious shortage of these facilities. The study also established that well-resourced schools are imperative in the enhancement of learners' performance in Physical Sciences. However, some secondary schools did not have adequate laboratories for conducting experiments. Furthermore, schools also suffered from the unavailability of qualified teachers that can successfully conduct laboratory experiments.

The use ICT gadgets was shown to play an important role in the enhancement of learners' performance. ICT gadgets such as laptops, overhead projectors and tablets are very useful in teaching since they save teachers a lot of time. Unfortunately, teachers and learners are unable to use most of the available technologies as most schools cannot afford to buy such electronic gadgets. The only ICT technologies they use are data projectors and laptops. Moreover, the unstable internet connection also

contributes to the challenges which teachers and learners encounter when using ICT technology.

Educational fieldtrips are crucial in the enhancement of learners' performance. However, some schools do not undertake these educational fieldtrips because the targeted factories for trips in Physical Sciences are located far from schools in the district under study. The financial challenge is the main factor hindering the execution of fieldtrips. The schools that were selected for this study are situated in poverty dominated areas where most bread winners do not have money to support their children's educational excursions or field trips.

The findings of the study revealed that the assessment of learners is very important because it assists learners to meet the required standards. Heads of departments play an important role in ensuring that teachers are properly implementing the assessment process. The HODs have a role to moderate the assessments that are designed for learners to ensure that teachers stick to the stipulated standards. They are also supposed to audit written works to ensure that teachers properly implement assessments in accordance with the assessment policies available. HODs hold meetings with teachers which serve as a platform to empower them on the way to properly implement assessment activities. Formal and informal assessments must be done in classrooms immediately after the execution of the lesson. HODs also organise school-based workshops in the form of subject meetings to discuss assessment procedures in ways that seek to promote a thorough understanding of assessment of learners.

### 6.4.2 Research Question 2: What Teaching Styles are Used by Teachers to Enhance Learners' Performance in Physical Sciences?

This research question sought to establish the teaching styles that were adopted by teachers to enhance learners' performance in Physical Sciences. The intention was to determine whether teaching approaches were used appropriately and that a variety of teaching approaches were adopted to cater for a diversity of learners.

Empirical findings showed that appropriate teaching approaches influence learners' academic performance and the use of relevant methods in teaching Physical Sciences is imperative since learners learn differently. The knowledge of learners' level of understanding and their learning styles can help teachers to select the best teaching methods that could be effectively applied.

Some teaching approaches are very effective in the teaching and learning of Physical Sciences. The inquiry-based method is shown as one of the most effective methods in teaching Physical Sciences. Inquiry based method enables learners to engage in investigations to discover issues on their own. The cooperative learning approach is also equally effective and is characterised by team building, positive interdependence, group interaction, structured activities and individual accountability.

### 6.4.3 Research Question 3: What Appropriate Learning Styles are Used by Learners to Enhance their Performance in Physical Sciences?

Research question 3 sought to establish the learning styles that were adopted by Physical Sciences learners to enhance learners' performance in Physical Sciences. The focus was on different learning styles preferred by learners, roles of teachers and HODs in ensuring learning styles are considered during the teaching of Physical Sciences.

The study revealed that activist learners learn better in collaborative teaching and they prefer interactive situations where they interact with other learners and teachers (2.2.1.1). On the same note, pragmatic learners prefer to learn through techniques, practicals and experiments. They desire to learn by attending to problems prevailing in the real world (See Sub-section 2.2.1.3). On the other hand, theorists learn by adapting observations, logical sounding theories, thinking problems and applying step by step methodologies (See Sub-section 2.2.1.4). Learners who are reflectors like to gather and assimilate as much information as possible from a variety of sources (See Sub-section 2.2.1.1). Some participants also suggested the learning styles that they

consider effective in the learning of Physical Sciences, inclusive of individual work, group work and discussion.

Teachers need to assist learners to realise the learning styles with which they are comfortable to learn. Teachers should always observe and adjust their teaching approaches to make sure that they best fit individual learners and in their diversity (See Sub-section 3.3.6). Individual learning styles are crucial in enhancing the understanding of learners in Physical Sciences.

Teachers should use several teaching approaches to accommodate the diverse individual styles of learners. For example, some learners prefer to work in groups while some prefer to work alone. In this regard, teachers should also try to encourage learners to use the learning styles which are affective and encourage them to share information with others through discussions, debate and cooperation. Most learners prefer to use learning styles which allow the exchange of ideas, information and cooperation with others.

### 6.4.4 Research Question 4: What Challenges Do Schools Encounter when Teaching Physical Sciences?

Research question 4 sought to establish the challenges faced by schools in the teaching Physical Sciences. The focus was on the lack of human resources in Physical Sciences and the limited material resources that Physical Sciences teachers and learners encounter.

The study established that qualified teachers are the most important factor in the provision of quality teaching and learning. They play an important role in effective curriculum delivery. Teachers should have the required knowledge and skills to teach. Qualifications assist teachers to develop a broader understanding of the subject and instruction skills for effective teaching (See Sub-section 2.2.5). The study also established that most countries are still faced with a serious shortage of qualified teachers (See Sub-section 2.3.1.2.3). Some schools are forced to outsource human

resources to assist them in the teaching of Physical Sciences. Some teachers are underqualified to teach Grade 12 Physical Sciences

The availability of adequate textbooks enables Physical Science teachers and learners to finish their syllabus well ahead of time since learners can study and revise at their own pace (See Sub-section 2.3.3.2.1). The use of text books improves teachers' flexibility and provides learners with new information direct from the source (See Sub-section 2.3.3.2.1). Few schools have inadequate Physical Sciences books while most schools have sufficient and a variety of textbooks. The study found out that most schools have relevant Physical Sciences text books and that these benefit learners in understanding important concepts. The availability of relevant textbooks improves the quality of teaching and learning and the eventual learner performance (Sub-section 2.10; 2.2.9). Most participants expressed the common challenge that their schools are situated far away from the factories and industries which are relevant for learners to visit to increase their knowledge of Physical Sciences. It is very difficult for teachers to take learners for fieldtrips because of financial constraints.

## 6.5 CONCLUSIONS

The study examined the strategies to enhance Grade 12 learners' performance in Physical Sciences in the Mopani District. The conclusions outlined below are based on the findings of the study.

### 6.5.1 Research Question 1: What Strategies are Employed to Enhance Learners' Performance in Physical Sciences?

There are a variety of strategies that may be employed to enhance the performance of Grade 12 Physical Sciences learners. The provision of teaching and learning resources is a crucial strategy to enhance learners' performance in Physical Sciences. Relevant and adequate text books are imperative to support effective teaching and learning processes. The use of different text books make assists learners to do their class and

home activities. Some schools operate without an adequate supply of textbooks, making it difficult for learners to improve academically.

Teachers who are knowledgeable and have required skills in the teaching of Physical Sciences enhance learners understanding. The provision of qualified Physical Sciences teachers is the main challenge in the Mopani District. Laboratory activities encourage cooperative learning in learners and the development of practical skills. The shortage of well-equipped laboratories hampers the teaching and learning of Physical Sciences.

Some schools do not have ICT technologies for teaching because they cannot afford purchasing such gadgets for their learners. The use of ICT technologies like computers, tablets, cell phones, internets and other computer software play a significant role in enhancing learner understanding and performance.

Field trips serve as a source of motivation for learners in their learning processes because they are exciting, and learners interact with each other outside the classroom. Few fieldtrips are organised in the Mopani district schools because of financial difficulties. Parental involvement in the education of their children creates cooperation between the two parties and influences a positive culture of learning. However, in the Mopani District some parents are illiterate and cannot therefore assist their children with schoolwork.

### 6.5.2 Research Question 2: What Teaching Styles are used by Teachers to Enhance Learners' Performance in Physical Sciences

The use of appropriate teaching approaches influences learners' academic performance. The employ of various teaching methods in Physical Sciences is imperative since learners do not learn in the same way. Teachers should know the level of understanding of learners and their learning styles to select the best teaching method that could be effectively applied in class. There are some teaching approaches that are more effective in the teaching and learning of Physical Sciences. Most Physical

Sciences teachers in the Mopani District use a combination of the inquiry-based and the cooperative methods teach Grade 12 Physical Sciences.

### 6.5.3 Research Question 3: What Appropriate Learning Styles are Used by Learners to Enhance their Performance in Physical Sciences?

Learners are unique beings and therefore differ in the way in which they learn. Learners can be categorised basing on their learning styles such as activist learners, pragmatic learners, theorists and reflectors. Learners' adopt learning styles that they believe are effective in the learning of Physical Sciences. Teachers and subject advisors must understand learners' learning styles to assist them to realise their learning potentials. Teachers should also adjust their teaching approaches to fit learners and their diversity in terms of learning styles. Teachers use a variety of methods to accommodate the different learning needs of individuals. Teachers do not consider it their duty to adjust to learners' different learning styles for them to master subject content.

### 6.5.4 Research Question 4: What Challenges Do Schools Encounter when Teaching Physical Sciences?

Qualified teachers are the most precious factor in the provision of quality teaching and learning. Teacher qualification ensures that teachers have the required knowledge and skills to teach Physical Sciences. Qualifications develop teachers' broader understanding and effective teaching skills. Most countries, like Mopani District, are still faced with serious shortages of qualified teachers. Outsourcing of human resources in Physical Sciences from other schools assists in the teaching of Physical Sciences. There are teachers who are underqualified to teach Grade 12 Physical Sciences in the district.

Schools are also faced with the challenge of not having adequate supply of text books. Adequate supply of relevant text books enables Physical Science teachers and learners to finish their syllabus well ahead of time. With the availability of adequate textbooks

learners can revise material at their own pace and time. An adequate supply of relevant textbook also enables teachers to adopt the text book method of teaching which provides teachers with some flexibility since it provides information from the source. There are schools in Mopani that do not have adequate text books and learner in such schools should share the available ones. Different text books assist learners to get different perspectives on the same concept.

Most schools in Mopani District do not have laboratories and laboratory equipments. Some Physical Sciences teachers and learners do not conduct the laboratory investigations since the laboratory facilities are not available in their schools.

The use of mobile laboratories in some schools stifles the conduct of experiments and the overall performance of learners. Some schools have laboratories which are not up to standard since they do not have apparatuses or have expired chemicals. Most schools experienced a common challenge regarding the undertakings of excursions because of financial challenges.

## 6.6 RECOMMENDATIONS

The study recommends the following:

### 6.6.1 Research Question 1: What Strategies are Employed to Enhance Learners' Performance in Physical Sciences?

- The district Department of Education should provide an adequate number of qualified teachers in all schools.

- The Department of Education should intensify the Continuing Professional Teacher Development (CPTD) to improve teachers' qualifications in the district.

- Teachers should also be encouraged to enroll with institutions of Higher Education to upgrade their qualifications.

- The district must also provide all schools with adequate and relevant Physical Sciences text books.

- The district should provide schools with different types of text books for effective teaching and learning in Physical Sciences.

- The district Department of Education should organise workshops to train Physical Sciences teachers on content knowledge and on how to conduct laboratory activities with learners.

- The district department should increase the norms and standard grants to enable schools to undertake educational excursions or fieldtrips.

- School principals and their management teams should organise and arrange fundraising programmes to raise money for fieldtrips and purchasing of ICT technological equipment.

- The use of modern technologies that are useful in teaching Physical Sciences.

- Parents must also procure Physical Sciences equipment for their children.

- Parents who are literate should also help their learners with their school work.

- Assessments should be properly done, and heads of departments should provide the necessary resources for assessment. They should also monitor teachers' assessment of learners and give the necessary support where needed.

### 6.6.2 Research Question 2: What Teaching Styles are used by Teachers to Enhance Learners' Performance in Physical Sciences?

- The district department and HODs should arrange subject meetings where teachers are trained and encouraged to use effective teaching approaches that are crucial in Physical Sciences.

- HODs should also encourage teachers to make use of a variety of teaching approaches, giving priority to inquiry-based and cooperative teaching approaches.

### 6.6.3 Research Question 3: What Appropriate Learning Styles are Used by Learners to Enhance their Performance in Physical Sciences?

- Teachers should acknowledge learners' individual learning styles in their teaching activities.

- Teachers must use teaching approaches that can accommodate all learners' learning styles.

- HODs should also ensure that teachers consider individual learning styles to enhance the performance of learners.

### 6.6.4 Research Question 4: What Challenges Do Schools Encounter when Teaching Physical Sciences?

- The DoE should develop a strategy to attract more Physical Sciences learners to enroll with universities and other Higher Education institution to train as teachers.

- The DoE should encourage unqualified Physical Sciences teachers who are already in the system to upgrade their qualifications.

- The District Department of Education must erect Physical Sciences laboratories that are well-resourced with adequate and relevant equipments and chemicals.

- The district must organise trainings or teacher workshops regarding the content knowledge and on how to conduct laboratory investigations.

- School management teams should organise fundraising programmes to get funds to pay for excursions or fieldtrips.

## 6.7 SUGGESTIONS FOR FURTHER STUDY

The study on the strategies to enhance Grade 12 learners' performance in Physical Sciences creates some opportunities for further study in this field. A research may be conducted in the same field making use of mixed research approach but with the Head of departments, school principals, subject advisors including the parents. This would solicit some information regarding their perceptions and the nature of their contribution in the teaching and learning of Physical Sciences in schools.

## 6.8 LIMITATIONS OF THE STUDY

The study on the enhancement of Grade 12 learners in Physical Sciences in the Mopani district involved all secondary schools in the district. Mopani is a rural district and its circuits and schools are sparsely distributed. This situation made it difficult for the researcher to move from school to school collecting data in different circuits within the district. Challenges emerged during the process of data collection where it was at times difficult to gather data when teachers and learners were busy with school programmes. The researcher had to arrange for another convenient date to collect data.

## 6.9 PROPOSED MODEL FOR THE ENHANCEMENT OF LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES.

Fig.6.1 shows the proposed model for the enhancement of learners' performance in Physical Sciences in schools. The proposed model suggests strategies for improving the performance of learners in Grade 12 Physical Sciences. This section presents a proposed model for the enhancement of learners' performance in Physical Sciences.

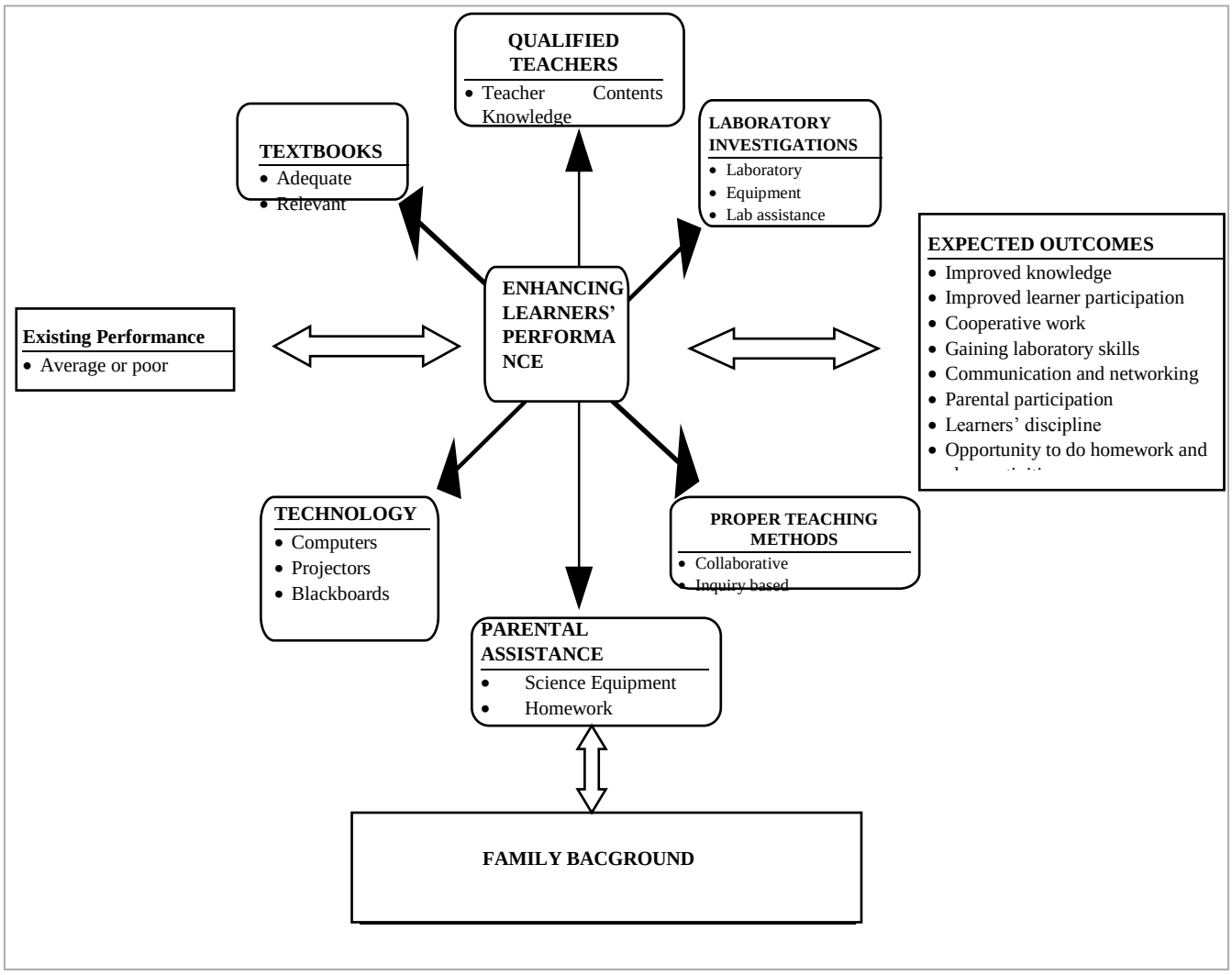



**Fig. 6.1: Proposed Model for the Enhancement of Learners' Performance in Physical Sciences**

Fig.6.1 shows the proposed model for the enhancement of learners' performance in Physical Sciences in schools. The proposed model suggests strategies for improving the performance of learners.

### 6.9.1 Existing Performance

The first thing to be done is to evaluate the initial performance of Physical Sciences learners. This will help teachers to know the position of schools in terms of learner performance. They should know the existing performance for proper planning regarding interventions that could be implemented to remedy the situation. Strategies that enhance learners' performance could then be identified and implemented guided by the results from the analysis of the presenting situation.

### 6.9.2 Qualified Teachers

Qualified teachers who have PKC and have outstanding professional content knowledge are required. Qualified teachers are the most precious factors for the implementation of quality teaching and learning. Qualified teachers are the basic requirement that the Department of Education should have for better teaching and learning of Physical Sciences. Teachers who are qualified and have knowledge and skills of how to conduct laboratory practical experiments contribute immensely to improve learner understanding and the consequent academic performance of learners. These would then teach guided by their experiences on the use of most effective strategies to enhance the performance of learners in Physical Sciences.

### 6.9.3 Textbooks

Text books are also crucial in the enhancement of learners' understanding in Physical Sciences. They help teachers and learners to conduct the text book method which is time saving and effective. If textbooks are adequately supplied, learners could get first-hand information from textbooks and have an opportunity to work on their own at school

and at home. Parents would also be able to assist learners with homework using text books. Learners would attend to planned activities and be able to find proposed solutions in the books as assisted and motivated by teachers and parents.

### 6.9.4 Laboratory Investigations

Laboratory investigations also play a crucial role in the enhancement of effective teaching and learning of Physical Sciences. The targeted goal would be good performance in the subject. Physical Sciences should not be taught and learned theoretically. If there are well-resourced laboratories, with adequate equipment, chemicals, knowledgeable teachers and laboratory assistants, the teaching and learning of Physical Sciences would become interesting and effective. Laboratories are crucial and could make a difference in the teaching and learning of Physical Sciences. They also encourage collaborative learning amongst learners where learners can exchange ideas and assist each other. Through laboratory activities, learners also develop love and interest in the subject through investigation. Learners also learn to develop hypotheses, problem solving skills, conduct investigations, and understand the reasons behind the use of apparatuses and chemicals.

### 6.9.5 Proper Teaching Methods

Proper teaching approaches are very significant in the enhancement of learner performance in Physical Sciences. There is no single teaching approach which is considered the best and which can be used alone. Different teaching approaches are used depending on what is being taught and learned or the concepts which the teacher intend to transfer to the learner. Inquiry-based and collaborative approaches are the most crucial in the teaching of Physical Sciences. These approaches always work to complement each other for the realisation of better outcomes. The preferred approaches are also hinged on the learning styles of individual learners. Learners are unique beings with different learning styles. The four learning styles recognise the activists, pragmatic learners, theorists and reflectors. Teachers should consider

learners' individual learning styles to make sure that their teaching approaches fit with the needs of learners for effective teaching and learning in Physical Sciences. Assessment should also be done properly inclusive of formative assessment, diagnostic assessment and summative assessment. Its purpose should be to check the congruence between the intended and the actual levels of attainments.

### 6.9.6 Technology

ICT gadgets and education technology are very crucial in the enhancement of learner performance. The use of ICT gadgets like computers, cell phones, laptops and tablets has an important role in the enhancement of learners' performance. Teachers and learners should effectively communicate using social networks and discuss, solve problems and share learning experiences. They can also share information and ideas through ICT gadgets. Teachers and learners should also teach, learn and observe experiments through online laboratories. These virtual platforms enhance the performance of learners as they are not limited by time, space, geography and so on.

### 6.9.7 Parental Assistance

Parental participation in the learning of their children is also important. When parents are involved in their children's learning, learners start to see the value of education. When they realise that the community and their parents have an interest in their education, they also take learning seriously. Parents' support for their children's education motivates learners to do their homework. Parents also get involved by assisting their children to write home activities. When parents make it their duty to assist their children to complete the homework activities, they have a chance of talking with their children about education in general. Parents could also notice their children's educational needs and satisfy them without delay. Parents could support their children buy purchase equipment to their children. They can also pay their children for extra lessons.

### 6.9.8 Expected Outcomes

The implementation of strategies to improve the performance of learners in Physical Sciences should lead behaviours such as improved participation of learners. There should be proper alignment of theoretical grounding and experimentation in the subject. Learners must work meaningfully in groups to respond to the needs of assigned activities. There must be open and free communication between the teacher and learners as well as among learners on academic issues in Physical Sciences. The interaction and collaboration in the process of experimentation should lead to critical thinking, problem solving skills and practical experience. Learners should comprehend laboratory activities in an intimate way. Parents should also be reigned fully in the teaching and learning processes in ways which make it automatic for them to be involved in purchasing needed equipment for experiments and assisting their children with home assignments.

## 6.10 CONCLUSION

This chapter presented and discussed the summary of the study. This was based on findings of the literature review and the quantitative and qualitative data analysis. The summary of the empirical study was also presented and discussed based on the research questions and from findings which emerged from gathered data on strategies to enhance learners' performance in Physical Sciences. Conclusions were drawn based on the findings of both the literature review and data analysis. The recommendations of the study were also given guided by the conclusions. The recommendations were on the enhancement of learners' performance in Physical Sciences. Limitations of the study were discussed and suggestions for further studies were also proposed. The chapter ended with the presentation of the proposed model for the enhancement of learners' performance in Physical Sciences.

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# APPENDICES

## APPENDIX A

## AN INVENTORY OF GRADE 12 LEARNERS PERFORMANCE IN PHYSICAL SCIENCES

### INTRODUCTION

This questionnaire contains statements that suggest some factors which may influence learners' academic performance in Physical Sciences. Kindly read through each statement and decide whether you strongly agree, agree, you are undecided, disagree or strongly disagree.

### SECTION 1: BIOGRAPHICAL DATA

**Kindly complete these items by giving appropriate answers where applicable or put an X in the provided space(s).**

**1.1 Gender** **Male** ☐ **Female** ☐

**1.2 Age (in years): ……...**

### SECTION 2: STATEMENTS THAT RELATE TO LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES

Choose a category that closely represents your perception on the extent to which each of the strategies employed in Physical Sciences teaching enhance your academic performance. Indicate your choice by marking with an **X** in the appropriate space from **SA = Strongly Agree, A= Agree, UD = Undecided, D = Disagree or SD = Strongly Disagree.**

| | SA | A | UD | D | SD |
|---|---|---|---|---|---|
| **STATEMENTS BASED ON THE PHYSICAL SCIENCES TEXT BOOKS USED** | | | | | |
| 2.1. I use my own text book to study Physical Sciences. | | | | | |
| 2.2. There are other text books available for use to study Physical Sciences. | | | | | |
| 2.3. Different text books to study assist me to achieve good results in Physical Sciences. | | | | | |
| **STATEMENTS BASED ON LABORATORY INVESTIGATIONS**. | | | | | |
| 2.4. My school has a well-equipped Physical Sciences laboratory. | | | | | |
| 2.5. We conduct Physical Sciences practical activities in the laboratory. | | | | | |
| 2.6. Conducting Physical Sciences activities in the laboratory enhances my performance in Physical Sciences. | | | | | |
| **STATEMENTS BASED ON TECHNOLOGY** | | | | | |
| 2.7. My Physical Sciences teacher also uses computer programmes to teach some Physical Sciences concepts. | | | | | |
| 2.8. The use of computers in learning Physical Sciences helps me to understand the subject better. | | | | | |
| **STATEMENTS ON EDUCATIONAL FIELDTRIPS** | | | | | |
| 2.9. Fieldtrips help me to gain a better understanding of Physical Sciences aspects. | | | | | |
| 2.10. Fieldtrips help me to perform better in Physical Sciences. | | | | | |
| | | | | | |

| STATEMENTS BASED ON MEASURES TO ENHANCE CONTENT MASTERY | | | | | |
|---|---|---|---|---|---|
| 2.11. The Physical Sciences teacher regularly gives Class activities. | | | | | |
| 2.12. The Physical Sciences teacher usually gives home activities that enhance understanding. | | | | | |
| 2.13. Extra lessons improve my performance in Physical Sciences. | | | | | |
| **STATEMENTS ON LEARNING STYLES** | | | | | |
| 2.14. Practical work in Physical Sciences helps me to understand concepts. | | | | | |
| 2.15. I learn best through teacher demonstrations. | | | | | |
| 2.16. I prefer learning through group work with my peers. | | | | | |
| **STATEMENTS ON PARENTAL INVOLVEMENT** | | | | | |
| 2.17. My parents buy me Physical Sciences equipments such as stop-watches, calculators and batteries. | | | | | |
| 2.18. My parents pay for my Physical Sciences extra lessons. | | | | | |

## APPENDIX B

## INTERVIEW SCHEDULE: PHYSICAL SCIENCES TEACHERS' VIEWS ON THE ENHANCEMENT OF LEARNERS' ACADEMIC PERFORMANCE ON PHYSICAL SCIENCES

### 1 BIOGRAPHICAL INFORMATION

1.1 Gender: Male ☐ Female ☐

1.2 Age (in years): ……

1.3 Experience in years as a Grade 12 Physical Sciences teacher: ……...

1.4 Professional Qualification ……..

1.5 Highest Academic Qualification in Physical Sciences…….

### 4 CONTEXUAL QUESTIONS

2.1 In what ways do text books contribute to learners' academic performance in Physical Sciences?

2.2 How do laboratory activities contribute to learners' academic performance in Physical Sciences?

2.3 What are the challenges you encounter when conducting laboratory activities with your learners?

2.4 The adoption of Information Communication Technologies (ICT) gadgets has gained acceptance in the current educational system worldwide. How do you find the use of ICT helpful in your teaching of Physical Sciences?

2.5 Education fieldtrips have an important role to play in the enhancement of learners' performance. How do you utilise the fieldtrips to teach Physical Sciences.

2.6 Under what circumstance do you apply a variety of teaching approaches to Physical Sciences learning activities?

2.7 In what types of learning styles do learners perform better in Physical Sciences activities?

2.8 How do fieldtrips contribute to the success of teaching Physical Sciences?

# APPENDIX C

## TRANSCRIPTIONS

The participants were comprised of eight Grade 10 Physical Sciences teachers. Concerning qualifications in Physical Sciences,1 teacher had BSC (Hons), 3 teachers had obtained BED degree, one had HED, one has STD and the last one held PGCE. Qualifications of these teachers satisfy the requirements to teach Physical Sciences. Minimum requirements to teach Physical Sciences in Grade 12 is a diploma or Advance Certificate in Education. The above information implies that qualifications of teachers were impressive.

**THE PERCEPTION OF PHYSICAL SCIENCES TEACHERS REGARDING THE ENHANCEMENT OF LEARNERS' PERFORMANCE IN PHYSICAL SCIENCES.**

The data collected from the interview session conducted with Physical Sciences teachers was analysed and presented.

**Question 1**

**Teaching and learning resources are vital in improving the learners' performance. In this view, what is your opinion on this statement?**

**Participants' responses:**

***T1***: *"Eee, it, it is very important to have teaching and learning materials in a class because I think in terms of the subject that we are offering, Physical Science is practical subjects in which it means learners must have to do it practically be done practically. Most of the things must be proved and there is a lot of practicals that are needed that is why if the learners are not having the practical materials it is not going to be fruitful for them to study in Physical Sciences.*

T3: *"jaa, it is true, they are very much vital even thou in our school we don't have much resources, we are still lacking because even if we don't have the apparatus we are lacking a lot. Some of the experiment we can't perform because we don't have enough apparatus. Currently. Mm... we do not have resources, we are still lacking. Some of the experiments are doing them theoretically, because we don't have apparatus and most of the experiments we are doing them theoretically".*

T2: *"I, resources such as apparatus used during the experiments help the learners to know more about what they are doing and whereas only teaching without them*

T6: "Jaa teaching resources are very important because learners want to see what they have been taught and they want to see how it was done not only to know by the teachers' words and through writing they must also want to experience what they have been taught".

T7: *"We do have text books, but we do not have enough in many cases we end up giving our learners you know few books and we end up grouping our learners to share the books. This is the only way. The only solution by grouping them and also by making some few copies at the office and give learners without books".*

T7: *"We do have all these other materials like textbooks and chalks and dusters but don't think they are enough because the world is changing almost every day and they use of ICT in the learning situations is very much important and it brings learning to a situation where you can find learning of Physical Sciences very interesting".*

T2: *" We are having the text books, we are using the solutions. They are adequate".*

T8: *"It is true because these resources play a crucial role. Of course, we don't have shortages of text books. For subjects like Physical Sciences and Mathematics we do have. They are available.*

T6: *"Yes I agree with this statement to say the resources are important in teaching. so, learners may have text books, sometimes they may not use them well. "Yes, text books sometimes, I can say they may have more than one text book sometimes, but sometimes they may not utilise them in a best way. So, I prefer that my learners use a two different text books. When learners have more than two text books, sometimes it causes confusion. You may find that learner may not know where to start or does not even know how to study using those text books. But every important for them to have text books. Yes, we do have textbooks, we provided them with text books and many of them have their own, otherwise we are using more than one text books".*

**Question 2**

**What are the challenges you encounter when conducting laboratory activities with your learners?**

**Participants' responses:**

T1: *"Mmm, the challenge that am facing ke shortage of apparatus as compared to the learners that am having. I've got bigger number that does not correspond with the material that in having. The lab is there but there are old things and apparatus which are not made for these learners".*

T2: *"Now we currently do not have laboratory, we borrow equipments from other schools and perform the experiment, so learners are afraid to explore equipment since they are not used to them since they do not have them in their school"*

T3: *" I think I have already mentioned that we don't have chemicals and apparatus, we have just a classroom were to put few apparatuses we have. Sometimes we interact and join other schools. But sometimes we find that those schools also do not have. Our circuit in general is lacking resources, Jaa... our circuit in general has got a challenge".*

T7: *The problem which we most of the time have is we don't have apparatus at all. So we don't have apparatus at all. So, we don't have apparatus at all, so we end up taking learners to the institutions with the apparatus and it consumes a lot of time and also the learners whom their parents are not working, and they end up going because they don't have money tom pay for the trips.*

T8: *"Jaa of course I have a mobile teaching laboratory. But further than that what I do. I arrange excursions to the laboratory to Giyani. I used to go to Giyani. I rely much on this centre unlike relying on my equipments because you will find that some are already expired. So, I usually take learners to the Science centre in Giyani".*

T6 *"Eee! the first problem is the running of the laboratory. We have the shortage of practical apparatus, and the second thing is the shortage of storage where we can put safely the chemicals that use. Most of the chemical are already contaminated because they are not safely kept".*

T2: *"Hey, challenges in labs is huge, the first one is lack of chemicals and chemicals infrastructures themselves. We don't have a science laboratory, we just have a storeroom top store things. But we don't have sinks, we don't have benches, we don't have gas chamber, we don't have running water system. So, in terms of laboratory, we don't have a lab … we don't have a lab".*

T6: *"Yes with this one I'm …. we do have the apparatus we do have some equipments, we do perform experiments and we are performing experiments but*

*the water we are using in this laboratory is not purified it is contaminated. The challenges with this one if you check here we don't have what we call a distilled water, so we do perform experiments with water which is contaminated. Distilled water is not there, and I don't know where to get it".*

**Question 3**

***The adoption of Information Communication Technologies (ICT) gadgets has gained acceptance in the current educational system worldwide. How do you find the use of ICT helpful in your teaching of Physical Sciences?***

***PARTICIPSANTS RESPONSES:***

*T1:* *"It is very difficult for us to use gadgets, on the first place, it has to do with the network that we are not having in our area. If we specifically say we are having gadgets that were donated by the MTN. Those gadgets are not working, the Wi-Fi that they provided is not working because of poor network around the school itself. So, we find it difficult to use those gadgets".*

T1 "*Learners need to be very much discipline in using their cellphones yes of course it can be helpful because most of the information we got nowadays we got when you go to internet and when you go for google. Then on other side some learners sometimes they misuse the phone by getting to social media and other networks that are addictive and distort learners' concentration".*

*T2:* *"The ICT gadgets are useful because they involve things that learners can see, learners may see what they learn. But we don't have gadgets and we don't have things like videos, TVs and other things. If we have them we could make use of them" T 10* "Like I've said, with the ICT, and all this gadget, we make sure that of all the information is there, learners will have different views because they will be able to *go to the internet and search for the information they want to learn.*

*Learners are able to debate and discuss scientific issues because they develop to have different views and understanding".*

T6: *What I do is just to encourage them to have chart groups and so forth and sometimes I send the what we call eee... eee information electronically to the learners them so that they can study at home, they can study with their friends they can share through what we call maybe what sup group". The most commonly used technology in our school is the overhead projectors and the laptops".*

T7: *"Technology can build or destroy. We sometimes request learners to bring their phones and use them to search for information. But learners need serious monitoring because if they are not checked, they start doing things that are obstructing their learning".*

T3: *"The norms and standard that we receive from the department cannot afford to purchase the necessary gadgets required. We need gadgets like tablets that learners may even share. We only have overhead projectors. We have only two computers in the office. I can only look for the information and print them for learners".*

T3: *Cell phones are seemed to be the most usable and simple devise that most learners may manage to have. But the main challenge facing most of the teachers and leaners is that in most schools, learners are not allowed to bring cellphones to schools.*

T2: *"They don't allow learners to use cell phones at school. They can use cell phones for learning only after school. Cell phones are not allowed at our school. Because learners use them for different purposes". If they can be workshopped and see the importance of education through those things the use of social network can be helpful in learning".*

**Question 4**

**Educational fieldtrips have an important role to play in the enhancement of learners' performance. How do you utilise the fieldtrips to teach Physical Sciences.**

PARTICIPANTS' RESPONSES:

T2: *"I think it would be a good idea for learners to visit sites in or Science in order to know more about Physical Sciences. They will see what is happening". We really had no time to plan for that events". I think it will be helpful because learners will have the real understanding of sciences wen the say what really Sciences is about".*

T7: *"Mm so in most cases as I have already said, field trips and educational tours or excursions are very much helpful. Educational trips and excursions are very expensive because places that we should touch for fieldtrips are far. We always have challenge since we do not have money. Ja money is the main challenge".*

T2: *"That one is limited because we don't have you know this kind of support. Learners would very be very happy to go to industries to see this system where fertilizers is made because there is a topic on referring to fertilizers. There could see the set up where there are different reactions so that they link what they learn and what is actually happening in the work and factories"*

T6: *"Excursions, I don't do that, but sometimes with the other teachers or is like we are having this people who are responsible for that they sometimes take these learners out. Learners' trips. The only excursion is that we just move around with the nearby schools. We let them have contacts with learners of nearby schools and interacts amongst themselves".*

T6: *"The main challenge is that our area is dominated by poverty in which most parents are not working, and they find it very difficult to pay for their children to take the fieldtrips and educational tours. I f things were easy, I may take them Impala Platinum Refinery is where I worked for two years so I know there is especially the experiments that performing here, I learned them there I was doing practicals there, I was in Intern there Impala Platinum Refinery is a Refining company for mineral yes platinum, gold and so forth".*

T1: *"Eish, aa, in that area I am not got but I think I must do something, Jaa I must do something"*

T3: *"Jaa, this one, I suggest this everyday so that we can, more especially because we don't have apparatus we should organise that we go to Giyani Sciences Centre for laboratory investigations". "Problem is only one, parents cannot pay for their children excursions".*

T3 *"Jaa from the way things are, we never did that and even if I propose that there is that issue that don't have funds. The school may say we don't have finance, and asking learners to pay for that I don't see these as proper things to ask learners who are not paying school fees to pay for something which is for learning "*

T6: *"The only excursion that we have is that we just move them around and make them have contacts with other learners of the schools where in they can exchange with other learners and teachers of other schools".*

**Question 5**

**The use of appropriate teaching approaches influence the learners' academic performance. What is your experience on this undertaking?**

Participants' responses:

T:3 *"Jaa I agree with the statement you have to use relevant methods in teaching Physical Sciences like you can't use narrative approach while teaching learners. You must engage the learners' by asking to do calculations, group discussions and also fieldtrips. I normally encourage them to work on their own so that they learn to extract the knowledge on their own and also I prefer them to work in group rather than teaching and teaching all the time. They can also make use of practical works and experiments".*

T3: *"The use of appropriate teaching influences learners' performance, it true what can I say? For example, during the winter school my learners told me how they understand some of the teachers and they don't understand some because of the teaching approaches".*

T3. *"Teaching questions treating questions more often, question and answers is the most effective method of teaching in Physical Sciences".*

T6: *"I think the approach is very important. Once you come up with the best approach of teaching your learners to see your learners, are going to fail otherwise. I'm not sure I can approach this question. Most of the time I prepare everything they need to learn through different approaches. I give the previous question papers and encourage them to work in small groups to help each other".*

T7: *"In terms of teaching methods, learners adhere to different teaching styles. To push theses learners, we, we normally use lecture and methods and incorporate it with visual. This is where we use gadgets and make them see what is going on in real life. We can also make use of visual laboratory in the internets".*

To respond to questions that were posed by the researcher about teaching approach that participants think is the best for the teaching of Physical Sciences, most of the participants indicated that collaborative teaching method and experimentation are the most effective in the teaching of Physical Sciences. The following are what some of the participants had say:

T7: *"Ok under this one, mmm…mm my views under this one, mm...mm yes indeed, now sometimes you find that the method that the teacher, uses the method that confuses learners. I use direct instruction approach but at the same time I use my learners an opportunity to interact with each other in small groups work in teams".*

T2: *"Jaa, when you talk of appropriate we are we talking of things which can support delivery of the concept, the understanding on the side of the learner. I really support that if we don't use appropriate technology, appropriate, strategies really it would fail to deliver".*

T6: *"In terms of teaching methods, learners adhere to different teaching strategies. To achieve this, learners we normally use lecture method and incorporate it with visual. This is where we make use of our technology gadgets and make them what is happening in real life. We can make use of visual labs".*

T2 *"In teaching Physical Sciences myself, I prefer discovery method where a learner should create the understanding and not the teacher to tell him the concept so myself I normally use the question and answers sessions or approach of teaching where learners should create the understanding not the teacher to tell him the concepts. So, myself normally I use question answer sessions. I use what I call flat classroom instead of me getting to class tell them exactly what they should know no. I give them problems to go and look for information and discover by themselves. Then we are in class is more of discussions and feedbacks".*

*"The other methods is experiments, we have to carry out experiments where we have objectives they create the hypothesis, they create their investigative questions and they look for the methods that they can use to in order they can discover what they want to discover. Then they share their experiences on how*

*they find their answers and information. And this is like collaboration, it is just more of collaboration".*

**Question 6**

**Learners prefer different styles in as far as content acquisition is concerned. What is your experience on this undertaking?**

**Participants' responses:**

T1: *"If you are not careful you may claim that your learners are good because they are coming from the same grade while it is not the case. Try to check learners who do not answer in the class as to whether they understand or not".*

T2: *"Ja, learners learn in different ways, so you can't teach all learners because learners are not the same. You may find that these learners prefer may be to talk and the other one prefers you to elaborate or demonstrations. But I normally encourage my learners to work together so that they may learn from each other. You may find that this learner is afraid to come to the teacher but be at ease and better if she goes to the friend and ask questions and exchange information".*

T6: *"Jaa it is true and fair, they don't only prefer different learning styles, for example now they are attending this enrichment programme and they are complaining that they just waste their time, but I know they don't waste their time. Learners need to learn in different approaches but otherwise they are complaining".*

T6 *"I normally encourage my learners to learn together so that they can manage to learn from each other. You can find that these learners learner is afraid to come to the teachers so is better if the learners goes to the".*

T3: *"Jaa, Mmm… When… I group the learners … mm they practice in groups, If you don't monitor … they do not read, you got to monitor them".*

T3: *"I think they need to learn through different approaches. Always give my learners previous question papers to encourage them to work in small numbers or wor5king groups. I profile my learners so that they work in groups and help each other".*

T2: *"They prefer different learning styles, jaa, learners are different as different human beings they understand better using different approaches. to enhance understanding of Physical Sciences, I use different approaches. I use the question and answer technique, I use discussion method and I use the discovery method when they carry experiments is the classroom as a way of trying to accommodate all learners".*

## APPENDIX D

## REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN THE HIGH SCHOOLS IN MOPANI DISTRICT

**Ratshivhadelo T.A**
**Cell: 0837701884**
**0791154188**

P.O. Box 2126
SIBASA
0970
05 July 2017

The District Senior Manager
Department of Basic Education
Mopani District
P/Bag X578
GIYANI
0826

Dear Sir / Madam

**RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN THE HIGH SCHOOLS WITHIN MOPANI DISTRICT**

I Ratshivhadelo Thivhilaeli Alex of the learner number 8700470 of the University of Venda am applying for a permission to conduct a research project in the following high schools which are within your jurisdiction: -Manonyaneng, Mahudu, Sekgosese, Sikhunyani, Gijangove, Mavalani, Bankuna, Giyani, Rotterdam and Modisha Secondary Schools. Details of the project are as follow: -

1. Topic: Enhancement of Grade 12 learner's performance in Physical Sciences within Mopani District.

2. Subjects: Secondary school principals, Grade 12 Physical Sciences teachers, Grade 12 Physical Sciences learners and Physical Sciences Subject advisors.

I promise to make findings of this project available to you, circuits and the secondary schools within Mopani District as soon as they are available.

Hope you will find this in order.

Yours Faithfully

**……..**

**Ratshivhadelo T.A (Mr)**

# APENDIX E

## PERMISSION TO CONDUCT RESEARCH FROM MOPANI DISTRICT DIRECTOR

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION
MOPANI DISTRICT

REF : 2/2/2
ENQ : NGHONYAMA K.S
DATE : 15 AUGUST 2017

TO : RATSHIVHADELO THIVHILAELI ALEX

**PERMISSION TO CONDUCT RESEARCH: ENHANCEMENT OF GRADE 12 LEARNERS' PHYSICAL SCIENCES WITHIN MOPANI DISTRICT**

1. The above matter refers.

2. Permission is granted to you to conduct a research on the above mentioned Topic.

3. Your focus should be limited only to schools which you requested i.e:

3.1. Bankuna Secondary
3.2. Gija - Ngove Secondary.
3.3. Giyani High School.
3.4. Modisha Secondary
3.5. Manonyaneng Secondaery.
3.6. Mahudu Secondary
3.7. Mavalani Secondary
3.8. Rotterdam Secondary
3.9. Sekgosese Secondary
3.10. Sikhunyani Secondary

4. Please make sure that you don't interfere with schools' work.

5. Hope you find this to be in order.

DISTRICT DIRECTOR

15/08/2017
DATE

DEPARTMENT OF EDUCATION
MOPANI DISTRICT, Private Bag X 578 GIYANI, 0826
Tel 015 811 7803 Fax No. 015 812 3412 or 086 663 3820
***The heartland of Southern Africa – development is about people***

# APPENDIX F

## EDITOR'S LETTER

**Editing and Proofreading Report**

29 January 2020

This letter serves to confirm that I, Dr I. Ndlovu of the English Department, University of Venda, have proofread and edited thesis of a PhD thesis titled "Enhancement of Grade 12 Learners' Performance in Physical Sciences within Mopani District, Limpopo Province" by Thivhilaeli Alex Ratshivhadelo, to be submitted in the Department of Curriculum Studies and Education Management in the School of Education at the University of Venda.

I carefully read through the thesis, focusing on proofreading and minor editorial issues. The recommended suggestions are clearly highlighted and can either be accepted or rejected using the Microsoft Track Changes Function.

Yours Sincerely

Dr Isaac Ndlovu, PhD Lecturer: English Department University of Venda Private Bag X5050 Thohoyandou 0950 South Africa Tel: +27 15 962 8305 Fax: +27 15 962 4749 E-mail: isaac.ndlovu@univen.ac.za

# APPENDIX G

## UNIVERSITY OF VENDA ETHICAL CLEARANCE LETTER

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
**Mr TA Ratshivhadelo**

**Student No:**
**8700470**

PROJECT TITLE: **Enhancement of Grade 12 physical sciences learners' performance within Mopani District.**

PROJECT NO: SEDU/17/CSEM/03/2906

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

| NAME | INSTITUTION & DEPARTMENT | ROLE |
|---|---|---|
| Prof MP Mulaudzi | University of Venda | Promoter |
| Dr SK Muthambi | University of Venda | Co- Promoter |
| Dr SJM Kaheru | University of Venda | Co- Promoter |
| Mr TA Ratshivhadelo | University of Venda | Investigator – Student |

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: June 2017
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2017 -07- 03
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950λ LIMPOPO PROVINCEλ SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 FAX (015) 962 9060
*"A quality driven financially sustainable, rural-based Comprehensive University"*