

CHALLENGES EXPERIENCED BY PHYSICAL SCIENCES TEACHERS WITH
THE IMPLEMENTATION OF THE CURRICULUM AND ASSESSMENT POLICY
STATEMENT IN SELECTED EASTERN CAPE SCHOOLS

by

MANDLA KOTI

submitted in accordance with the requirements
for the degree of

MASTER OF EDUCATION WITH SPECIALISATION IN CURRICULUM
STUDIES

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROFESSOR JG FERREIRA

FEBRUARY 2016

DECLARATION

I, MANDLA KOTI, do hereby declare that this dissertation is the result of my own investigation and research and that it has not been submitted in part or full for any other degree or to any other university.

Signature

Date

ACKNOWLEDGEMENTS

I take this opportunity to tender my thanks to all the people who assisted me when I was doing this research. That I have completed this investigation is due to this assistance that you gave me. Your help to me was in various forms. These included participating in the interviews and supplying the relevant information that I needed to complete the project, advising and encouraging me to carry on with the investigation, allowing me to do research in your schools, taking time to talk to me when I visited your schools and offices so that this project would be a success; you were really keen to assist me.

It will not be possible for me to name all the people who helped me in this project but I do feel that I should mention my supervisor Prof JG Ferreira without whom I could not have even commenced this investigation. Her wisdom and warmth of personality greatly assisted and spurred me on to complete this research. I also express my thanks to the people of the University of South Africa who work in the library for providing me with everything that I asked them to give me as well as the people who work in the registration offices for the invaluable assistance they gave me. I tender my thanks to the Research Ethical Clearance Committee of the College of Education of the University of South Africa for granting me the opportunity to do this research.

I tender my thanks also to my wife and children who supported me when doing the investigation.

I tender my thanks to God who in Christ gave me the opportunity to complete this project.

I thank you all

Sincerely

Mandla Koti

ABSTRACT

Learners who take Physical Sciences in the Further Education and Training Phase in Eastern Cape schools have been performing poorly in the subject in the final examinations in Grade 12. This raised the concern of the researcher to determine issues that underlie this. In attempting to determine the cause of the poor results, a Physical Sciences subject advisor and six Physical Sciences teachers were interviewed to gather information on this problem. The following issues were considered: the Physical Sciences curriculum, the nature and structure of the Curriculum and Assessment Policy Statement (Physical Sciences), learner performance in Physical Sciences, a review of literature on science teaching, strategies of teaching and learning, the role of science teachers, classroom interaction between teachers and learners and the challenges experienced with science teaching. Data collected through the interviews were analysed leading to the identification of core issues and recommendations on how to address these.

Key terms: Further Education and Training; Learning Programme; Physical Sciences Theory; Practical Work; Poor Performance; Curriculum and Assessment Policy Statement; Learner; Educator; Subject; Learning Outcomes.

ACRONYMS

CAPS	=	Curriculum and Assessment Policy Statement
CoP	=	Community of Practice
CTAs	=	Common Tasks of Assessments
DBE	=	Department of Basic Education
FAL	=	First Additional Language
FET	=	Further Education and Training
GET	=	General Education and Training
IKS	=	Indigenous Knowledge System
IP	=	Intermediate Phase
LTSM	=	Learning and Teaching Support Materials
MTT	=	Ministerial Task Team
NCS	=	National Curriculum Statement
NDE	=	National Department of Education
NGOs	=	Non-Governmental Organisations
NQF	=	National Qualifications Framework
OBE	=	Outcomes-Based Education
RNCS	=	Revised National Curriculum Statement
RSA	=	Republic of South Africa
SASA	=	South African Schools Act
SMT	=	School Management Team

Table of Contents

Declaration		2
Acknowledgements		3
Abstract		4
Acronyms		5
	CHAPTER 1	12
	ORIENTATION	12
1.1	INTRODDUCTION	12
1.2	CURRCULUM CHANGE	13
1.3	PHYSICAL SCIENCES AND THE LEARNERS	16
1.4	TEACHING PHYSICAL SCIENCES	18
1.5	THE RESEARCH PROBLEM	21
1.6	THE RESEARCH QUESTION	22
1.7	AIMS AND OBJECTIVES OF THE STUDY	22
1.8	THE RESEAECH DESIGN	23
1.9	SIGNIFICANCE OF STUDY	24
1.10	OUTLINE OF THE CHAPTERS	26
	CHAPTER 2	28
	LITERATURE REVIEW	28

2.1	INTRODUCTION AND RATIONALE	28
2.1.1	Introduction	28
2.1.2	Rationale for teaching science	28
2.2	CONCEPTUAL UNDERPINNINGS OF THE RESEARCH	29
2.2.1	Context of implementation	29
2.2.2	Research paradigm	32
2.3	CAPS: PHYSICAL SCIENCES	33
2.4	PHYSICAL SCIENCES TEACHING AND LEARNING	36
2.4.1	Strategies of teaching and learning	36
2.4.2	The role of Physical Sciences teachers	39
2.4.3	The role learners	42
2.4.4	Classroom interaction between teachers and learners	48
2.4.5	Challenges experienced with Physical Sciences teaching	49
2.5	CONCLUSION	50
	CHAPTER 3	51
	RESEARCH METHODOLOGY	51
3.1	INTRODUCTION	51
3.2	RESEARCH DESIGN	51
3.2.1	Defining a research design	51
3.2.2	Qualitative and quantitative approaches	52

3.2.3	Case study design	53
3.2.4	Interviewing strategy	54
3.3	CONCEPTUALISING SAMPLING	55
3.3.1	Population	55
3.3.2	Sampling	56
3.3.3	Selection of participants	56
3.4	ETHICAL ASPECTS OF RESEARCH	57
3.5	INTERVIEW SCHEDULES FOR DATA COLLECTION	60
3.6	DATA COLLECTION, ANALYSIS AND INTERPRETATION	62
3.6.1	Data collection	62
3.6.2	Data analysis and interpretation	63
3.7	INSTRUMENT RELIABILITY AND CREDIBILITY OF DATA	64
3.7.1	Data reliability and credibility	64
3.7.2	Piloting the study	66
3.7.3	Triangulation	66
3.8	CONCLUSION	67
	CHAPTER 4	68
	FINDINGS AND DISCUSSION OF FINDINGS	68
4.1	INTRODUCTION	68
4.2	FINDINGS AND DISCUSSION OF FINDINGS	68
4.2.1	BIOGRAPHICAL PROFILE OF PARTICIPANTS	68

4.2.1.1	What are your qualifications?	68
4.2.1.2	In which grade/s are you teaching Physical Sciences?	70
4.2.1.3	How long have you been teaching Physical Sciences?	70
4.2.2	HOW WELL DO YOUR PHYSICAL SCIENCES LEARNERS PERFORM?	71
4.2.3	TEACHING THEORY IN PHYSICAL SCIENCES	74
4.2.3.1	What problems do you encounter when teaching theory in Physical Sciences?	74
4.2.3.2	What equipment does your school have which enables you to do your work?	78
4.2.3.3	How do you solve these problems?	79
4.2.4	EXPERIMENTAL ISSUES	81
4.2.4.1	Do you perform experiments in your school?	81
4.2.4.2	Is your laboratory well – equipped for you to do your work well?	83
4.2.4.3	What problems do you encounter when you teach practical work in Physical Sciences?	84
4.2.4.4	How do you solve these problems?	87
4.2.5	DO YOU GET ANY ASSISTANCE FROM THE SCHOOL MANAGERS IN YOUR SCHOOL?	89
4.2.6	WHAT ASSISTANCE DOES YOUR DISTRICT OFFICE OFFER YOU THROUGH THE SUBJECT ADVISOR?	90
4.2.7	IS THE ASSISTANCE YOU ACQUIRE FROM THE SCHOOL MANAGERS AND THE SUBJECT ADVISOR ADEQUATE?	93
4.2.8	WHAT MORE COULD BE DONE TO ASSIST YOU IMPROVE YOUR WORK?	95
4.2.9	ARE YOU SATISFIED WITH YOUR WORK AS A SCIENCE TEACHER?	97
4.2.10	CONCLUSION	98

	CHAPTER 5	99
	CONCLUSIONS AND RECOMMENDATIONS	99
5.1	INTRODUCTION	99
5.2	SUMMARY OF THE RESEARCH	99
5.2.1	BIOGRAPHICAL PROFILE OF PARTICIPANTS	99
5.2.1.1	What are your qualifications?	99
5.2.1.2	In which grade/s are you teaching Physical Sciences?	100
5.2.1.3	How long have you been teaching Physical Sciences?	101
5.2.2	HOW WELL DO YOUR PHYSICAL SCIENCES LEARNERS PERFORM?	101
5.2.3	TEACHING THEORY IN PHYSICAL SCIENCES	101
5.2.3.1	What problems do you encounter when teaching theory in Physical Sciences?	102
5.2.3.2	What equipment does your school have which enables you to do your work?	102
5.2.3.3	How do you solve these problems?	102
5.2.4	EXPERIMENTAL ISSUES	103
5.2.4.1	Do you perform experiments in your school?	103
5.2.4.2	Is your laboratory well – equipped for you to do your work well?	103
5.2.4.3	What problems do you encounter when you teach practical work in Physical Sciences?	103
5.2.4.4	How do you solve these problems?	104
5.2.5	DO YOU GET ANY ASSISTANCE FROM THE SCHOOL MANAGERS IN YOUR SCHOOL?	104

5.2.6	WHAT ASSISTANCE DOES YOUR DISTRICT OFFICE OFFER YOU THROUGH THE SUBJECT ADVISOR?	105
5.2.7	IS THE ASSISTANCE YOU ACQUIRE FROM THE SCHOOL MANAGERS AND THE SUBJECT ADVISOR ADEQUATE?	106
5.2.8	WHAT MORE COULD BE DONE TO ASSIST YOU IMPROVE YOUR WORK?	106
5.2.9	ARE YOU SATISFIED WITH YOUR WORK AS A SCIENCE TEACHER?	107
5.3	RECOMMENDATIONS	107
5.3.1	Department of Education	108
5.3.2	The participating schools	109
5.4	REFLECTION ON THE STUDY	109
5.5	LIMITATIONS	110
5.6	REFLECTION ON THE RESEARCH RESULTS	110
5.7	FURTHER RESEARCH	111
5.8	CONCLUSIONS	111
6	REFERENCES	113
7	APPENDIX A	118
8	APPENDIX B	119
9	APPENDIX C	121

CHAPTER 1

ORIENTATION

1.1 INTRODUCTION.

Learners in the Eastern Cape have persistently performed unsatisfactorily in terms of results during the past decade. This is particularly the case in science-related subjects. Learners taking Physical Sciences have constantly produced unsatisfactory results. These are predominantly learners from previously disadvantaged schools. The pass rate for Physical Sciences in the Ngcobo District of Eastern Cape Province has averaged below 30% in 2010. For paper 1 the percentage of those who passed was 27,3; and for those who passed paper 2 it was 30,7. (Assessment and Examinations Directorate, 2010:16&22). The Provincial percentage pass for paper 1 was 25,2; and for paper 2 it was 28,4 (Assessment and Examinations Directorate, 2010:16&22). This problem though is seemingly not for the Eastern Cape alone but for South Africa as a whole for Educare (1998:7) states that South African schools are not in a position to be complacent about or proud of the standard of science teaching if the 1997 matriculation examination result in Gauteng is anything to go by because 54% of the learners passed Physical Sciences in that year. Muzah (2011:7) states that corresponding evidence is established from more recent results which shows that of the 724 learners who wrote science at matriculation level in Alexandra Township (Gauteng Province) high schools in the year 2006, only a negligible 5,3 per cent passed science at higher grade. In South African context, a science learner should obtain 30% to pass science while 29% is considered as a fail. Setati (2011:5) states that in a world-wide study on science achievement, the Third International Mathematics and Science Study (TIMSS) report of 1995 and the Third International Mathematics and Science Study report of 1998, South Africa performed worst among 38 participating countries. The grades 7 and 8

and grade 12 learners representing South Africa were considered scientifically illiterate; especially female learners from all population groups performed particularly poorly.

Some sort of intervention is therefore necessary and with the implementation of the Curriculum and Assessment Policy Statement (NCS, 2011:iii), it has become necessary to investigate the reasons for poor learner achievement and to identify possible strategies to solve this problem. This research consequently intends to get information from teachers about the problems they experience in their daily work as they implement CAPS Physical Sciences in the Further Education and Training (FET) band in four selected schools of Ngcobo District of the Eastern Cape.

1.2 CURRICULUM CHANGE

The adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) (in 1997) provided a basis for curriculum transformation and development in South Africa. The Constitution states that it aims to heal the divisions of past and establish a society based on democratic values, social justice and fundamental human rights; as well as to improve the quality of life of all citizens and free the potential of each person; and to further education which the State, through reasonable measures, must make progressively available and accessible. (National Curriculum Statement, 2003:1). Gultig, Hoadley and Jansen (2002:30) state that the National Department of Education (NDE) published its first official statement on outcomes-based education in March 1997 with the launch of *Curriculum 2005* on 27 March 1997. According to Gultig et al (2002:73) outcomes-based (OBE) education had to be implemented in all grade 1 classrooms across the country in January 1998. By way of definition a learning outcome is a statement of an intended result of learning and teaching (National Curriculum Statement, 2003:7). Outcomes describe knowledge, skills, and values that learners should acquire by the end of the Further Education and Training band (FET). *Curriculum 2005* was fraught with challenges due to insufficient teacher training and a rush to effect change (Jansen, 1999). Gultig et al (2002:85) state that although *Curriculum 2005* was still being introduced into the Foundation Phase at the time of the research, many of the teachers

observed were not yet engaged in implementing the new curriculum; but the investigation revealed a great deal of unfocused and unsystematic teaching which seemingly was in danger of becoming more prevalent and even more confused as a result of widespread misinterpretation of what outcomes – based education was all about. In the South African context, educators had barely achieved stability with *Curriculum 2005* when it was amended to the Revised National Curriculum Statement (RNCS) and shortly afterwards the National Curriculum Statement (NCS). Setati (2011:142) states that the failure of the OBE methodology was exacerbated by the introduction of a whole lot of policies which were implemented at the same time without being thought through and without having the proper resources for implementation.

In 2009 the Minister Mrs Angie Motshekga of the Department of Basic Education appointed a Ministerial Task Team (MTT) to review the implementation of the National Curriculum Statement from grades R to 12. Its brief was to identify the challenges and pressure points that impact negatively on the quality of teaching in schools and to propose mechanisms that could address these (Curriculum News, 2011:4). The report of the Ministerial Task Team made several recommendations to improve the curriculum, and on 20 October 2009 the Minister announced her decision to implement the recommendations. The Minister categorized the recommendations into those for the short term and those for the long term (Curriculum News, 2011:4). Recommendations for the short term were implemented in 2010. These were the discontinuation of learner portfolios; the requirement for a single teacher file for planning; the reduction of the number of projects required from learners; and the discontinuation of common tasks of assessments (CTAs). Longer term recommendations were to be implemented between 2012 and 2014 namely the reduction of the number of learning areas in the Intermediate Phase (IP) of the General Education and Training (GET) band; the teaching of English as a First Additional Language (FAL) to be given priority alongside the mother tongue and that it should be taught from Grade 1; regular external systematic assessment of Mathematics, the home language and English First Additional Language in Grades 3, 6 and 9; and the development of the National Curriculum and Assessment Policy Statements (CAPS) per subject (Curriculum News, 2011:4).

These actions by the Minister of Basic Education suggest that she identified a problem in the NCS and decided to rectify the situation. This is further inferred in the recommendations that she accepted from the Task Team and henceforth used as a benchmark for future planning. The Minister accepted the recommendations of the Task Team and acted on them as she possibly desired to eliminate uncertainty in policy implementation. Teacher Toolkit (2012:2) has stated that CAPS is not a new curriculum, but an amendment to the NCS Grades R-12 Subject Statements. It therefore still follows the same requirements of process and procedure as described in the NCS Grades R-12. This view is supported by the Minister of Basic Education Mrs Angie Motshekga in NCS (2011:III) where she states that the *National Curriculum Statement for Grades R – 12* builds on the previous curriculum but also updates it and aims to provide a clearer specification of what is to be taught and learnt on a term – by –term basis. CAPS is an adjustment to what is taught (curriculum) and not how it is taught (teaching methods). It is the curriculum that has changed and not the teaching methods. There is much debate and discussion about outcomes-based (OBE) being removed, however OBE is a method of teaching and not a curriculum. Nevertheless the way the curriculum is written is now in content format rather than an outcomes format, so it is more prone to traditional teaching methods rather than OBE (Teacher Toolkit, 2012:2).

The Department of Basic Education has stated that *the Regulations pertaining to the National Curriculum Statement Grades R-12* represents a policy statement for learning and teaching in South African schools and has CAPS as one of its components for each approved school subject, including Physical Sciences (NCS, 2011:iii). For all subjects, provincial and district subject advisors were trained in preparation for the curriculum changes that would be made and for the implementation of CAPS in the various phases. Core training materials had to be provided to ensure consistency throughout the system. The task of the subject advisors was to then familiarise teachers with the content, assessment, teaching methodology, resources and management of classrooms in CAPS in each of the districts (Curriculum News, 2011:16 – 17). However Setati (2011:141) states that OBE training of educators had not been extensive enough and that outcomes – based education was rushed into South African schools and teachers were inadequately prepared to cope with the curriculum changes.

1.3 PHYSICAL SCIENCES AND THE LEARNERS.

For certification purposes a successful learner who has complied with the programme and promotion requirements as stated in CAPS will be issued with the National Senior Certificate (NCS, 2011:28). The National Senior Certificate fulfils a number of goals, namely that it has a defined purpose and provides qualifying learners with applied competence and a basis for further learning; it enriches the qualifying learner and provides benefits to society and the economy; it complies with the objectives of the National Qualifications Framework (NQF); it incorporates integrated assessment, and sets the rules governing the award of the qualification. Against these certification requirements, learners' performance in Physical Sciences is reviewed and what first prompted the need for this study.

In 2011 the Eastern Cape Department of Education released a document showing the performance of learners who sat for the grade 12 Physical Sciences and Mathematics examinations in 2010. This document indicates the performance of learners in the Province and in the clusters which are made up of various school districts. There are three clusters in the Eastern Cape. Table 1.1 shows the performance of learners in papers 1 and 2 in Physical Sciences in 2010 in the Eastern Cape.

Table 1.1: Physical Sciences results in the Eastern Cape (NCS Mathematics and Physical Science: Question by Question Project Analysis, 2010).

Paper 1		Paper 2	
Max marks for paper 1	150	Max marks for paper 2	150
Average pass percent (%)	25,2	Average pass percent (%)	28,4
Number of candidates	33849	Number of candidates	33886

From the table the poor performance of learners is evident. Only 25,2% of the learners who wrote paper 1 passed and 28,4% passed paper 2. The only deduction that can be made out of this is that there is a fundamental problem that underlies this unacceptable performance in the Eastern Cape, because this clearly shows that the learners of the Province were not doing well in Physical Sciences and consequently that this be investigated. The Provincial pass rate for Physical Sciences from 2011 to 2013 reflects an improvement. In 2011, 48,2% of the learners passed ; in 2012, 50,5% passed and in 2013, 53,8% passed. Although the pass rate has improved, what raises concern is the decrease in the number of candidates.

In Table 1.2 the numbers of learners and the percentages of passes per category are set out.

Table 1.2: Physical Sciences results in the Eastern Cape 2011-2013 (National Senior Certificate Results 2013 – 07 January 2014)

Category	2011	2012	2013
Number of candidates	26 367	25 603	25 218
Fail: 0% - 29%	13663 (51,8%)	12681 (49,5%)	11156 (44,2%)
Pass: 30% -39%	5860 (22,2%)	5986 (23,4%)	6527 (25,9%)
Pass: 40% - 49%	3079 (11,7%)	3201 (12,5%)	3612 (14,3%)
Pass: 50% - 59%	1783 (6,8%)	1799 (7,0%)	1972 (7,8%)
Pass: 60%- 69%	952 (3,6%)	945 (3,7%)	1082 (4,3%)
Pass: 70% - 79%	568 (2,2%)	622 (2,4%)	531 (2,1%)
Pass: 80% - 100%	454 (1,7%)	354 (1,4%)	337 (1,3%)

The statistics in Table .1.2 still shows that very few learners delivered a satisfactory performance in these years. This research therefore endeavours to identify some of the underlying factors that could be responsible for the poor achievement of learners in Physical Sciences particularly in the selected schools of the Ngcobo District of the Eastern Cape.

Table 1.3: Physical Sciences results of the Ngcobo District (NCS Mathematics and Physical Science: Question by Question Project Analysis 2010)

Paper 1		Paper 2	
Maximum marks	150	Maximum marks	150
Average pass percent	27,3	Average pass percent	30,7
Number of candidates	649	Number of candidates	649

In 2010 in the Ngcobo District only 27,3% of the candidates passed paper 1. Paper 2 had only 30,7% of the candidates passing that year. This shows that there is a problem of poor performance in the District when it comes to Physical Sciences performance.

The preceding discussions focussed on the Physical Sciences CAPS curriculum and learners' performance in the Eastern Cape to which belongs the Ngcobo District. In an attempt to determine what could be done to address the issue, it is necessary to review literature on the teaching and learning of Physical Sciences in an attempt to determine the causes of poor learner achievement in this field.

1.4 TEACHING PHYSICAL SCIENCES

With the advent of democracy in 1994 the Government felt it necessary to change the curriculum of the country as is stated in National Curriculum Statement (NCS) (2003:1) and that the adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa so as to heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights, as well as improve the life of all citizens and free the potential of each person. Within that context the subject Physical Sciences was also changed and defined as follows: Physical Sciences focuses on investigating physical and chemical phenomena through scientific

inquiry by applying scientific models, theories and laws to explain and predict events (NCS 2003:9).

Outcomes – based education (OBE) forms the foundation for the curriculum in South Africa states NCS (2003:2) and strives to enable all learners to reach their maximum potential by setting the learning outcomes to be achieved by the end of the education process. The National Curriculum Statement builds its learning outcomes for grades 10 – 12 on the critical and developmental outcomes that were inspired by Constitution and developed through a democratic process. Educare (1998:19) states that outcomes – based education is an educational approach which is results – oriented and which requires teachers and learners to focus their attention on the two following aspects:

- First, the focus is on the desired end results of each learning process. These desired end results are called the outcomes of learning and at the end of a period, lesson, study unit or programme learners will need to demonstrate that they have indeed attained these outcomes, and
- Second, the focus on OBE is on the content and processes that guide the learners to the required end results. Content (what is learned) and process (how it can be learned) are both essential ingredients of a balanced outcomes – based learning programme.

In developing science teaching material little attention may have been paid to the ideas that learners bring to the learning task, even though these may have a significant influence on what learners could do or learn from their Physical Sciences lessons. This perspective on learning suggests that it is as important in teaching and curriculum development to consider and understand learners' prior knowledge and ideas as these give a clear indication of how teaching should be planned and implemented. Besides this point, curriculum dissemination needs to focus on the practicality of curriculum implementation because though Physical Sciences has both a theoretical and practical side, the teaching of the subject should form an integrated whole. Gultig et al (2002:6) state that certain areas of learning mathematics, technology, science, home languages and arts and certain aspects of education and training have either not been equally available to all learners in the past or have been grossly neglected. Muzah

(2011:150) states that in the NCS the educators are introduced to new topics based on the principles of outcomes – based (OBE) which describes learning from the perspective of the learner which implies that educators are compelled to use new skills in teaching and learning of science. Some of the skills that are now required in science include the ability to teach and assess the investigative methods and the relationship of science to humankind and the environment. In this regard, even qualified educators lack skills required by this new approach since such skills have never been taught.

Teaching Physical Sciences to learners in the classroom requires skill that will enable the learners perceive the aim behind the lesson. According to Palmer (2007:42) the methods used must be inventive, encouraging, interesting, beneficial, and provide tools that can be applied to the learners' real life. Some techniques for assuring success is to state the goals and objectives for the lesson, provide simple and clear explanations, ask the learners to express their comments, questions and provide hands-on activities as often as possible. The question can be raised: How does a teacher present a lesson so that the learners are motivated to actively participate in the lesson; ask questions and make comments, and is this practised in the schools in this study? A teacher should also be able to guide learners to appreciate the role of science in society. Learners should also understand that research in science and conceptualization are ongoing processes. How teachers go about involving learners could be the key to improving learner achievement. Consequently, teachers in particular, should be afforded the opportunity to make sense of the intended innovation of a curriculum for their benefit and that of the innovation itself. All key stakeholders, particularly those at the forefront of the implementation process, should be afforded the opportunity to understand and internalise the curriculum changes with due regard to their own environments (Carl, 2012:111; Ndawi & Maravanyika, 2011:71). This will entail the understanding of all relevant science concepts; the development of cognitive and psychomotor skills of learners; the ability to facilitate the undertaking of inquiries by learners; understanding the nature of the scientific enterprise and the relationship between science and society, and the development of a sense of personal worth (Driver, 1983:73). Outcomes – Based Education requires teaching and learning to take place in an integrated way and this is done by learning programmes which serve as guides that allow

teachers to be innovative in facilitating learners to achieve desired outcomes (Educare, 1998:20).

The preceding sections set the background to the identified need to modify NCS for Physical Sciences to CAPS currently in use in schools. The origin of the NCS was revealed and the inadequacies mentioned that led to Minister Angie Motshekga to effect change that resulted in the formulation of CAPS. This research therefore stems from a desire to determine the challenges Physical Sciences teachers in the Further Education and Training (FET) band have had to face; how they teach Physical Sciences and how they implement CAPS. It also seeks to identify possible solutions for the under-achievement of Physical Sciences learners in the selected schools of the Ngcobo District of the Eastern Cape.

1.5 THE RESEARCH PROBLEM

According to Creswell (2012:66) a research problem is an educational issue, concern or controversy that the researcher investigates. Curriculum change and implementation is an educational issue warranting investigation to ensure continuous improvement.

Curriculum change in South Africa has implied a complete paradigm shift in the outlook of all stakeholders involved in curriculum development. Beckmann, Klopper, Maree, Prinsloo and Roos (1995:2) state that the introduction of the Constitution of 1993 (Act No. 200 of 1993) signalled a decisive break with the established legal environment in terms of which education was managed and regulated before 27 April 1994 when the first democratic elections were held in South Africa. One cannot dispute that the success or failure of such changes may only be realized years down the line, but the changes are seldom implemented long enough to have the required effect. This is exactly the situation in South Africa. Educators have had to adapt to changes that started from *Curriculum 2005*, which was underpinned by OBE, the RNCS, the NCS and more recently, CAPS (NCS 2011:iii). This repeated change could be exhausting for teachers who have hardly grasped the tenets of one curriculum, when they are forced to implement

further changes. It is therefore necessary to get the input of teachers about their experiences with the implementation of CAPS, particularly those of Physical Sciences teachers.

The problem that this study is going to investigate is that of identifying the challenges experienced by the Physical Sciences teachers as they implement CAPS in the FET band of some schools in the Ngcobo District of the Eastern Cape.

1.6 THE RESEARCH QUESTION.

The main question considered in this research is: What problems do teachers experience with the implementation of CAPS for Physical Sciences in the FET band?

From this the following sub-questions are identified:

- What difficulties do teachers encounter with regard to teaching and learning of Physical Sciences?
- How are classrooms equipped for practical work?
- How do subject advisors and school management teams (SMTs) support teachers and their initiatives?
- What recommendations can be made to address the challenges experienced by Physical Sciences teachers in the implementation of CAPS?

1.7 AIMS AND OBJECTIVES OF THE STUDY

The main aim in this study is to determine the obstacles teachers experience with the implementation of CAPS and how these could be addressed.

The objectives of the study are to:

- Identify particular challenges regarding the teaching and learning of CAPS Physical Sciences in the selected schools,
- Determine whether the selected schools in the District have the required laboratories and equipment to teach Physical Sciences,

- Determine the kind of needed assistance that subject advisors and school management teams give to the participating teachers,
- Identify recommendations that can be made to address the challenges experienced by the participating Physical Sciences teachers in the implementation of CAPS in their schools.

1.8 THE RESEARCH DESIGN

McMillan and Schumacher (1993:31) state that the research design refers to the plan and structure of the investigation that is used to obtain evidence to answer research questions. The purpose of a research design is to provide the most valid and accurate answers possible to research questions. Accordingly the current study is planned such that the most reliable and valid findings are obtained through careful investigation in terms of taking into consideration intrinsic and extrinsic factors that affect the implementation of the CAPS in the selected schools.

Mouton (2001:55-56) distinguishes between a research design and a research methodology by saying that these are two different aspects of a research project. A research design focuses on the end product, that is, what kind of study is being planned and what kind of result is aimed at? On the other hand, a research methodology focuses on the research process and the kind of tools and the procedures to be used.

De Vos, Strydom, Fouche and Delpont (2002:120) state that the section on research methodology should include a description of the specific techniques to be employed, the specific measuring instruments to be utilized, and the specific series of activities to be conducted in making the measurements. Mouton (2001:100) states that in the human sciences, measuring instruments are referred to as questionnaires, observations schedules, interviewing schedules and psychological tests. In this particular study, the researcher is going to develop semi-structured interview schedules to interview selected participants because the information

needed to answer the research question must be obtained through face – to – face dialogues with the participants.

McMillan and Schumacher (1993:14) point out that both qualitative and quantitative research studies are conducted in education, and that the terms are used to identify different approaches to research. The terms refer to distinctions about the nature of knowledge; how one understands the world and the ultimate purpose of the research. The terms also refer to the research methods; how data were collected and analysed; and the type of generalizations that were derived from the data. Quantitative research presents statistical results represented by numbers, whereas qualitative research presents facts in a narration with words. The distinctions, however, are more than in the form of data presentation. Purists suggest that quantitative and qualitative research methods are based on different assumptions and world view, the research purpose, research methods, prototypical studies, the researcher role, and the importance of context in the study. This study will use the qualitative approach because it intends obtaining input from teachers about the problems they experience with the implementation of CAPS Physical Sciences in the FET band through semi-structured interviews. The interview schedule will be developed and will be used to interview each of the participants using an audio - recorder whereupon these interviews will be transcribed and analysed.

De Vos et al (2002:334) state that in qualitative research, sampling occurs subsequent to establishing the circumstances of the study clearly and directly. Sampling or participant selection in qualitative research is relatively limited; is based on saturation; is not representative; its size is not statistically determined; involves low cost and is not time-consuming. The participants in the study will be six Physical Sciences teachers from four different schools in the Ngcobo District in the Eastern Cape. A subject advisor from the district office will also participate. The selected schools are all from a rural setting because it is here that most poor examination results are achieved.

1.9 SIGNIFICANCE OF THE STUDY

The study has potential to provide detailed information about problems teachers may experience with the teaching of Physical Sciences. It could help to determine how curriculum developers' decisions are interpreted and practiced in the classrooms. Valuable information can be gleaned that could assist decision makers to develop better teaching and learning materials and make these available to all schools. The study could also help to identify the practical challenges faced by Physical Sciences teachers. It hopes to identify potential and actual problems as experienced and recommend possible solutions to improve school results. Thijs and Van den Akker (2009:43) assert that it is critical to gain insight in the existing situation and the possibilities for improvement and innovation. Hence it is imperative to take a look at the implementation of CAPS and address possible problems as soon as possible.

1.10 DEFINITIONS OF TERMS

Moll (1999:42) states that definition and interpretation of terms should be done for the purpose of the study. The study thus defines the following terms:

Further Education and Training (FET): it includes learning programmes that are registered on the National Qualifications Framework (NQF) from levels 2 to 4, and that correspond with the present grades 10 to 12 in the school system and N1 to N3 in the technical college system. A successful FET system provides diversified programmes offering knowledge, skills, attitudes and values South Africans require as individuals and citizens, as lifelong learners and as economically productive members of society. It provides the vital intermediate to higher level skills and competencies the country needs to chart its own course in the global competitive world of the 21st century (Education White Paper 4) (EWP) 1998:6).

Learning programme consists of relevant specific outcomes as well as possible learning materials and methodology by means of which learners can achieve agreed learning outcomes (Educare 1998: 20).

Experiment refers to a set of outlined instructions for learners to follow in order to obtain results to verify an established theory (Kelder CAPS:A8).

Practical work (activity) refers to practical demonstrations, experiments or projects that are used to strengthen the concepts being taught (Kelder CAPS:A8).

Poor performance denotes learners who are categorised as having ‘not achieved’ meaning that they obtained pass rates in Physical Sciences in grade 12 of 0% to 29% (NCS 2011:13).

Curriculum and Assessment Policy Statements (CAPS) means the policy documents stipulating the aim, scope, content and assessment for each subject listed in the *National Curriculum Statement (NCS) Grades R – 12* (NCS 2011:viii).

Learner (student) means any person enrolled in an education institution (NCS 2011:ix).

Educator (teacher) means any person who teaches, educates or trains other persons at an education institution or assists in rendering education services provided by an education department (National Education Policy Act 27 of 1996) (NEPA)(1996: A – 3).

A subject in an outcomes – based curriculum is broadly defined by learning outcomes and not only by its body of content. Learning outcomes are flexible and make allowances for the inclusion of local inputs. Learning outcomes should by design lead to the achievement of the critical and developmental outcomes (NCS 2003:6).

1.11 OUTLINE OF CHAPTERS

Chapter 1 provides an orientation to the study which includes the introduction and background to the problem; the problem statement; research question and the aims and objectives of the

study; curriculum change; Physical Sciences and learners; significance of the study; definition of terms and outline of chapters. The structure of the dissertation is as follows:

Chapter 2 is the literature review which will focus on curriculum change in the South African context; conceptual underpinnings of the research; an outline of CAPS and implementing the new Physical Sciences curriculum, and teaching and learning of Physical Sciences in class.

Chapter 3 describes the research design and methodology; conceptualising sampling; ethical aspects of research; interviewing schedules for data collection; data collection, analysis and interpretation; instrument reliability and credibility of data, along with specific measures to ensure research ethics are respected.

The findings of the research will be presented and will be discussed in Chapter 4. The researcher will attempt to identify patterns and themes from the responses of educators.

In Chapter 5 the conclusions and limitations of the study will be presented. Recommendations will be made and hopefully these recommendations will be useful for curriculum developers, other educators and school management teams to improve Physical Sciences teaching and learning.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION AND RATIONALE

2.1.1 Introduction

This chapter reviews literature that has been written about science teaching in South Africa. This review of literature will also involve an international dimension of science teaching and learning for comparison purposes because our education must be on a par with that which is offered abroad since our country does business with other countries. The literature review should yield the information on activities of Government in preparing the groundwork for planning, formulating, implementing, monitoring and evaluating the process of science teaching and learning in the country. The researcher also intends to gather information on what impact this support has had on schools and especially in terms of improving the performance of science learners. Therefore the next step is to examine the curricular issues and other provisions of Government for Physical Sciences teaching and learning in South Africa.

2.1.2 Rationale for teaching science

South Africa is teaching science in schools because it “aims to develop a high level of knowledge and skills in learners” (NCS 2003:3). Ramnarain and Modiba (2013:66-67) state that a common rationale given for studying science in schools is the achievement of scientific literacy, which refers to being well educated and well informed in science, and implies immersing learners in the authentic questions and processes of science and in real problems and design strategies of technology as opposed to the meaningless memorisation of vocabulary. In the course of this activity Government takes the responsibility to make this possible: it builds schools, provides furniture, textbooks and stationery; other equipment and utensils, and employs teachers

(South African Schools Act 84 of 1996: B – 17) [SASA: 1996]. Muzah (2011:3-5) states that development in South Africa faces a deepening crisis related to under – achievement in science at secondary school level. This has caused acute shortages of scientific oriented professionals such as engineers, technologies, skilled artisans, technicians, doctors and chartered accountants. The number of scientists and engineers produced by a country is an important indicator of a country’s scientific and technological infrastructure as well as its ability to make a contribution in the scientific and technological world. An army of adequate and well – trained scientific workforce is pivotal for economic growth, social development and improved quality of life for all citizens.

The preceding section dealt with the introduction to the chapter and the rationale for science teaching in schools. The next section will take on conceptual underpinnings of the study.

2.2 CONCEPTUAL UNDERPINNINGS OF THE RESEARCH

2.2.1 Context of implementation

Understanding implementation issues accompanying a change in the curriculum of a country is important. Gultig et al (2002:73) states that the announcement that OBE would be implemented in all grade 1 classrooms in January 1998 triggered a vigorous public debate about, inter alia, the prospects of implementation given the lack of teacher training, the low levels of material support for the new curriculum and the complexity of this curriculum innovation. Physical Sciences in the participating schools in this research has not been performed well by most learners and this would indicate that the preceding statement has some validity. The four schools chosen for this research are in a rural setting of the Ngcobo District of the Eastern Cape where most of the learners are African. This makes the situation for preparedness in terms of acquiring the resources for teaching and learning, as well as the organisation of classroom teaching and the equipping of laboratories with the necessary equipment a challenge. Setati (2011:8-9) states that African schools are located in areas where

most Africans live and these are characterised by high levels of poverty and unemployment. Previously designated White schools are located in areas where, previously, White households were located and these are, generally, in better socioeconomic conditions. This racial categorisation of schools provides an indication of difference in infrastructure, qualifications of educators, management, governance of schools, educational culture and resource base of schools; and socioeconomic status of learners. Muzah (2011:78) states that of many researchers who looked at factors associated with poor performance of science in South Africa some agreed on at least the following points: inadequate communication of learners and educators in language of instruction, large classes, lack of qualified science educators, poor teaching methods, inadequate educator knowledge, poor time management, lack of material resources such as textbooks, scientific calculators and laboratory equipment; disruption in class, content coverage and lack of professional leadership. Setati (2011:10) states that since the 1990's there has been an alarming decline in the level of participation and performance in science in secondary schools. Even with the best of resources, curricula, management and so on, if the learners and educators are unable to communicate effectively, then all the other improvements are in vain. It is now evident that the language of teaching and learning (LoLT) which is English is a barrier to effective learning and teaching especially to the conceptualisation of the intricate science concepts that calls for the mastery of the LoLT. Muzah (2011:87) states that it is believed that the quality of a science educator's teaching, interaction with learners, the process of learning, satisfaction and active learners' participation decline with an increase in the size of the class. Achievements in smaller science classes of less than 15 learners exceed achievement in both average science classes of about 25 learners and large science classes of more than 30 learners; while achievement of 25 learners is only marginally better than the achievement of learners in bigger science classes. Muzah (2011:81) also states that in South African public high schools (FET band) data generally indicates that very few science educators are dominant in both content and pedagogical knowledge. Muzah (2011:89) states that a national survey of schools in 2003 revealed high – levels of educator and learner absenteeism and late coming as a widespread problem in South African schools; and that many educators spend less than half their time teaching. Instead of focussing on science learners'

usable knowledge and skills during the lesson as stipulated in OBE, educators spend much time completing endless paperwork which does not serve the purpose for the learning process other than the bureaucratic compliance such as formalistic planning documents, extensive and frequent assessment reports and forms required by the new science curriculum.

Howie (2004:44) states that implementation began in 1998 in grade 1, followed by grade 2 in 1999, grades 3 and 7 in 2000, grades 4 and 8 in 2001, and was supposed to be followed by grades 5 and 9 in 2002. Simultaneously, programmes in teacher education and classroom support were implemented, involving national and provincial education departments, NGOs, television and newspapers, higher education institutions and private publishers. There were widespread concerns regarding the implementation of C2005. The basic documents, themselves problematic, also led to a variety of interpretations by the trainers, education department officers, NGOs, and writers of learning materials. This was made worse by the fact that most of the teachers and trainers' experience and habits were very different from those outlined in C2005. Additionally, very few teachers and trainers had firsthand knowledge of the kinds of curriculum and teaching envisaged, and very few schools had the capacity to manage the changes. In cases where schools and teachers embraced learner – centred education, the original vision of C2005 was lost in the implementation. Because of the attention drawn to integrating learning areas, the progression of concept development from grade to grade was often lost.

NCS (2011:iii) states that in 1997 we introduced outcomes – based education to overcome the curricular divisions of the past, but the experience of implementation prompted a review in 2000. This led to the first curricular revision: the *Revised National Curriculum Statement for Grades R-9* and the *National Curriculum Statement Grades 10-12* (2002). Ongoing implementation challenges resulted in another review in 2009 and we revised the *Revised National Curriculum Statement for Grades R-9 (2002)* and the *National Curriculum Statement Grades 10-12* to produce this document of CAPS.

The foregoing discussion indicates that implementation issues as shown above have had difficulties in education from one curriculum to the next in general and also to the FET Physical Sciences in particular. The researcher is of the view that an understanding of these implementation challenges would help address them leading to improvement of performance for learners in Physical Sciences.

The preceding section highlights the implementation context of this study. The following section delves on the research paradigm of the study.

2.2.2 Research paradigm

De Vos et al (2002:44-45) state that all scientific research is conducted within a specific paradigm which is a way of viewing one's material. Researchers must therefore decide within what paradigm they are working and spell this out in their report. Accordingly this research has been conducted within the qualitative paradigm which refers to the research that elicits participant accounts of meaning, experience or perceptions. It also produces descriptive data in the participant's own written or spoken words. It involves identifying the participant's beliefs and values that underlie the phenomena vis a vis the quantitative approach which is based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures in order to determine whether the predictive generalisations of the theory hold true. (De Vos et al 2002:79). The researcher talked with some teachers of Physical Sciences pertaining to the implementation of CAPS Physical Sciences, in the FET band, of the Ngcobo District of the Eastern Cape because of the poor performance of learners in the subject. The researcher wanted to know what challenges were encountered by the teachers as they implemented the CAPS and how did they thought these could be addressed. This therefore was an evaluation of the programme of implementing CAPS for Physical Sciences in the FET band. De Vos et al (2002:373-374) state that programme evaluation assumes the prior existence of a programme or intervention designed or developed by someone else; and that evaluation in its more general sense means the general process of weighing or assessing the value of something.

Thus currently in this research the researcher is assessing the implementation of CAPS Physical Sciences in the selected schools as to whether it takes place well.

The researcher utilised four selected schools of the Ngcobo District of Education to retrieve information from the six participating teachers that indicated the problems underlying the implementation of CAPS Physical Sciences in their schools. Thus the researcher used the strategy of programme evaluation to unpack issues pertaining to the implementation. De Voss et al (2002:375) state that evaluation research is the systematic application of social research procedures for assessing the conceptualisation, design, implementation and utility of social intervention programmes.

De Vos et al (2002:266) state that once the researcher has determined his paradigm he then selects from literature qualitative strategies (designs) that will be utilised. Thus this current study used the case study design because the investigation is regarded as an exploration that would afford the researcher an opportunity to learn the issues of the implementation of CAPS Physical Sciences in the FET band. McMillan Schumacher (1993:377) state that case study designs are appropriate in evaluation studies when a programme or innovation must be systematically studied before more structured designs can be developed. The four sub – questions formulated for this study form the basis for getting the needed information from the teachers concerning the implementation issues.

The preceding section dealt with the paradigm that would provide the framework for this study. The next section will deal with the CAPS for Physical Sciences.

2.3 CAPS: PHYSICALSCIENCES

In this section the CAPS of Physical Sciences will be reviewed. In order to not only motivate teachers, but also learners, it is necessary to consider the rationale for teaching Physical Sciences knowledge and reflect on methodology, assessment and other issues.

National Curriculum Statement (2011:8) states that Physical Sciences investigate physical and chemical phenomena. This is done through scientific inquiry, application of scientific models, theories and laws in order to explain and predict events in the physical environment. It also deals with society's need to understand how the physical environment works in order to benefit from it and responsibly care for it. All scientific and technological knowledge, including Indigenous Knowledge Systems (IKS), is used to address challenges facing society. Indigenous knowledge is knowledge that communities have held, used or are still using. This knowledge has been passed on through generations and has been a source of many innovations and developments including scientific developments. Some concepts found in Indigenous Knowledge Systems lend themselves to explanation using the scientific method while other concepts do not; this is still knowledge however. Though still relevant, the focus on indigenous knowledge needs to be accommodated and promoted.

According to National Curriculum Statement (2011:8-9) Physical Sciences is made up of six knowledge areas namely: Matter and Materials, Chemical Systems, Mechanics, Wave, Sound and Light, and Electricity and Magnetism. Within these knowledge areas amendments have been made to the Physical Sciences content that is taught in schools in Grades 10 to 12. Some topics have been removed and others have been added; for instance in Grade 10 "Geometric Optics" has been removed and "Reactions in Aqueous Solutions" and "Stoichiometry" have been added. In Grade 11 "Longitudinal Waves" has been removed, and in Grade 12 "Acids and Bases" has been added and "Production of Colour", "Colour Spectrum" and "Electronics" have been removed (Teacher Toolkit, 2012:6).

To cover the content as prescribed the National Curriculum Statement (2011:7) stipulates that instructional time for Physical Sciences should be 4 hours per week for FET phase. This therefore requires that there is proper weekly planning to ensure that the time is used optimally. Efficient planning requires the Physical Sciences CAPS policy document; a work schedule (which is an annual teaching plan and indicates sequencing of topics); a programme of

assessment that shows the number of tests and examinations; practical work, experiments and projects to be given per year to learners; the required textbooks, apparatus, lesson preparation and assessment tasks. Once this planning has been done, the ideal teaching methods should be identified. To achieve the goals that have been set up for Physical Sciences the Department of Basic Education through NCS (2011:12) suggests the following teaching and problem solving methods: Teaching can be done by lecturing or telling, using demonstrations, illustrations, and the correct use of the textbook. For problem solving development of experiments, models, practical investigations, posters and building a device to name but a few, can be used. Muzah (2011:63) states that it is documented that scientific knowledge obtained through observation and experimentation is usually reliable since it is objectively proven knowledge and derived from facts of experience acquired.

Kelder ((CAPS):iv) states that as a teacher at FET your two main resources are:

- Your expertise in the subject
- Your teaching experience and knowing how to help learners master the skills and knowledge of the subject.

Moreover the following demands are made on you as a teacher by CAPS ((Kelder (CAPS):iv):

- To follow a learning programme that enables learners to develop all the skills, knowledge, values and attitudes relevant to Physical Sciences
- To have a sound up – to – date knowledge of the content and methods of your subject, and a clear understanding of its social relevance, so that you can act as a guide, facilitator and subject expert in the classroom..

The preceding discussion of CAPS for Physical Sciences provides the framework and guidance to teachers to plan and teach Physical Sciences and highlights what is expected of them in terms of the curriculum. Teachers and learners are enabled to sequence their work within distinct parameters of time; and they also are afforded an opportunity to evaluate and decide on what preparations they should make to achieve the stated goals. The discussion is also important for

this research because it is essential to know what CAPS entails and that the expectations of the researcher and the expectations from the participants are in sync.

2.4 PHYSICAL SCIENCES TEACHING AND LEARNING

In this section the literature review looks at science teaching. This discussion will deal with issues and challenges such as teaching and learning strategies that can be used, the availability of apparatus and equipment, the role of learners and the classroom interactions between teachers and learners.

2.4.1 Strategies of teaching and learning

For any teaching situation, it is essential to address clear and appropriate learning goals and objectives, to build concepts and principles in such a way that learners grasp them with ease; to develop skills and to practise dispositions that are valued by the community (Hammerman, 2006:xiv-xv). This can be done by effective lesson planning and learning. Muzah (2011:25) states that literature demonstrates the growing realisation that most learning theories have great value in the organisation of knowledge, have value in the direction of research for new knowledge, are used in the solution of problems, are of importance in understanding how children learn and hence facilitate learning and teaching processes in our daily situation and in classroom in particular.

The point of departure would be to select a topic or theme from the Physical Sciences curriculum and to then research and review the content information about the topic. The set of key concepts and principles to be developed that are appropriate for the grade level and content are then selected. Ideally teachers should then design one or more graphic organisers to show the relationships between concepts or concept categories. Throughout the lesson planning exercise, it is important to consider the development of process skills of science, critical and creative thinking skills, and dispositions to include and emphasise (Hammerman,

2006: xiv-xv). This procedure is salient for science educators and their learners to follow as it would facilitate a more effective and structured science lesson planning and learning effort.

Hammerman (2006: xiv-xv) states that diversity should be accommodated through meaningful contexts. This can be done by considering various types of contexts for the development of quality instruction and include a cultural context especially when indigenous knowledge is revealed. Ideally varied methods should be used that engage and challenge learners intellectually and address prior learning, misconceptions, and new learning, and embeds strategies that allow learners to develop new or modified thinking frames with links to their own lives, technology, and issues relevant to their communities. It is important to research learning activities and experiences and to modify existing activities or design new activities. A consistent format should be applied to craft each instructional activity and experience, and should include multiple and varied methods and strategies for meeting the needs of learners. Activities and experiences for re-learning and for extended learning should be considered to assist learners with barriers as well as gifted learners. Every Physical Sciences teacher should apply diversity in the lessons by asking questions from the syllabi of previous grades to determine how far the learners are in their understandings of their previous work. In addition, classroom teaching and learning should be complemented by performing practical work in the laboratory.

Instead of only using traditional teaching methods, such as the lecture method, learners could be requested to make models of molecules and other things to improve concept formation through visualisation. Learners could be requested to write projects on selected topics as group work and after an agreed-upon time to report in turn to the whole class and discuss these reports. As an incentive learners could be taken on excursions to institutions of higher learning particularly to their Physics and Chemistry departments to stimulate interest in Physical Sciences and possible career opportunities

Besides mastery of content, the development of critical thinking and problem-solving skills need to be considered. This could be done by using questioning and other techniques for learners to make sense of what they are learning (Fisher, 1995:92; Hammerman, 2006:xiv-xv). A variety of ways should be identified for learners to frame their thoughts and to link new learning to prior learning and in so doing making connections to their lives, technology and society. To do this, learners should have notebooks that reflect what learners design, do, record, write, research and so forth throughout the year. In class learners must take notes in writing of what is taught in a lesson; they must solve problems given to them by the teacher or those found in the textbook and need to actually conduct experiments in the laboratory assisted by the teacher (Laursen, Hunter, Seymour, Thiry & Melton, 2010:39-40).

It is important to use equipment, materials and resources to enhance learning and provide a challenging learning environment. Resources, equipment and materials that will be needed for effective teaching should be considered as well as management strategies and safety issues. Finally a well-designed assessment system should be implemented to monitor and guide the learning process and to provide feedback to learners about their learning. A rich assortment of formative assessments needs to be designed as well as rubrics to enable learners to assess themselves. Assessment data can be used to assess the effectiveness of teaching and learning. Learners need to write tests and sit for examinations, complete assignments and projects. It is always helpful for learners to ask the teacher questions as well as other learners. This enables learners to increase their learning and understanding (Laursen et al, 2010:39-40).

The preceding guidelines could be used by Physical Sciences teachers for effective teaching in the classroom setting. They are quite practical in most learning environments and would make sense to learners too as the intention is to enable learners to become scientific thinkers. Stone (2007:39) states that learners will be good thinkers when they have a deep understanding of key scientific concepts and that good scientific thinking means being able to generate questions for inquiry, develop sound hypotheses, design controlled experiments, collect and present appropriate data, use evidence to support a conclusion, and effectively communicate an

experimental process. The acquisition of these skills will not only be useful for the mastery of Physical Sciences, but will also be useful for learners in future irrespective of the careers they follow.

2.4.2 The role of Physical Sciences teachers

Halloun (2006:12) states that science education is concerned with helping learners to develop knowledge about physical realities that are in line with scientific knowledge. The Physical Sciences teacher would therefore involve three major entities, namely the individual learner and his/her knowledge and beliefs about the world and science; the physical realities addressed in the curriculum, and the related scientific knowledge. A brief comment about these entities should explain their relevance.

A Physical Sciences teacher should try always to give individual attention to learners as this would help both the teacher and the learner to understand the extent of knowledge that the learner has in the subject (Fisher, 1995:92). This would enable the teacher and the learner to put remedial measures in place. Physical realities addressed in the curriculum have to be known and both the teacher and learner have to make sense of what these are and how to work with them. The related scientific knowledge such as the work that was done in previous grades has to be put in context in terms of using it in the current lessons and linking prior knowledge to new content. Teachers can use various methods to do so. The previous section briefly referred to the use of a variety of teaching methods to keep learners motivated. Hammerman (2006:76-78) groups these in five so-called strategies:

Expository strategy: In the Physical Sciences classroom expository teaching takes the form of telling facts, giving information, or telling a story as well as by writing on a board or transparency for learners to copy and showing a film or videotape or by reading a text.

Discussion strategy: This is effective when learners have had experiences that reach beyond an awareness level and bring a wealth of prior knowledge or general data to the table. In the classroom discussion questions might focus on designs of investigations, processes that were used, data that was collected, and conclusions that were drawn relative to an investigation or research that was undertaken.

Demonstration strategy: A demonstration involves one or more persons that give a presentation to an audience or show practical experiments to the entire class. Demonstrations with interactions allow learners to have input and to ask questions and stimulate visual perception. The exchange of ideas between teachers and learners can be enlightening and informative for all learners.

Guided inquiry: Through inquiry learners design action plans for investigating questions; they make predictions or hypotheses, and engage in activities using a variety of materials and equipment. Inquiry involves the use of process and thinking skills, use of tools and technologies to gather data, analysis and interpretation of data, and posing plausible solutions or conclusions.

Open inquiry or Problem-based learning: This strategy is based on focused experiential learning that is organised around an investigation and resolution of muddled real-world problems. Problem-based learning is both a curriculum organiser and a reading strategy.

The importance of these strategies comes to the fore when teachers need to cater for different learners in a class. Learners in the same class may be at different developmental levels and may have different life experiences that could affect their learning. Versatility in class is necessary as it allows for all the learners to benefit when a particular method is used that best suits them. This understanding of the necessity of using various methods in a class leads one to want to know the character of science.

Akerson, Cullen and Hanson (2009:1090) state that when science education underwent reforms in the 1990s, the nature of science which influences learners' scientific literacy rose to the forefront. This nature of science suggests that scientific knowledge is both reliable and tentative and that no single scientific method exists (there are shared characteristics of scientific approaches). Creativity plays a role in the development of scientific knowledge and there is a crucial distinction between observations and inferences that are made. Though science strives for objectivity, there is always an element of subjectivity, and social and cultural contexts play a role in the development of scientific knowledge (Akerson et al, 2009: 1092). This aspect of the nature of science has been accommodated in CAPS particularly with the inclusion of indigenous knowledge systems. However, not all teachers may be *au fait* with the views on the nature of science and may disagree with these. Ideally a community of practice (CoP) should be developed (Akerson et al, 2009: 1092) where teachers work together to refine their teaching practice and to help improve learning of both teachers and learners. The components of mutual engagement, a joint enterprise and a shared repertoire make an effective CoP. Mutual engagement is achieved by having teachers share training experiences and commit to a professional development programme to engage in learning and practice activities. This would enable teachers to embark on a shared goal of improving science teaching and to incorporate the nature of science. A shared repertoire is achieved by sharing knowledge and learning experiences as well as resources and activities that have been modelled for professional development of participants. Learning experiences must be flexible and open to personalization for the individual and the specific context in which to apply the learning. The question therefore would be to find out the extent in which the teachers have used their knowledge of the nature of science in class for teaching practice.

Salloum and Abd-El-Khalick (2010: 929) state that changing teachers' practices has been an object of study since the 1960s through process-product research and later by examining teacher knowledge and beliefs and their influence on learner learning and classroom dynamics. These authors suggest that teachers should be committed to prepare learners for national examinations, to develop conceptual understandings of learners, and to challenge learners to

develop higher order thinking skills. To prepare learners for the examinations, learning science concepts must go beyond conceptual understandings and entail knowledge and skills to navigate examinations by correctly interpreting verbs and appropriately choosing solutions procedures (Salloum & Abd-El-Khalick, 2010:939-944). There is growing evidence that high-impact practices can further improve learners' success, such as demanding a high level of learners' participation and promoting substantial and meaningful interaction between learners. Teachers should also provide immediate feedback to learners about their performance, and allow learners to apply, integrate, and synthesize their learning within a coherent context (Laursen et al, 2010:39-40).

Committed, competent and qualified teachers can contribute to the development of an ethic of learning and set the example for learners to focus on what is required for success. By adapting teaching methods to accommodate all learners, examination results can be improved. Having considered teaching methods and the role of teachers in teaching Physical Sciences, the next step is to look into the role of learners who ultimately are the main reason teachers devise the means that would assist in improving learner achievement.

2.4.3 The role of learners

Setati (2011:32) states that learners bring into the science classroom a great variety of common sense or views derived from individual experiences of the world. These contribute to the social context of the classroom where learners' own discourses become extended to incorporate scientific discourse. Educare (1998:20) states that outcomes – based education requires teaching and learning to take place in an integrated way. Gultig et al (2002:5) state that adopting an integrated approach to education and training is one way of responding to the changes in which learning is being organised and certified. Kelder (2005:8) states that integration should be achieved within and across subjects and fields of learning; and that this integration of knowledge and skills and terrains of practice is crucial for achieving applied competence. Besides working across subjects, the importance of language in teaching and

learning needs to be highlighted. O'Brien (2011:38) states that to learn science is to learn the language of science and learners need to be sold on the importance of becoming fluent in the initially foreign language of science. Most Physical Sciences learners in South Africa have to study the subject in their second or third language and besides having to understand the language of science, they need to master the medium of instruction. This disadvantages learners to a large extent. Precision in language leads to precision in thought, experimentation and reasoned discourse and argumentation about empirical evidence and theories, all of which are necessary elements for learning and contributing to science. Science also requires learners to connect unfamiliar and foreign sounds with new concepts that in many cases are not directly accessible through unaided senses e.g. atoms, cells, and electromagnetic fields. In some cases, science uses familiar words e.g. work, energy, power and force in specific ways that differ from their general use in everyday conversations. This shows the need for learners to understand and develop their technical vocabulary of Physical Sciences terms, and also try to use these terms correctly when performing experiments or doing calculations and writing assignments. Setati (2011:27) states that it is acknowledged that expecting learners to learn a new and difficult subject through the medium of a second language is unreasonable because this gives them a double task of mastering science content and the language.

Hamm and Adams (1998:45-46) state that themes are an effective way to connect ideas of science to historical, social and personal issues; and that the spirit of inquiry can be strengthened when science, language and literacy are embedded in thematic lessons. It is therefore important to broadly define the content that the learners need to know for them to become informed, confident and competent. The following unifying themes, concepts and processes of science and the language arts include some of the important scientific and linguistic concerns that learners could use to make their learning more meaningful (Hamm & Adams 1998:46):

Systems, order and interactions: A system such as the number system and the education system are an organised collection of things that can have some influence on one another and

appear to constitute a unified whole. Learners can form an understanding of order in systems. There is a sense of regularity in nature where events can be predicted and described. Learners can then develop understandings of basic principles, laws, theories or models to explain the world.

Evidence, models and explanations: A model is a simple representation that helps learners to understand the concept better. Learners can make models of the structures of molecules such as a water molecule using small sticks and rolled pieces of paper.

Constancy, change and measurement: Constancy refers to ways in which systems do not change such as when they attain a state of equilibrium. Change is important for understanding what will happen as well as predicting what will happen. Learners can for instance be required to measure the amount of acid, using a pipette, needed to titrate against a known quantity of base in a beaker.

Evolution and equilibrium: The theory of evolution states that the present arise from the forms of the past. Learners can read and debate this concept. Arms and Camp (1979:798) state that the theory of evolution states that species of organisms have arisen by descent and modification from more ancient forms of life. Evolution can also be defined in more modern terms as a change in the gene pool of a population from one generation to the next. One way in which evolution occurs is by the mechanism of natural selection, the differential survival and reproduction of genotypes in each generation of a species. According to the theory of evolution by natural selection, inherited characteristics which improve an organism's chances of living and reproducing in any particular environment will be more common in the next generation than those that decrease the chances of reproducing. Inherited characteristics are controlled by genes.

The Oxford English Dictionary (2000:391) defines equilibrium as a state of balance between opposing forces or influences. The term equilibrium has the following notions in science:

dynamic equilibrium which is a situation in which the rate of one change proceeds at the rate as the opposing change; static equilibrium is a state of balance in which no further changes occur; phase equilibrium is when the rate of change of a substance from one phase to another is equal to the rate of the opposing phase change; and chemical equilibrium is when the rate of the forward chemical reaction is equal to the rate of the reverse reaction (Brookes, Gibbon & Patrick 2007:210).

Energy, form and function: Energy is a central concept of the physical sciences that includes Mathematics, Biology and Geology as it underlies all systems of interactions. Chemical reactions between atoms need energy to occur and learners can use sunlight to melt a piece of ice. The Educational Support Services Trust Matriculation Programme (ESST) (1995:17) defines energy as the capacity for doing work. The energy of an object can be determined by calculating the quantity of work it can do. There is the potential energy which is the energy an object has as a result of its position or state; kinetic energy is the energy an object has as a result of its motion; and mechanical energy is the combination of potential energy and kinetic energy. Chemical reactions occur when energy changes take place in chemical reactions (Brookes et al 2007:204).

Language and language structure: Language is the most powerful tool for communication, defining our culture and for representing us. Learners can be given an assignment to prepare in writing and present it in turns to the class. NCS (2011:14) states that teachers of Physical Sciences should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners for whom the language of learning and teaching is not their home language. It is important to provide learners with opportunities to develop and improve their language skills in the context of learning Physical Sciences. It will therefore be critical to afford learners opportunities to read scientific texts, to write reports, paragraphs and short essays as part of the assessment, especially in the informal assessments of learning.

Reading: Reading a wide range of texts and literature forms part of science and language learning and gives learners new perspectives on their experiences and allows for them to discover how literature can make their lives richer and more meaningful.

Researching: As learners ask questions, pose problems, and generate ideas concerning language and science, they accumulate, analyse and evaluate data from many sources to communicate information and their discoveries for a specific purpose. This is research.

According to Farenga and Joyce (1997:248) young children bring a variety of experiences to the classroom. To connect new data with pre-existing mental constructs teachers need to be aware of students' prior experiences. To ensure that science education includes all children Farenga and Joyce (1997:250-251) state that educators must use methods of assessment that acknowledge the effect of previous experience on future learning. Educators treating all students as if they were the same will only lead to further inequities. Because young boys and girls are socialised differently they come to school with vastly different science related experiences. Based on valid means of assessment constructivist strategies can be employed that maximise students' prior knowledge and interest. Teachers who recognise the importance as individuals will foster and accept student initiative by encouraging students to be both problem finders and problem solvers. Science programmes must integrate what is known about young students' experiential backgrounds to develop a more productive and inclusive science pedagogy. A major goal of science education should be to identify techniques that encourage active participation of all young students in science.

Hammerman (2006:91-92) states that the following checklist affords best practices for learners because they are a set of researched – based approaches. The list can be useful when analysing instructional materials for the ways they address important aspects of science or for analysing instruction.

- Function as a facilitator of learning; guide and mediate the learning experience
- Provide a safe and supportive student – centred environment for learning

- Structure lessons to build on prior learning and lead to more complexity
- Use inquiry as a primary approach
- Use the vocabulary of science in communication
- Provide opportunities for students to ask inquiry questions and to generate hypotheses
- Provide opportunities for students to plan investigations to test hypotheses
- Use manipulative materials to build/reinforce concepts
- Use cooperative, collaborative activity as opposed to competitive activity
- Use heterogeneous grouping and individualised instruction
- Use equipment, materials and resources for multisensory learning
- Provide opportunities for students to develop logical reasoning and thinking skills
- Involve students in problem solving
- Use student – centred activities such as products and projects
- Use a variety of instructional resources and data bases, simulations and Web links
- Motivate and challenge students
- Use notebooks to organise thought and integrate writing
- Use appropriate technology (calculators, measurement tools, balances, computers)
- Use questions to engage students in discussions based on experiences and thought
- Apply learning to lives of students and community, country and global society
- Include connections to technology and explore technological design
- Devote time to reading books, nonfiction material and current events
- Give responsibility to students for quality work, goal – setting, recordkeeping, monitoring, evaluation and so forth; empower students
- Give students choices (activities, resources, projects, research topics, partners, etc.)
- Give attention to affective needs and cognitive styles of learners; differentiate
- Model and practice principles of democracy and dispositions of science

The preceding discussions highlighted what teachers can do to facilitate learning and briefly focussed on barriers that Physical Sciences' learners in South Africa encounter that would affect

learner achievement in the subject. Classroom interaction and what happens during lessons between teachers and learners should also be considered.

2.4.4 Classroom interaction between teachers and learners

Classroom interactions between teachers and learners comprise all the actions of teachers and learners during a lesson in the classroom or experiment in the laboratory. Fisher (1995:12) states that social interaction is the key to success in learning. We learn more in collaboration with others, namely, parents, other learners and adults than we can by ourselves. Stone (2007:5) states that over the preceding 21 years of teaching science he had worked increasingly hard to find, modify, and include hands-on, minds-on activities in his classroom. He began by collecting laboratory activities from dozens of text series and books of hands-on science activities. Activities were modified to emphasise observation, data collection, data analysis, conclusions, support for conclusions, and applications that entail the development of process skills. His goal was to find activities for every major concept that learners needed to learn forming the primary mode of instruction. Stone succinctly reiterates the necessity of actually doing things during the teaching and learning in the science classroom to help learners to internalize the knowledge.

Farenga and Joyce (1997:248) state that young children bring a variety of experiences to the classroom; therefore teachers are required to engage learners in learning experiences that build upon this prior knowledge. Thus to connect the new data with the pre-existing knowledge teachers need to be aware of learners' prior experiences. One way to do this is by using baseline assessment at the start of a grade or a section of work to establish what the learners already know or what their level of skill is in a particular kind of activity (Kelder:2005:23). For instance, at the start of Grade 10, learners may be assessed as to how well they can set up an experiment by following a list of written instructions.

Another idea that could help both the teacher and learners structure their deliberations in the classroom would be to construct a framework for small groups for discussions (Ratcliffe, 1998:55). Such a framework could be organised with items and under each item there would be a number of questions that learners would have to work on. Such a framework would assist the teacher to engage learners by way of clarifying their deliberations and conclusions. Further classroom implications of this activity could be to encourage learners to relate their experience of school science to real problems and to develop social responsibility. Teachers can motivate the learners to further explore the issue, and assist learners to verbalise, listen and to argue logically. The framework could also assist learners to develop skills of systematic and thoughtful reasoning and analysis, and help learners to understand science concepts (Ratcliffe, 1998:57). This may lead to successful classroom interactions between the teacher and learners during the science lessons and promote Physical Sciences mastery.

Discussion on challenges experienced with Physical Sciences teaching follows.

2.4.5 Challenges experienced with Physical Sciences teaching.

Stavy and Tirosh (2000:vii-viii) state that a major thrust in science education has been the study of learners' conceptions and reasoning in science . Such studies have been carried out in Physics. Most of this research has been content-specific and concerned with providing detailed descriptions of specific alternative concepts. In view of the volume of documented instances of alternative conceptions, preconceptions (ideas or opinions that are formed before having enough information or experience) and misconceptions (ideas or beliefs that are not based on correct information) in science, a description covering categorisation, general resources and appropriate educational approaches would seem to be in order. Such a description would have both explanatory and predictive powers and should enable researchers and teachers to foresee learners' inappropriate reactions to specific situations in science.

Ramnarain and Modiba (2013:65-66) state that in South Africa a new conceptualisation of science literacy in a revised curriculum places an immense burden on science teachers in first translating the goals of scientific literacy as elucidated in the curriculum, and then drawing upon curriculum design principles in advancing these goals. Further, Ramnarain and Modiba (2013:68) state that a reconceptualisation of scientific literacy from a curriculum dominated by content specification to one where the goals of scientific literacy are more broadly defined has resulted in uncertainty among many South African teachers. Further the regular curriculum changes have had a negative effect on teacher morale as they hardly master the requirements of a curriculum before another is introduced. These challenges would have an effect on teacher commitment and in that way influence learner achievement. Particular challenges that are experienced by teachers need to be identified and addressed to enable teachers and researchers to prepare possible remedial measures for these challenges.

The preceding section identified some of the challenges facing science teachers in South Africa as they do their work at school. There are many of these challenges warranting that the powers that be in the education of the country address them so as to smooth the education process of the land for learner science performance improvement

2.5 CONCLUSION

This chapter examined literature pertaining to science teaching and focused on the development of CAPS: Physical Sciences and on generic issues regarding teaching and learning of Physical Sciences. As the purpose of this research is to focus on solving problems that may be the cause of poor learner achievement in schools literature on teaching and learning was reviewed. The next chapter describes the research design and methodology and how the research was undertaken.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter is on research methodology and looks into how the research question has been investigated. McMillan and Schumacher (1993:45) state that in the methodology section the researcher indicates the subjects, instruments and procedures that will be used in the study. De Vos et al (2002:79) state that at present there are two well-known and recognized approaches to research, namely: the qualitative approach and the quantitative approach. Research methodology encompasses issues such as the methods and techniques that will be used in the research process; populations and sampling strategies as well as data collection strategies and instruments that will be in the research. It also involves the reporting of the findings of the research project in writing. The rationale for studying research methodology according to Moll (1999:34) is that it affords the prospective researcher an opportunity to access many research guidelines such as ethical aspects, writing guidelines and other practical tips that should help to facilitate the research task. This also familiarizes one with the relevant literature. This has paved the way to take a look at the methods and techniques that were used in this research. This was imperative as it allowed the researcher to choose the most fitting strategies and methods in undertaking the research.

3.2 RESEARCH DESIGN

3.2.1 Defining a research design

Mouton (2001:55-56) states that a research design is a plan or a blueprint of how one intends to conduct research. A research design focuses on the end product, that is, what kind of study is being planned and what kind of result is aimed at? Thus research methodology consists of the

systematic use of methods and tools that are used to perform different tasks, and the accurate execution of the design. According to De Vos et al (2002:77) research methodology is a term that describes the way to solve problems in the research process.

In light of the above the researcher designed the study such that there was a schedule guide and an audio – tape to extract and record information from the participants in the face – to – face dialogue of a semi – structured interview process which enabled accessing the objective of the study which is to determine the obstacles experienced by the teachers with the implementation of CAPS and how these could be addressed. In essence the researcher has evaluated an implementation programme as to how successful it has been.

3.2.2 Qualitative and quantitative approaches

As mentioned in the preceding sections one of two salient research approaches used is the qualitative approach. De Vos et al (2002:79) point out that qualitative research elicits a participant’s account of meanings, experiences or perceptions. It produces descriptive data in the participant’s written or spoken words and involves identifying the participant’s beliefs and values that underlie the phenomena. Qualitative research is concerned with the understanding and not the explaining of issues. It is based on naturalistic observation rather than on controlled measurement as well as the subjective exploration of reality from the point of view of the insider. McMillan and Schumacher (1993:375) mention that qualitative research can investigate small, distinct groups such as participants in a school; learners in a selected class; one principal’s role for an academic year, one institution or multiple sites with subsets of larger groups. In context of this current research the four participating schools constitute the multiple sites where the research was undertaken

De Vos et al (2002:302) state that a schedule to guide interviews is called an interview schedule or guide. This provides a researcher with a set of predetermined questions that might be used to engage the interviewee/s. The qualitative approach thus allowed the setting between the

researcher and the participants to be a dialogue leading to a subjective as well as a deeper understanding of the issue under investigation because this study is about issues that pertain to experiences of individuals with respect to the implementation of CAPS in their schools. Setati (2011:112) states that the strength of qualitative interviewing is that in listening to a participant one learns about what one cannot see and one obtains explanations of such experiences.

Moll (1999:68) states that in qualitative research, the data that is collected, analysed and interpreted and is rich in description of people, places and conversations; it is not easily handled by statistical procedures. This would require that there be an appropriate way of dealing with the collected data in terms analysing, interpreting and understanding it.

Accordingly data was collected using interviews between the researcher and the participants and these two – way dialogues yielded the necessary information because the settings were relaxed, conversational and held at convenient times and places for both the researcher and the participants who had had the interview guide with them for about a month. This type of relaxed dialogue afforded an opportunity for the researcher to talk extensively with a participant concerning the research questions and objectives within the context of the interview guide. The data were arranged according to themes or question areas, analysed and interpreted for meaning.

3.2.3 Case study design

As previously stated this research used the case study design to answer the research question and sub – questions. Four specific cases (schools) were under focus in this study to reveal what lies behind the seemingly problematic implementation of the CAPS Physical Sciences as is suggested by the unacceptable performance of the learners of the District in the subject. De Vos et al (2002:275) state that a case study is an exploration or an in – depth analysis of a bounded system by time and/or place. McMillan and Schumacher (1993:377) state that case studies are appropriate in evaluation studies of new programmes.

The implementation of the CAPS for Physical Sciences is quite a recent phenomenon in the four selected schools of the Ngcobo District as this was done for first in 2012 (CN 2011:5). An evaluation of the process in terms of whether it yielded the needed results or not was necessary and this research provided such an opportunity. The researcher made plans to conduct interviews with the teachers who teach the learners the Physical Sciences in the schools that yielded the necessary data for analysis and meaning making.

3.2.4 Interviewing strategy

Setati (2011:112) states that interviews are used if one is looking for information based on emotions, feelings and experiences, information on potentially sensitive issues, and information based on insider experience and privileged insights.

De Voss et al (2002:297) distinguish between nine types of one-to-one interviews, (the structured interview, semi-structured interview, survey interview, counselling interview, diary interview, life history interview, ethnographic interview, informal or unstructured interview, and conversation). In this research semi-structured one-to-one interviews were used to collect data. A researcher uses a semi-structured one-to-one interview to gain a detailed picture of a participant's beliefs about or perceptions of or accounts of a particular topic (De Vos et al, 2002:302-303). This method gives flexibility to both the participant and the researcher during an interview. The researcher will have a set of predetermined questions on an interview schedule. The interview will be guided by the schedule and not dictated to by it. The sequencing of questions is one of the things to take note of when using this strategy pertaining to the range of themes or question areas to be covered in the interview. Two points in particular need attention such as: what is the most logical order to address these question areas, and which is the most sensitive question area. The researcher should think of appropriate questions related to each question area. For instance it could be meaningful to arrange the questions from the simple to the more complex and from the broad to more

specific in order to allow for the participant to adjust to the pattern of the interview as time goes on. Semi-structured interviews take time to do and they can be intense and involved; but not every question needs to be asked. The interview could digress from the interview schedule and the researcher would have to decide on the degree of deviation. McMillan and Schumacher (1993:427-428) argue that the contents of questions vary because of different research purposes and problems; and that qualitative interviewing requires asking truly open-ended questions. In section 3.5 the development of the interview schedules will be discussed.

The researcher thus used the semi –structured interview approach to probe the research question in a one – to – one setting dialogue between the researcher and a participant. A voice recorder was used to record the interview process whereupon the interviews were transcribed. The issue under investigation required that individuals be approached and that they furnish information that is relevant to the research question.

The preceding section dealt with issues of methods and techniques used in this research .The following section will take on issues of sampling and selection of participants for this study.

3.3 CONCEPTUALISING SAMPLING

3.3.1 Population

A population is defined by De Vos et al (2002:199) as the totality of persons, events, organisation units, case records or other sampling units with which the research problem is concerned. The 22 schools of the Ngcobo District which is situated in the Eastern Cape constitute the population from which the sample for the study has been drawn. The District is rural largely and has had poor Physical Sciences results as seen in table 1.3. The researcher is of the view that this delineated area set boundaries for the study that yielded the required information to understand the research question What problems do teachers experience with the implementation of CAPS for Physical Sciences in the FET band?

3.3.2 Sampling

De Vos et al (2002:197-199) state that sampling is one of the most important concepts in research, which entails the taking of a portion from a population as representative of that population. Sampling is necessary in research because a complete coverage of a population is seldom possible. The 22 FET schools of the Ngcobo District of the Eastern Cape are many and of necessity therefore a sample was drawn from amongst them for this study. This argument afforded an occasion for the researcher to select four schools or cases in the District purposely to be evaluated in terms of the implementation issues pertaining to the CAPS Physical Sciences in the schools thus constituting a case study. De Vos et al (2002:334) state that in qualitative studies non-probability sampling methods are used and that purposive sampling is utilised rather than random sampling. McMillan and Schumacher (1993:378) state that purposive sampling is contrary to probabilistic sampling in that it selects information-rich cases for an in-depth study. The researcher is of the view that the four schools have provided enough data to attain to the objective of the study which is to determine the obstacles teachers experience with the implementation of CAPS Physical Sciences and how these could be addressed.

3.3.3 Selection of participants

Six teachers who teach the learners in the four schools were selected as the research is concerned with implementation issues of grades 10 – 12. The teachers were targeted to participate in the research as they are the ones who currently teach the CAPS Physical Sciences in these schools. This is in line with the target sampling strategy for obtaining systematic information from a controlled list of specified names (De Vos et al 2002:208). These are the participants who were sent letters of invitation and consent forms in their schools to participate in the study by hand by the researcher together with the interview guides so that a rapport could be formed between the researcher and the participants even before the interviews were undertaken. Moll 1999:68) states that qualitative researchers tend to collect their data through sustained contact with people in settings where they normally spend their time.

The preceding section described the population, sampling and selection of participants for this research. Before these individuals could be interviewed, ethical issues needed to be considered.

3.4 ETHICAL ASPECTS OF RESEARCH

McMillan and Schumacher (1993:397) state that qualitative researchers need to be sensitive to ethical principles because of their research topic, face – to – face interactive data collection, an emergent design and reciprocity with participants. Setati (2011:121) states that ethics plays a major role in judging qualitative research because qualitative researchers spend a great deal of time with participants and should treat them with dignity. The current study adhered to this ethical requirement by observing the following: informed consent, anonymity and confidentiality, actions and competence of the researcher and release or publication of the findings (De Vos et al 2002:65-72).

- **Informed consent:** McMillan and Schumacher (1993:398) state that most ethical situations require researchers to determine situational priorities. This involves that the researcher conducts discussions with the participants on the research process. This implies that all possible or adequate information on the goal of the investigation, the procedures that will be followed during the investigation, the possible advantages and disadvantages and dangers to which the participants or respondents may be exposed, as well as the credibility of the researcher should be rendered to potential participants or their legal representatives. Participants must fully comprehend the investigation and consequently be able to make a voluntary and a thoroughly reasoned decision whether or not to become involved in the research.

In line with the above argument the researcher therefore prepared a letter of invitation and a consent form that were telling about the title and the aim of the research and took it to the Ngcobo District of Education for the education development officer (EDO)

to grant permission to the researcher to conduct research in the District. Similar letters were also sent by hand to the school principals and the teachers of the selected schools by the researcher so that questions about the research that could arise should be dealt with there and then. Both the letter of invitation and the consent form were fetched a month later allowing the participants to fully understand the implications of taking part in the study. This personal contact between the researcher and the participants enabled the researcher to gain the confidence of the participants such that during the interviewing sessions the participants were relaxed and were frank in responding to the questions from the interview schedule.

- **Anonymity and confidentiality:** Mouton (2001:238) states that the ethics of science concerns what is wrong and what is right in the conduct of research, because scientific research is a form of human conduct. It follows that such conduct has to conform to generally accepted norms and values.

Interviews sessions with the participants were conducted privately in their chosen places so as to ensure that the information that they gave was not overheard. A voice recorder was used in the interviews to record the dialogue and it was accessible to the researcher alone and the information therein was utilised for the research aim only. This information given anonymously ensured the privacy of the subjects or participants and the participating schools. Setati (2011: 122) states that he believed that protecting the schools and the participants' anonymity was paramount and also assured the subjects of privacy and confidentiality with information revealed. This current research has made sure that handling of information has been confidential so access of this information by others has been avoided.

- **Actions and competence of the researcher:** De Vos et al (2002:62-63) state that the fact that human beings are the objects of study in social sciences brings unique ethical problems. The concepts of ethics, values, morality, community standards, laws and

professionalism differ from one another without necessarily being mutually exclusive. Ethical guidelines serve as standards and as the basis on which a researcher ought to evaluate his conduct; and as such this aspect should be borne in mind continuously. The researcher is obliged ethically to ensure that he is competent and adequately skilled to undertake the proposed investigation and that this requirement is even more important when sensitive issues are involved.

Prior to data collection the researcher applied to the Research Ethical Clearance Committee of the College of Education of the University of South Africa for a clearance certificate to do this research of which a copy of the certificate has been attached as Appendix A.

- **Release or publication of the findings:** The researcher should write the report and give feedback to participants. This feedback should contain all the necessary information so that participants are aware of the results of the research. De Vos et al (2002:249) state that the research report is the essence of, and serves as a model for, an investigation in which the written results as they relate to the conclusions, recommendations and evaluation of the collected material are presented to the public for reading. Further De Vos et al (2002:256) state that if a report is written after the investigation has been completed the past tense is used. When the contents are discussed immediately the present tense is used; while the future tense is used for that which has still to be done.

The researcher prepared a report of the research in writing giving details of the procedures that were undertaken to commence the study as well as those that were used throughout the process to the end. This report is available to the participants and to any person who would want to read it.

The preceding section dealt with salient ethical issues pertaining to conducting research as it is important that a researcher should be aware of these in his/her endeavours to collect data from the participants.

3.5 INTERVIEW SCHEDULES FOR DATA COLLECTION

Moll (1999:32) states that a qualitative design involves only a few respondents with the aim to understand and describe; instead of using calculations, words are used in the analysis and interpretation of results. A schedule has been prepared with fifteen questions to serve as an interview schedule or guide during the interviews of the six teachers (See Appendix B). Another schedule for interviewing the subject advisor has also been prepared with eleven questions (See Appendix C). The researcher felt it necessary to separate the guides because of the different roles of the teachers and the subject advisor. The questions in the guides have some overlaps generally but there are also differences that focus on the specific roles of the teachers and the subject advisor. Both guides contain questions that should answer the aim of the study which is to determine obstacles that the teachers experience with the implementation of CAPS and how these could be addressed.

De Vos et al (2002:303) state that when constructing the questions a focused literature study should be done to guide the researcher in understanding the construct at hand and to know what questions to ask to cover the construct. Muzah (2011:108-110) categorised questions into themes according to those that dealt with the biographical information of the participants; the availability of science resources such as science educators who are qualified to teach at FET level, infrastructure such laboratories and classrooms, furniture, science textbooks, laboratory equipment and consumables within the school as an organisation. Some questions were included as an opinion survey to determine the views of the respondents about teaching and learning in general, their science department and the school as a whole as well as aspects such as recognition, job satisfaction, opportunities for professional growth, team work, timetable

which takes into cognizance weak learners, allocation of subjects according to subject(s) of specialisation and equitable distribution of loads.

The questions, 15 of them, in the teachers' guide could be arranged according to the following question areas or themes (Refer to Setati 2011: 116)

- Those that probe biographical aspects of participants, that is, questions 1 to 3;
- And one that probes the performance of the learners;
- Experimental issues are covered in questions 5 to 7 and questions 9 to 10;
- The aspect of teaching theory in class is covered in questions 8 and 10;
- Probing about assistance from the school management and District office is dealt with in questions 11 to 13;
- The issue of job satisfaction is taken care of in question 14;
- And lastly the probe on what more could be done to assist the participants is dealt with in question 15.

The guide for the subject advisor follows the same trend because he also is a teacher except that he is based at the District office but the number of questions for the subject advisor is 11 and are similar to those of the teachers but question number 7 seeks to know more about his duties as a subject advisor.

Muzah (2011:106) states that the major purpose of both questionnaires was to identify and establish the school – based factors that cause high failure rates at matriculation levels in science by comparing ideas, views and opinions of both science learners and educators in order to come out with strategies of increasing and improving the performances of both learners and educators.

In this current study the two guides serve the aims of retrieving data from the teachers and the subject advisor for analysis, interpretation, understanding and meaning making about challenging issues in the implementation of the CAPS for Physical Sciences in the participating

schools. The questions are meant to answer the main research question which is what problems do teachers experience with the implementation of the CAPS for Physical Sciences in the FET band? These questions are such that both the teachers and the subject advisor can answer and give their views and opinions on the implementation issues in the schools.

The preceding section looked into interview schedules for data collection. The next section will discuss data collection, analysis and interpretation.

3.6 DATA COLLECTION, ANALYSIS AND INTERPRETATION

3.6.1 Data collection

McMillan and Schumacher (1993:383) state that qualitative phases of data collection and analyses are interactive research processes that occur in overlapping cycles. The researcher met the participants in their work places and some in their residential areas at agreed upon times as per the arrangements with the participants. The setting was a one – to – one face to face dialogue between the researcher and a participant. The researcher asked the participants questions from the interview guide that had been with the participant for about a month so that the participant had enough time either to make a decision to participate or not. Each participant had had enough time to prepare for the questions. This was done by the researcher so that the participants would trust and be confident of the researcher seeing that he was transparent in his dealings with them. McMillan and Schumacher (1993:399) state that interview times and places are selected by the participants because the researcher seeks to establish a trusting relationship with the participants.

In this semi – structured setting the participants answered the questions extensively but this was nevertheless done within the limits of the questions in the guide. Things that needed more explanation during the interviewing process were attended to in this relaxed but solemn setting. De Voss et al (2002:304) state that if possible and if permission has been obtained from

the participants the researcher should record the interviews on a tape or video. Each dialogue lasted for about fifty minutes and was recorded in a voice recorder. This time was long enough to get the needed information from a participant according to the guide and to make sure that each participant gave all and was deeply involved in the interviewing process because De Vos et al (2002:303) state that semi – structured interviews generally last for a considerable amount of time and can become intense and involved depending on the particular topic. Having collected the data the recordings were kept safe and were made inaccessible to any one; and the data were only used for this research after they had been transcribed.

The preceding section delved on data collection and the next will be on data analysis and interpretation.

3.6.2 Data analysis and interpretation

Muzah (2011:120) states that this chapter concentrates on analysis and presentation of data. It presents the views and opinions of respondents regarding the school related factors that cause high matriculation failure rates in science in public high schools. Against the background of the literature review, the views and opinions of the respondents, as they are reflected in the answers from the two questionnaires that directed the study are analysed, summarised, organised and presented.

Mouton (2001:108-109) states that all fieldwork culminates in the analysis and interpretation of data. Analysis involves turning data into manageable themes, patterns, trends and relationships. The aim of this is to understand the various constitutive elements of the data by an examination of the relationships between concepts and variables to identify patterns and establish themes. Interpretation involves the synthesis of the data into larger coherent wholes; and it also means taking into account rival interpretations of the data and show what levels of support the data provide for the preferred interpretation.

Moll (1999:74) states that data generated by qualitative research are usually voluminous, and therefore the first step is to sort out the data by physically organising and subdividing the data. This process also entails dividing the data into meaningful segments. Qualitative data analysis is a rigorous and systematic process of selecting, categorising, comparing, synthesising and interpreting of data. Categories and patterns emerge from the data instead of being imposed on the data.

Audio-recordings of the interviews were transcribed. Data was then read from the transcripts and arranged according to question areas as seen in section 3.5 and then analysed and interpreted to get the meanings they contained. De Voss et al (2002:344) state that classifying means taking the text or qualitative information apart to look for categories, themes or dimensions of information. The transcriptions were therefore arranged according to the themes and reported in this manner. Muzah (2011:122) states that the results were analysed separately to obtain what each sub – sample (theme) perceived as school related factors that caused high matriculation failure rates in science.

The preceding section dealt with data analysis and interpretation. The next section will deal with instrument reliability and the credibility of data.

3.7 INSTRUMENT RELIABILITY AND CREDIBILITY OF DATA

3.7.1 Data reliability and credibility

This section takes a look into how reliable the data collected by means of the interview schedules was, and hence, how valid the data produced by using these instruments is. Setati (2011:20) states that validity is the accuracy of inferences that are made based on the outcome measure and reliability as the consistency of the outcome measure. Moll (1999:70) states that the researcher in qualitative studies is the instrument and that much depends on what he/she sees and hears, and this rests on his/her powers of observation and listening. The kinds of skills

that are involved are those of social management, which are interpersonal skills that facilitate the negotiation of access into private thoughts. This also develops the kind of trust and rapport that encourages people to relax, to be natural and to go about their everyday business in the researcher's presence; this also encourages the respondents not to hold anything back. As mentioned before this research intended accessing information from participants by means of one-to-one interviews. To make sure that the data obtained from the participants were reliable and credible the researcher took the guides by hand to the participants with the consent forms indicating that the participation in the research was voluntary and that one could stop participating anytime one wished to do so without penalty. These were left with the prospective participants for about a month so that the decision to take part in the research had been well thought. This paid off because during the interview sessions the respondents. In relaxed fashion, gave as much as they could in answering the questions in the guides; some at home and others in their work places.

McMillan and Schumacher (1993:498) state that gauging data trustworthiness is done at the time of each field experience and should be done again during intensive data analysis. Trustworthy evidence is selected for pattern-seeking by assessing solicited versus unsolicited data; and this also involves an awareness of the researcher's assumptions, predispositions and influence on the social situation. Lastly, McMillan and Schumacher (1993:498) state that researchers actively search for discrepant or negative evidence that modifies or refutes a pattern. A negative case is a situation, a social scene or a participant's views that contradict a pattern of meanings. These exceptions are very useful because they make the original pattern more distinctive and yield insights to modify patterns. During the interviewing process the participants gave similar and different answers to the same questions; sometimes contradictory responses were given and this made the researcher to believe that the data that had been obtained were true reflections of the opinions of the participants about the implementation issues of the CAPS in their schools. Furthermore the guides were piloted to ensure that they served the purpose for which they had been made.

3.7.2 Piloting the study

Piloting the interview schedule was conducted to improve its effectiveness. De Voss et al (2002: 300) state that researchers should organise a pilot venture in which they try out their interviewing design with a small number of participants. This will enable the researcher to come to grips with some of the practical aspects of establishing access, making contact and conducting the interview, as well as become alert of their level of interviewing skills. During the formation of the guides the researcher sent first the questions to the supervisor for her opinion whereupon she moderated and modified the questions. Mouton (2001:17) states that the supervisor guides the student through the research process. The researcher then, before collecting the data, met, discussed and enquired from two educators and the subject advisor at different times and places for their opinions on the questions in the guides that had been with them for some time and see how they would respond to these questions. The educators and the subject advisor were satisfied with the guides. Muzah (2011:114) states that a pilot study was carried out in order to: enhance both validity and reliability; ensure that the questions meant the same to all respondents; estimate how long it would take the respondents to answer the questions; checked that all the questions and instruments were concise and clear; and checked biased items

3.7.3 Triangulation

McMillan and Schumacher (1993:498) describe triangulation as a cross-validation among data sources, data collection strategies and periods of time. Triangulation determines credibility. The researcher compares different sources, situations and methods to determine regularities in the data. De Vos et al (2002:342) list the following advantages of using triangulation in qualitative research:

- Triangulation allows a researcher to be more confident of his or her results and this is the overall strength of this multi-method design.

- This approach may also help to uncover a deviant dimension of a phenomenon. In addition, divergent results from this multi-method approach can lead to an enriched explanation of a research problem.

In the context of this research triangulation would relate to the use of the four schools, six teachers and a subject advisor to retrieve information from the different scenarios and to consider the aspects highlighted in the literature review. The six participants gave different views on the same questions but sometimes they had similar views. The information from the subject advisor added another acceptable and enriching dimension to the data. These different contributions from the participants increased the validity, credibility and reliability of the data. Setati (2011:120) states that the most important use of triangulation is that it checks out the validity of findings generated by different approaches, sources, time periods and theoretical schemes involved.

The preceding section was on triangulation and the next will conclude the chapter.

3.8 CONCLUSION

This third chapter highlighted the research design and dealt with conceptualising of sampling. Ethical aspects of research, interview schedules for data collection, analysis and interpretation were also discussed. Lastly instrument reliability and credibility of data were examined.

CHAPTER 4

FINDINGS AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

The preceding chapter 3 discussed the research methodology used in this study. This chapter presents the responses that the participants gave to the questions of the interview guides, analyses them and extracts the findings, and ultimately discusses these findings. This is done by successive tackling of the themes identified in this research. Refer to section 3.5. Thus the questions of the interview guides form the themes for data analysis (Setati 2011:138). Using the semi – structured strategy, one – to – one interviews were undertaken with the participants who responded to the questions of the interview guides so that the aim of the research could be realised which is to determine the obstacles teachers experience with the implementation of CAPS and how these could be addressed. Thus the case study of the four schools of the Ngcobo District had had its programme of implementing CAPS Physical Sciences evaluated by the researcher as to whether it had been successful or not. The following discussion of the findings will attempt to reveal this

4.2 FINDINGS AND DISCUSSION OF FINDINGS

4.2.1 BIOGRAPHICAL PROFILE OF PARTICIPANTS

4.2.1.1 What are your qualifications for teaching Physical Sciences? (Question 3)

The participants were requested to indicate their academic and professional qualifications to determine whether they are qualified to teach Physical Sciences.

- P1 said: “. I have got a diploma in education in which I majored in science teaching, then I am also doing B. Sc, that is Physics and Chemistry at Unisa and I am in my second year now”.
- P2 said: “I did a Bachelor of Science with the University of Fort Hare, where I was majoring in Chemistry and Microbiology; then I did a national diploma, a professional diploma in education with the Walter Sisulu University; this year I finished my post graduate certificate in education with the University of South Africa”.
- P3 said: “I am holding a B.Sc degree in Chemistry; I also did Higher Diploma in Education specialising in Physical Sciences”.
- P4 said: “ I am having Physics 1 and Chemistry 1 but I also attended training programmes that are designed by the Province for Physical Sciences resulting in me being one of the teachers of Physical Sciences in the Province”
- P5 said: “I did engineering, mechanical per se; I did Physical Science and teaching Mechanical Engineering”.
- P6 said: “I have a Bachelor of Science degree in Mathematics and Physics”.
- P7 said: “I have my junior degree which is B.Sc in education and I also have B.Ed honours and majored in natural science”.

Muzah (2011:72) states that educator qualifications together with content knowledge in mathematics and science have become a popular topic in countries such as the United States, Australia, New Zealand, Canada and other countries due to acute shortage of educators in these fields that has caused retarding success in science. Muzah (2011:79) states that there is extensive literature in South Africa that has attached poor performance of learners in science to serious shortage of properly qualified and competent science educators. In my view the qualifications of the participants indicate that they do qualify to teach Physical Sciences in the selected schools and therefore the hurdle of not having qualified teachers does not exist. Muzah (2011:129) states that specialisation in one subject during teacher training course provides in – depth and extensive knowledge and skills such that one becomes an expert in that particular subject.

The preceding suggests that the participants are knowledgeable people with relevant and appropriate qualifications and are teaching Physical Sciences to learners in grades 10 to 12 in the schools where they work. They are aware of all the deliberations that impact both positively

and negatively on Physical Sciences in their work regarding teaching this subject to their learners.

4.2.1.2 In which grade/s are you teaching Physical Sciences? (Question 2)

The participants mostly teach grades 10 to 12 learners.

- Participants 1, 2, 3 and 4 (P1, P2, P3 and P4) teach Physical Sciences to grade 10 to 12 learners.
- Participant 5 (P5) is currently teaching Physical Sciences to learners in grades 10 to 11.
- Participant 6 (P6) teaches Physical Sciences to grades 10 to 12 and is also a member the School Management Team (SMT).
- Participant 7 (P7) is a subject advisor but had taught Physical Sciences to grades 10 to 12.

In my opinion the participants are doing the work of teaching Physical Sciences in the schools in line with their academic qualifications which should lead to effective learning of the subject by the learners. Kelder (CAPS:IV) states that CAPS demands that teachers should have a sound, up – to – date knowledge of the content and methods of the subject, and a clear understanding of its social relevance so as to act as facilitators and subject experts in the classrooms.

4.2.1.3 How long have you been teaching Physical Sciences? (Question 1)

Most of the participants have been teaching Physical Sciences in FET for a number of years.

- P1 has been teaching Physical Sciences for approximately nine years.
- P5 and P2 have been teaching Physical Sciences for five and six years respectively.
- Participants 3 and 4 have been teaching Physical Sciences for 16 and 18 years respectively.

- P6 has the most experience and has been teaching Physical Sciences for almost 34 years. This participant also serves as a member of the SMT.
- P7 taught Physical Sciences for 15 years and is currently the subject advisor for the District.

The participants differ wildly in experience which in my view would have a bearing in their teaching effectively. P6 being the most experienced teacher with 34 years of teaching should be the most effective of the participants and I think that I am supported in my view by the fact that he is a member of the SMT. P7, P3, P4 with 15, 16 and 18 years respectively should also do their work with effect because they also are quite experienced. Moreover P7 is a subject advisor. P1 with 9 years is also experienced and P5 and P2 with 5 and 6 years respectively are the least experienced science teachers. Muzah (2011:124) states that teaching experience is a very important aspect that influences the educator's effectiveness in the teaching of science.

4.2.2 HOW WELL DO YOUR PHYSICAL SCIENCES' LEARNERS PERFORM? (Question 4)

The general preparedness of the learners taking Physical Sciences in the schools has been examined as far as how ready they are when it comes to studying the subject. Most of the participants assert that the learners who take Physical Sciences do well during the final examinations. Below are some of the **positive** things raised about the learners:

P7 said: "The performance was fairly good because in those days we had the higher grade and the standard grade learners. So I used to produce the A's and B's on the higher grade and many of them could be able to get university entries." P6 raised a question: "They have been performing well except for this year. I don't know whether it is the new curriculum we have started with of CAPS; but we have been getting above 70% and in some years we have registered level 7's in Physical Sciences." P1 was not totally satisfied with the results: "If I have to check on last year's results, they performed well – they performed well because almost all of them passed the levels there. The majority got level 4, which was some good performance according to last year's results; but every time I get a level 4 and last year I got a level 6 and that

other year a level 5, but still the numbers are few.” P5 has a similar opinion: “They are a bit average because some are very good and others are above average; they are okay. They performed well I can say so because of the higher percentage; it is few of them who do not go through, that is why I can say they are not bad – they are okay. It is the effort we are trying to put in, pushing the learners above their limit and also because of the teachers’ commitment.” P4 said: “I can’t say they are not performing well but what I know about them is that they are having the quality results. I used to have the 100% performance, but now since I have changed the school I have not yet reached that target.” P2 was hesitant saying: “It is quite a difficult question because we are dealing with different learners every year because last year I had many learners who were performing very well and one of the learners got 92% in Physical Sciences; but other learners found it difficult even to get level 2s, but most of the learners I would say they are average.”

The participants generally are of the view that the learners are performing well; ‘one of the learners got 92%’ for instance. This general opinion of the participants does not tally with the results as seen in table 1.3 where the Ngcobo District recorded 27,3% of the candidates passing paper 1; and paper 2 being passed by 30,7% only of the candidates. This sad situation also manifests itself in the Province where learners achieved 25,2% in paper 1 and 28,4% in paper 2 in 2010 (Table 1.1).

Negative aspects were raised. P7 said: “The problem is that our learners don’t make the right choices in terms of subjects that they need to do. And it seems as if there is no career guidance that they have. You would notice that in many of our schools many learners are doing Physical Sciences and find out that they have no special reasons why they are in those classes; it’s just that we can say that teachers are not advising them accordingly as they enter the high school.” P6 was not happy with the preparation of learners: “There is a lot of frustration because of the things I have mentioned because you are given learners who have not been well taught in the lower grades and unfortunately my school starts from grade 10, so people come from other schools where there is no standard of measuring their ability; each school passes them

according to their wants; and sometimes you find that you are dealing with people who have actually not been taught - you get frustrated somehow.” P2 said: “The criteria are there but now at the same time the Department will say they cannot allow a situation where you cannot admit a learner because everybody has a right to education, so you find out that now we are admitting more learners because of that.” P4 said: No, we don’t (select learners) “All the learners when they apply they always say ‘we want to do science’; because when you listen to the radios they always say the jobs are there if the learners are doing the science subjects; they will get the jobs, and learners when they go to school they picture themselves being those doctors and nurses and engineers and everything – you know.” This links with the P7’s point of view that learners do not get appropriate career guidance. P5 said: “Some of the problems that we encounter linked to some learners underperforming is lack of concentration right; and then lack of understanding. That is challenging in their minds in terms of the Physical Sciences problems.”

The preparedness of the learners in the schools was probed as attested by the preceding discussion and it was found to be quite lacking in the various ways as outlined in the discussion. With so many challenges in the schools as seen above it is no wonder that underperformance of the learners is the consequence.

Moreover the points above also show the shortcomings of the learners taking Physical Sciences in the schools. Some found it difficult even to obtain level 2s and the rest were average showing the problem of having large numbers of learners in class so that only those who sit in the front benefit and those at the back don’t see anything, leading to the mediocrity in performance. Again the policy of the Department of Education to promote learners to the next grade just because they have been four years in a phase is counter-productive. A further criticism is that the Department of Education insists that a learner is entitled to take Physical Sciences if s/he wishes to do so irrespective of her/his previous performance in the preceding grades. This approach renders the purpose of the examinations futile. Consequently this does not assist the learners as they continue to fail and get frustrated and eventually drop out of the school.

Schools that pass their learners to the next grade without measuring their abilities are doing a disservice to their communities because they ultimately underperform in these grades.

Following are some of the factors causing under-performance identified by Muzah (2011:83) when he states that factors associated with poor performance of learners in science in South Africa include the following: science in most public schools of South Africa are characterised by educator – centred instruction associated to the drilling of scientific concepts and chorus recitation that leads to memorisation of scientific definitions, formulas as well as immediate solutions of scientific exercises without logical sequence or clear relationships between scientific concepts. This as a result encourages most science learners to rehearse scientific laws, rules and formulas without attaching meaning to them and understanding them conceptually, leading to short term retention, and low motivation and poor performance at grade 12. Some of the factors have been identified by Setati (2011: 7) when he stated that language proficiency is important for both social and academic interactions. Conditions of poverty are associated with lower levels of literacy in the population. In south Africa some of the learners who use English as a second or third language for learning generally live in circumstances of poverty where there is already poor quality teaching and learning in English. African learners in South Africa have particular difficulties in science when their home language is not compatible with the language of science.

The above discussion has delved on the fitness of the learners taking Physical Sciences in the schools. The next section will look into how the participants want their problems be solved.

4.2.3 TEACHING THEORY IN PHYSICAL SCIENCES

4.2.3.1 What problems do you encounter when teaching theory in Physical Sciences? (Question 8)

When asked how they manage issues pertaining to teaching Physical Sciences to learners various responses were received. P1 said: "The theory part is always difficult; it is always difficult when you explain some of these concepts, they are abstract, like now I am struggling to teach the atomic structure and when you are trying to explain to them the atomic structure it becomes difficult." P2 concurred when she said: "The problem is that Physical Sciences has always been perceived as a very difficult subject so most learners sometimes get bored so we always make demonstrations for them in classes to try and engage and make them interested, even though sometimes it is difficult because they are many in class." P4 said: "If the number of learners cannot – I mean the class size for Physical Sciences, if it does not have learners more than 30. Make 30 the maximum because that needs individual attention for learners." P6 said: "You know in Physical Science the Physics part involves a lot of calculations and so on, and the problem we find is lack of basics in Mathematics and this wastes time going back to teaching Mathematics when we have to apply it so that learners understand the concepts." P1 said: "There are problems especially the theory part, but we are always improvising; we draw diagrams of pictures from these books so that we try to explain them better. It is always difficult to explain these things theoretically when the kids are not seeing anything." P4 referred to application to daily life: "O, the first is that as Physical Sciences is dealing with physical quantities; the first thing that we get a problem with is that the learners do not associate whatever we do in the classroom with what is in the environment. They just take it in isolation as if it is something that stands on its own. Yet Physical Science relates to what we do every day and secondly, there are those physical quantities that we deal with and they are converted to symbols in Physical Sciences and each symbol is converted to units of measurement. But what the learners do – they do not associate them; as a result you are dealing with something that needs their analysis and they are not able to analyse it correctly. And then they will not be able to select if they have to use a formula for instance, they will not be able to use it because they are not able to associate the physical quantity with the symbol that represents it; they do not associate it with the language they are using. So the main problem is the language; that is the main problem – the language that we are using when teaching them." P5 said: "Some of the problems that we encounter linked to some learners

underperforming is lack of concentration right...and then lack of understanding and that is challenging their minds in terms of the Physical Sciences problems.” P3 stated that the problem is that “...sometimes Physical Sciences is like an abstract subject where learners have to think out of the box and if you don’t do demonstrations and don’t have equipment so that you demonstrate while you are teaching that will give you problems; some learners have a problem in thinking out of the box, they don’t have that critical thinking.”

Salloum and Abd-El-Khalick (2010:929) state that changing teachers’ practices has been an object of study since the 1960s through process-product research and later by examining teacher knowledge and beliefs and their influence on learner learning and classroom dynamics. These authors suggest that teachers should be committed to prepare learners for national examinations, to develop conceptual understandings of learners, and to challenge learners to develop higher order thinking skills. To prepare learners for the examinations, learning science concepts must go beyond conceptual understandings and entail knowledge and skills to navigate examinations by correctly interpreting verbs and appropriately choosing solutions procedures (Salloum & Abd-El-Khalick, 2010:939-944).

There is growing evidence that high-impact practices can further improve learners’ success, such as demanding a high level of learners’ participation and promoting substantial and meaningful interaction between learners. Teachers should also provide immediate feedback to learners about their performance, and allow learners to apply, integrate, and synthesize their learning within a coherent context (Laursen et al, 2010:39-40).

Muzah (2011 86) states that South African township and rural schools lack cognitive academic language proficiency required to execute similar higher order cognitive operations through a second language such as English. This is compounded by the fact that they are faced with triple challenges during a single science lesson that involves:

- Mastering of science academic content,
- Mastering of mathematical concepts used in science, and

- Mastering of English, a medium of instruction, they are not proficient in, other than their mother tongue.

The problem of large science was prevalent in the schools and was seen as one of the factors that caused under – performance. Muzah (2011:87) states that achievement in smaller classes of less than 15 learners exceed achievement in both average classes of about 25 and large classes of more than 30 learners while achievement of 25 learners is only marginally better than the achievement of learners in bigger science classes. Setati (2011 8) states that African learners in rural areas have little exposure to English apart from television and popular music whereas the language of reading and writing and assessment at school is English. Setati (2011:139) states that a number of educators held the notion that science subjects were too difficult for learners with language difficulties and failure was inevitable.

Another idea that could help both the teacher and learners structure their deliberations in the classroom would be to construct a framework for small groups for discussions (Ratcliffe, 1998:55). Such a framework could be organised with items and under each item there would be a number of questions that learners would have to work on. Such a framework would assist the teacher to engage learners by way of clarifying their deliberations and conclusions. Further classroom implications of this activity could be to encourage learners to relate their experience of school science to real problems and to develop social responsibility.

The preceding shows some of the challenges faced by the participants when teaching theory to the learners. The participants state that the theory part of Physical Sciences is difficult involving a lot of calculations that require skills in Mathematics that the learners sometimes do not have making the participants revert to teaching Mathematics instead of the learners applying it. This wastes time in the teaching process. This also somehow indicates insufficient monitoring of the teaching activities in the schools by the school management and the District officials. The language used as a medium of instruction (English) should also be closely monitored by the school management and the District officials when it comes to teaching it because some

learners fail because they have a problem with understanding the language of teaching. Knowledge transfer should also be encouraged by the schools so that learners can learn to apply their school knowledge in real life situations. There seems to be an inability to convey this applicability to learners.

The challenges that the participants cite as affecting the learners are diverse and quite serious and unless something is done to address them under-performance is likely to continue to exist in these schools.

This discussion highlights some of the challenges that the participants notice in their work of teaching Physical Sciences theory in their classes. The next section will deal with the work that is done in the laboratories.

4.2.3.2 What equipment does your school have which enables you to do your work well? (Question 7)

The following items are identified by the participants as being essential for them to carry out their work of teaching Physical Sciences as well as for the learners to utilise them to learn Physical Sciences at school successfully: The classroom, desks, chairs, chalk, chalkboards, dusters, textbooks, charts, printing materials, data projectors, writing books, revision books, computers, laptops and access to the Internet, overhead projectors, tables etc.

Hammerman (2006:91-92) states that educators should use for teaching and learning equipment, materials and resources for multisensory learning; and use notebooks to organise thoughts and integrate writing as well as use appropriate technology such as calculators, measurement tools, balances and computers. There should also be connections to technology and exploration of technological design.

Besides the issue of equipment, respondents were asked about how they dealt with issues related to the teaching of Physical Sciences.

4.2.3.3 How do you solve these problems? (Question 10)

The following are some of the things that may help solve the problems encountered by the participants when teaching Physical Sciences in class to the learners:

During the course of offering tuition to the learners in Physical Sciences one problem that is pervasive is that of the huge numbers of the learners that they have to contend with in their Physical Sciences classes. P1 said: “The problem I am facing especially this year is the numbers – they are too many. These are some of the challenges that we have – the numbers of the kids.” During classroom teaching no special arrangement is accorded to this problem but just to teach them all in a class, but the ideal is that a science class should not have more than 30 learners which would allow for individual attention. “If the number of learners in a Physical Sciences class cannot be more than 30; make 30 to be the maximum number because that needs individual attention for the learners” (P4).

This issue of the large numbers of learners in the classrooms which causes under-performance would appear to in disharmony with the following statement. Mzah (2011:88) states that one school had an average of 54 learners in its science classes and produced the best science results. The school scored 75% and was the highest rating among the top 100 schools.

According to P2 the Department of Education will not allow a situation where learners are not allowed to take Physical Sciences if they so wish as everybody has a right to education and this makes them admit more learners in their classes. One way of overcoming this dilemma according to P7 would be that of encouraging the teachers to furnish assistance to learners in terms of subject choice at high school level. The restructuring of schools by the Department of Education to make high schools start at grade 8 will ease their frustrations as they will be with

the learners for a longer period of time from grade 8 to grade 12. Currently they have learners with them for only 3 years in high school (P6).

Finally P5 advises that there is the desire on the part of the participants that in Physical Sciences there should be a separation of the Physics portion from that of the Chemistry portion and that they be taught as separate subjects if that is possible as he put it: “We do whatever we can to improve it, they should also look into it in the future. From experience in other countries it is not easy to find anything like this that Chemistry and Physics are combined being taught in class; you have teachers for Chemistry and those for Physics and that if they look into that it will improve the pass rate I think so.”

These suggestions from the participants to alleviate the problems in the teaching and learning of science in the schools are practical and the onus would be with the powers that be in the Department of Education to consider looking at them in detail for possible piloting and ultimately implementation. Participants believe that the issue of the large numbers should be addressed so that a science class should not have learners in excess of 30 which will enable them to give individual attention, increase effectiveness and relieve them in the work they do. This desire on the part of the participants is reasonable because overcrowding in classes has certainly led to the malfunctioning of the schools in terms of the learners performing poorly in science. Setati (2011:96) states that the type and kind of an educational programme offered in a school has relevance for the capacity of the building. When the capacity of the building is exceeded, extreme pressure is exerted upon all of the facilities and areas that educators, administrators and learners need to use for an effective educational programme. The National Education Policy Act (NEPA) (1996: B – 50) states that the Member of the Executive Council (MEC) for Education of each province must ensure that there are enough school places to enable each child living in the province to attend school during the compulsory phase. It is my view that this has not been done to satisfaction by the Department of Education and so this must be addressed.

Career guidance lessons for learners should be furnished to encourage learners to choose subjects that meet their requirements. Perhaps the restructuring of schools to have high schools commencing at grade 8 may help. However, the problem of large classes implies that there is an insufficient number of teachers to teach the subject in the schools hence the overload. It would be better to solve the problems that currently exist first for instance to employ more teachers and then to do the restructuring. Gultig et al (2002:4) states that learners should be encouraged to reflect on their own learning progress and to develop the skills and strategies needed to study through open learning. As for the separation of Physics from Chemistry, it would probably raise further problems in other subjects such as life sciences.

Having dealt with the issues that could alleviate the problems encountered in teaching Physical Sciences, the next section will focus on solving issues related to practical work

4.2.4 EXPERIMENTAL ISSUES

4.2.4.1 (i) Do you perform experiments in your school? (Question 5)

Muzah (2011: 72-73) states that early research study provides some valuable insights that suggest that laboratory activities play an important role in two educational outcomes such as science achievement and cognitive development; and that appropriate interaction with materials and events in a laboratory that involve both hands – on and minds – on develop higher order skills like problem solving skills, creative and critical thinking skills, collaboration and communication skills. Laboratory work is believed to be one of the most challenging aspects of science teaching because it requires careful planning and considerable expertise on the part of the science educator.

All the participants indicated that they perform experiments in their schools to enhance Physical Sciences understanding of their learners. Even though all of them agree that they do perform experiments the situation is that this depends on the availability of the equipment to

do the experiments. Some schools are better resourced than others in terms of the availability of the materials that enable them to perform the experiments.

As far as the importance of experiments to enhance Physical Sciences understanding of the learners is concerned, P7 mentioned the following: “Practical work is very important because if you want to introduce a particular concept and you do it through performing a demonstration then it helps learners for conceptual development.” P6 said: “We do experiments so that the learners understand the theory; question learners on what we have taught so that they get the concepts, the laws and so on and by the time they experiment they know what is expected, so that when it does not happen – that is the outcome is not what is expected so that they can give reasons why it did not happen and so on.” According to P4 there is some complimentary teaching that takes place during practical work because learners are asked questions immediately after the experiment in addition to the report they will write later. She said: “Most of the time you present the lesson in class, and they go there and you present the practical. Immediately you have to make sure that after the practical they have some questions to answer there and not just depend on the report they have to write later, so which means you have to do it while you are teaching, not to do teaching separately and then go to the lab. During the practical, if they are doing the practical, you do it together with your theory.”

What the participants generally do agrees well with the following views: In class learners must take notes in writing of what is taught in a lesson; they must solve problems given to them by the teacher or those found in the textbook and need to actually conduct experiments in the laboratory assisted by the teacher (Laursen, Hunter, Seymour, Thiry & Melton, 2010:39-40). Besides mastery of content, the development of critical thinking and problem-solving skills need to be considered. This could be done by using questioning and other techniques for learners to make sense of what they are learning (Fisher, 1995:92; Hammerman, 2006:xiv-xv);).

According to the participants doing practical work in the schools enhances conceptual development in the learners and enables the learners to understand the lessons. It is therefore

necessary for the Department of Education to make sure that the relevant science kits and other equipment are supplied to the schools to contribute to the learning environment. Hammerman (2006: xiv – xv) states that every Physical Sciences teacher should apply diversity in the lessons by asking questions from the syllabi of previous grades to determine how far the learners are in their understandings of their previous work. In addition, classroom teaching and learning should be complemented by performing practical work in the laboratory.

4.2.4.2 **(ii) Is your laboratory well – equipped for you to do your work well? (Question 6)**

As for who provides the equipment for doing the experiments, two highlight the role of the Department of Education. The equipment for doing the experiments generally comes from the Department of Education but the schools also play a role. P2 said: “For us to improve in Physical Sciences the subject advisor has arranged with us as a District that we write the common tests before they write the examinations for each term, and also in terms of experiments to arrange as a District as other schools do not have equipments, so we are able to help each other.” P1 said: “I always approach the admin that is the clerk – via the clerk they always purchase those things for me.” P6 said: “We rely on donations from groups like Engen programme, Maths and Science Centre, and from the Department. Our budget is not enough for us to buy equipment, to replace what has been broken on a regular basis, so the school budget is not enough...we do buy a few things but we rely mostly on donations from those organisations I have stated.” P3 said: “Yes, if I have shortages sometimes I normally ask from my neighbouring schools if they can help with the equipment or chemicals that I need to use, but if I can’t get it I ask the school to improvise and buy it for me”. This following quotation from SASA states that it is the responsibility of Government to provide for the school needs to facilitate learning and teaching at school. In the course of this (educational) activity Government takes the responsibility to make this possible: it builds schools, provides furniture, textbooks and stationery; other equipment and utensils, and employs teachers (South African Schools Act 84 of 1996 [SASA] B-17).

When asked what equipment and apparatus they have in their schools, the general response is that they have enough equipment to do the experiments indicated in the syllabus. This is substantiated by the following statements: P2 said: “We have all the necessary equipment that is required for doing the experiments.” P1 said: “We have a lot of equipment especially when you have to look at the syllabus that we have.” P3 said: “Ja, it (the laboratory) is well-resourced; it is well-equipped.” However one participant said that he performed experiments on a minimal scale because there were no science kits available in his school. “So basically there were no science kits and it was very difficult to perform all the experiments that would assist learners”.

Participants enumerated the following laboratory equipment: Boyle’s Law apparatus, dynamics trolleys, spring scales, mobile laboratories and so on. This equipment that the participants use is clearly relevant for the work of teaching Physical Sciences in the schools.

Even though the majority of the participants indicate sufficiency of the equipment in their schools there is still a long way to go in terms of equipping the schools with the necessary kits that would enable the teachers and their learners to do their work well. Setati (2011:95) states that the researcher is of the opinion that a well-equipped laboratory would probably stimulate learners’ interest and practical tuition in science.

The preceding discussion was on the availability of the science equipment in the school laboratories and the reasons for performing these experiments. The next section will look at some of the challenges the participants meet in doing practical work in their school.

4.2.4.3 What problems do you encounter when you teach practical work in Physical Sciences? (Question 9)

When asked about the challenges participants encountered during the course of their practical work activity, it became apparent that not all the schools are equally resourced when it comes

to the science kits they have. The result is that some schools do well when performing experiments for their learners whereas others lag behind. Below are some of the things the participants say constitute these shortfalls:

P4 said: “Yes I can say so because we do have the apparatus that we need, although some of the apparatus that are provided do not actually reflect what we need for the practicals, for them – they are not enough.” P5 said: “We normally don’t have much problems when we are teaching the practicals but at times chemicals we think we have are expired; and learners sometimes are breaking some of the equipment. Those are the problems we used to have.” P3 added to this: “Now and again when I am there and they are doing a practical for an example I have to demonstrate for them first, sometimes what I encounter is that some of the chemicals might be contaminated and old and they cannot work out – they cannot give us good results.”

P2 asserted: “The problem is that they are many, and that in our policy documents there is no time that is allocated for practicals of which the practicals take a lot of time.” P1 agreed and elaborated: “You know when there are many, maybe we don’t have enough equipment even if you group them still they are too many. Now there are problems, people are sitting at the back and do not see anything; so it only benefits those that are seated at the front. These are some of the challenges that we have the number of the kids.” P6 pointed out that the learners “...start carrying out an experiment without imagining the outcome. Usually with our experiments you know what you are expecting to get. They embark on an experiment without knowing what the outcome would be”. This needs to be addressed. The availability of laboratories was raised by one participant: “As for now I am having a problem with the laboratory because they are taking it as a classroom, so it becomes difficult when you want to prepare something for the space there is too small.”

Muzah (2011:90) states that in South Africa most science educators are of poor quality such that they cannot plan for a science practical accordingly because most of the science practicals

do not have clear objectives and as a result learners waste time verifying established laws and principles or on the discovery of objectively knowable facts.

Above are some of the things that hamper practical work in the schools such as the equipment the schools have that do not always reflect the needs of the syllabus. This problem should be resolved so that what is supplied is what the schools requested for their experimental work. Problems such as expired chemicals, learners breaking science kits, huge numbers of learners in science classes leading to a situation of learners divided between those sitting in the front and others sitting at the back and not seeing a thing during demonstrations. These have a negative bearing on the work of the participants. The problems above do not seem to have a priority in terms of the Department of Education solving them because these problems have persisted for some time as stipulated by the participants. It also appears as though the SMTs are not monitoring to the best of their abilities as chemicals are allowed to expire and also to be contaminated. This calls for vigilance and meticulous monitoring on the part of the SMTs and the science teachers. Up to date records should be kept on everything that the laboratories contain and issues should be addressed to rectify the situation.

Gultig et al (2002:73) states that the announcement that OBE would be implemented in all grade 1 classrooms in January 1998 triggered a vigorous public debate about, inter alia, the prospects of implementation given the lack of teacher training, the low levels of material support for the new curriculum and the complexity of this curriculum innovation.

The preceding discussion highlights the problems that the participants and their learners face during practical activity in their school laboratories. These problems need an urgent attention of the Department of Education, the District office and the schools themselves because they are numerous and diverse and are likely to be some of the factors that result in the unsatisfactory performance of the learners in the schools.

This section has dealt with the problems that the participants have in doing their practical work. Next will be a look at how the participants solve the problems.

4.2.4.4 How do you solve these problems? (Question 10)

The following are suggestions from participants to resolve the problems that they have when practical work is underway in their school laboratories:

To solve the issue pertaining to practical work with large numbers of the learners P2 said: “I have decided that I take them during the weekends that is on Saturdays. I have the whole day to work with them. I become more patient with them, so they are able to do their work properly, because when it is during the week they are so many and so we do the rush–rush thing, that is why I decided that we do the practical work on Saturdays. I take extra classes with them.” To solve the problem of learners sitting at the back in the laboratory during practical demonstrations and not seeing anything because of the large number of learners and which makes only those who sit in the front to benefit, P1 said: “I try to break them into groups. You see – this group, this group; we don’t have time. It is time consuming when you break them and they do the same experiment, but I normally group them so that everyone participates if it is an experiment or it is a practical work – they participate. P4 has decided to monitor the learners once they get into the laboratory because they forget that they are there for a special purpose of learning and she said: “We have to monitor the learners in the first place. Once they go to the lab they forget that they are there for a special purpose. As a result they just think it is a game. They are not aware that they are studying when doing the practical, as a result you ask them questions on what they have observed and they cannot explain – they cannot answer those questions.” P2 said: “For us to improve in Physical Science the subject advisor has arranged with us as a District that we write common tests before they write the examinations for each term. This is the common test that we usually have to write. And also this year there have been some teachers who have been enrolled in the NMMU (*Nelson Mandela Metropolitan University*) to do some workshops there so that we improve in the Physical Sciences; and in

terms of experiments to arrange as a District as other schools do not have equipments, so we are able to help each other; we borrow equipments from each other where a teacher if he does not understand something or encountering problems in class, they will be able to discuss how they are going to solve the problems.”

The preceding suggestions are some of the creative things that the participants use to solve the problems encountered during practical work. Weekends are being used to do and complete the work that should have been done during normal tuition time, which adds to the strain of the overload of the science teachers. This though shows commitment on the part of the participants and is commendable. Unless the Department of Education pays them for this overtime duty this is unfair because the participants are adults with families that need them during the weekends. A lot of social events such as shopping, wedding feasts, funerals, etc take place during weekends and working over weekends denies them an opportunity of attending to these activities. The Department of Education should urgently address the problem of the large numbers of learners at school, which leads to overcrowding during practical demonstrations by employing more teachers because the shortage of the teachers appears to be the root cause of the problem of underperformance.

Setati (2011:187) posits that:

- contextual factors such as infrastructure development and societal economies have a bearing on the academic performance of science learners
- education of rural learners is disadvantaged and held to ransom by inadequate provision of learner support material
- educator performance is hampered by their lack of proper training in the teaching of science using English as a language of teaching.

This preceding discussion delved into the issues faced by the participants in handling practical work in their laboratories. The following section will deal with the assistance from the SMTs of the participating schools.

4.2.5 DO YOU GET ANY ASSISTANCE FROM THE SCHOOL MANAGERS IN YOUR SCHOOL? (Question 11)

Participants have indicated that when there is deficiency in the equipment in their school laboratories they attempt to resolve this shortfall by using a variety of means. P7 referred to the time when he was still teaching: “We did experiments but to a very minimal scale because in our schools we do not have enough of science kits so that the only experiments I would be able to perform are those I would be able to do something about. So basically there were no science kits and it was very difficult to perform all the experiments that would assist the learners.” P6 said: “We try – yes because like printing materials, like acquiring revision books, like getting equipment, we do get them and for me I am part of the management and so in one way or another it helps me to get what I need within our budgetary restrictions.” P1 said: “I always approach the admin, that is the clerk – via the clerk; they always purchase those things for me.” P4 said: “Whatever we need, we request it from the Principal of the school.” P5 said: “Yes, we get a lot of assistance; they are always helping us because Physical Sciences is a critical subject. For Physical Sciences and Mathematics whatever we request – we put in, if it is not beyond their capacity they help us; at times when it is beyond our control at the school we go to the subject advisor who will link with all the processes and get all that we need.” P4 said: “If there is something that I need that I do not understand I just go there to the subject advisor for assistance. Sometimes they assist us in this sense that we as a District are always doing whatever we do as a team.” P5 said: “We normally don’t have many problems when we are teaching the practicals, but at times of the chemicals we think we have are expired and that is only where the school comes in if it is available then the school will buy for us. We also relate to other schools and see if they have something.” P3 said: “Yes if I have shortages I normally ask

from my neighbouring schools if they can help with the equipment or chemicals that I need to use, but if I can't get it I ask the school to improvise and buy it for me.

Muzah (2011:92) states that school's leadership influences the destiny of both educators and learners. The school leadership is responsible for instructional practices and supervision processes, such that its organisation stands or falls on the strength of its leaders. Effective leadership in the school makes a major impact on the calibre of education, promotes effective teaching and learning which in turn influences the performance of learners.

The District Office and the school management should make an audit at the end of the year of the laboratory equipment that has been used so that it can be replenished annually and not as the problem arise. For a teacher to leave school and go to another school searching for chemicals is rather disturbing because this time should be used for marking and preparing future lessons. Every school should be equipped so that it renders optimal tuition to its learners.

This section has examined the way that the SMTs assist the participants. The next section will look at the assistance afforded by the District Office to the schools in the process of teaching the learners Physical Sciences.

4.2.6 WHAT ASSISTANCE DOES YOUR DISTRICT OFFICE OFFER YOU THROUGH THE SUBJECT ADVISORS? (Question 12)

This section looks at the assistance that the District Office renders to the schools to make the deliberations of the participants in teaching Physical Sciences in the schools more effective. It appears that a lot of assistance is channelled to the schools by the District office as all the participants apprise as follows:

P1 mentions: "Yes, a lot of help; there is a lot of help from the HoD (*Head of Department*); from these other guys in the Department; yes there is a lot of assistance." P6 elaborates: "There are

workshops every quarter I think. We meet twice about every quarter. In one of such meetings we have workshops. That is where problem areas are discussed among teachers from the District.” P3 said: “Ja, they normally help us with policy documents, work schedules and also help us with common tasks where you have to expose your learners not only to your style of setting and also to other teachers’ styles as well, ja.” P2 supplements the preceding: “The subject advisor has arranged with us as a District that we write the common tests before they write the examinations for each term; and in terms of the experiments to arrange as a District as other schools do not have equipments so that we are able to help each other; we borrow equipment from each other and where a teacher does not understand something or is encountering problems in class they will be able to discuss how they are going to solve the problems.” According to P1 the Department of Education assisted a lot: “This improved my work, like now I am attending this other course there...the science upgrading course. It is like we are being taught on these challenging topics there. The District is assisting and this is helping my work.” P4 said: “Even now the informal tasks we make seem to be formal because we write the same informal tasks in the District. I also attended training programmes that are designed by the Province for Physical Sciences.” P6 pointed out that that they follow guidelines: “We are always informed of developments from the Province and the National Departments so that we don’t waste time teaching things that are not required so we stay and keep within the guidelines”.

The assistance from the District Office to the schools is quite good and is commended for continuation. However, some shortcomings in the assistance that is granted by the District Office have been mentioned by the participants in terms of them doing their work of teaching Physical Sciences well. The equipping of the schools with the necessary science kits is inadequate and it appears as though not all the schools and teachers benefit. According to P4, for example, “We have the computers that we are using while in the telematics programme we are dealing with in the University of Stellenbosch.” This therefore should be extended to other schools and teachers as well for participation. The District makes teachers leave the schools for experiments at the District Office, which has a negative bearing on the work of the teachers

who should be doing their school work in their schools. Rural schools are not well-equipped in terms of the necessary things that are used to teach the learners. “In a rural district like Libode you find that there are no science equipments”. (P7). Training of the teachers is not adequate either: “It’s not enough yet because like for our school we are a huge number so the training usually maybe is for one teacher. I think there is still more to be done” (P2). Although a concerted effort is made, it seems as though the District Office is not doing its job thoroughly in terms of checking promotions in the lower grades at the end of the year where some schools pass the learners according to their wants instead of using promotion documents from the Department of Education. This should alert the District officials to be more vigilant when checking promotion of learners at the end of the year.

It is therefore imperative that the Department of Education expedites this assistance sought by the participants as it comes from those who do the teaching practice and are therefore in a better position to comment on these things. They are aware of the vicissitudes of their work. As we have seen in the previous sections the Department is trying its best to meet its obligations in terms of supporting the schools to achieve their objectives but more needs to be done as the participants assert. A special focus should be paid to rural schools in terms of furnishing them with the necessary equipment without neglecting the other schools. Vigorous monitoring by subject advisors should be done based on an itinerary that has been agreed upon by the District Office and the schools. The subject advisors should not only visit and check on the progress in terms of the coverage of the syllabus, but they also should support and demonstrate to the teachers and learners how some of the science kits can be utilised in the schools because P7 said: “I would say the same problems that I encountered with my learners because even these days many of our teachers don’t seem to have the know-how to perform these experiments.”

Muzah (2011:92) states that he discovered that the inability to teach science practically was because some educators could not operate certain apparatus or equipment which was already in the schools and as a result they avoided them and let them gather dust.

The Department of Education should desist from promoting learners to the next grade just because they have been in a phase for 4 years as this is counter-productive because according to P2 “Now learners are taken to grade 12 where they cannot perform in Physical Sciences.” It is commendable that the Department affords further training to the teachers in terms of conducting upgrading courses for them as well as the workshops in an effort to improve the performance of the learners who take Physical Sciences, “it’s not enough yet because like for our school we are a huge number so the training usually maybe is for one teacher. I think there is still more to be done” (P2).

Muzah (2011:93) states that a study in a rural province of South Africa provides a composite picture of a number of features that cause higher failure rates at matriculation level which are associated with poor management skills and leadership. They recorded higher pass rates in rural schools that managed their resources effectively and created a learning environment which maximized learning by monitoring curriculum coverage, provide opportunities for in-service development of educators, supervision of educators and planning, while on the other hand, they recorded poor performance by learners with poor management and leadership skills. Their findings demonstrated the growing realisation that the effectiveness of school leadership has a far reaching influence on the school’s ability to mobilise both human and material resources and enhancement of academic performance.

The preceding section has discussed the assistance and its shortcomings from the District. The next section will investigate as to whether the assistance from the SMTs and the subject advisor is adequate.

4.2.7 IS THE ASSISTANCE YOU ACQUIRE FROM THE SCHOOL MANAGERS AND THE SUBJECT ADVISORS ADEQUATE? (Question13)

The participants indicated that they would like more support arguing that the assistance is inadequate. P7 said: “In a rural district like Libode you find out that there are no science

equipments and it is not even easy to assist those teachers to make use of their science kits that they are having so that they can assist learners to understand some of these concepts. So you find out again that most of our teachers in this area are the foreign nationals who sometimes are out of class because of many reasons that are systemic. So there are lots of challenges I am encountering.” P2 said: “It’s not enough yet because like for our school we are a huge number and the training usually will be for one teacher for instance; I think there is still more to be done.” P4 referred to class size: “It is not that adequate because there are certain things that are beyond our control, just for an example there is the class size problem with us and the load that the teachers are having because of the numbers that are in the school; that is, the number of the teachers that is associated with the number of the learners. So that means the teacher has the overload and you end up not having enough time to do the individual attention.” P6 said: “There is a lot of frustration because you are given learners who have not been well taught in the lower grades and unfortunately my school starts from grade 10, so people come from other schools where there is no standard of measuring their ability; each school passes them according to their wants. And sometimes you find that you are dealing with people who have actually not been taught, you get frustrated somehow.”

Muzah (2011:87) states that spelling out difficulties faced by educators, the Basic Education Minister indicated that teaching large classes of 50 or more in public schools is one of the many long - standing concerns facing the education system in South Africa. Science educators who teach smaller classes experience more positive attitudes to learners and their work and consequently better matriculation results in comparison to those who teach larger science classes, where the majority of characteristics and conditions such as lack of discipline, disruptions and other problems present themselves as interrelated and collective constraints that impede meaningful teaching and learning.

Preceding sections have already indicated the need on the part of the Department of Education to address these concerns of the participants.

4.2.8 WHAT MORE COULD BE DONE TO ASSIST YOU IMPROVE YOUR WORK? (Question 15)

The participants were asked what more could be done for them to improve their work and they gave the following responses:

P2 said: “Yoh! What can be done to improve our work neh? I think I just have to push myself because some of the things are beyond my powers, like right now there is this new thing in education where learners – when they are failing they (*Department*) say learners should not stay for more than 4 years in a phase of which now learners are taken to grade 12 where they cannot perform in Physical Science and Maths. Now it is left with the teachers what to do.”

Muzah (2011:85) states that it is established that science educators who teach such learners frequently perceive them as having no prior knowledge and are usually delayed in their access of scientific knowledge and are further hindered from full participation in class.

P7: “I think basically it is to encourage teachers to assist learners in terms of subject choice when they come to the high school level; and also try by all means that the content that is dealt with in our curriculum is such that teachers are taken on board, because it is unfortunately so that some of the topics that we are having in the curriculum as of now are the topics that our teachers never met before. So it is important that we take all teachers on board so that they can have a clear understanding of what these topics are all about; and now that will also assist them to be confident enough to assist these learners.”

Muzah (2011:82) states that educators should take responsibility to increase their own knowledge of the new topics of the ever changing curriculum so that they do not omit topics which they do not understand and choose to teach only those they know.

P6 said: "I think the idea of restructuring schools will help in solving our problems in teaching science if we can have 5 years with these learners, not just from grade 10; probably it will help because when I see the people we get in grade 12 – we don't just promote people during final exams – so if we have them for a longer time I think that one will ease our problems." P7 said: "The Department of Education is supposed to be training subject advisors on various aspects of their work, so what they are doing – they are still struggling to do that effectively because we don't normally get these trainings as we would have loved".

P1 said: "I am sure as it is now even the Department of Education assisted me a lot to improve this work, like now I am attending this other course there, the science upgrading course. These are some of the things which will help us improve; it is like we are being taught on these challenging topics there. So I think they are doing more especially on the side of the Department and even at the District they are assisting and this is helping my work." P5 said: "Ja, the necessary equipment they have been giving us. I think they continue with the workshops we have been attending; the necessary tools we need they always come. They should look into the future – that is what I am talking about because from experience in other countries it is not easy to find anything like this that Chemistry and Physics are combined being taught in class; you have teachers for Chemistry and those for Physics and that if they look into that it will improve the pass rate; I think so".

Some of the experiences of the participants during this time of CAPS implementation indicate that the Department of Education has placed a huge burden on the participants pertaining to issues of CAPS implementation as the preceding section shows even with the assistance that it gives them.

Ramnarain and Modiba (2013:65-66) state that in South Africa a new conceptualisation of science literacy in a revised curriculum places an immense burden on science teachers in first translating the goals of scientific literacy as elucidated in the curriculum, and then drawing upon curriculum design principles in advancing these goals. Further, Ramnarain and Modiba

(2013:68) state that a reconceptualisation of scientific literacy from a curriculum dominated by content specification to one where the goals of scientific literacy are more broadly defined has resulted in uncertainty among many South African teachers. Setati (2011:140) states that the report's revelation that educators underwent about two to four weeks of training to prepare for the curriculum, while principals were not trained at all, do not do our country's education system any good at all; and that if educators were not adequately trained learners would continue to struggle in the learning of complex subjects like science.

The preceding section dealt with the question of what more could be done by the Department of Education to help the participants improve their work. A look into the satisfaction of the participants follows.

4.2.9 ARE YOU SATISFIED WITH YOUR WORK AS A SCIENCE TEACHER? (Question 14)

The satisfaction that the participants derive from their work of teaching Physical Sciences in their schools varied. They have different views about the satisfaction that they get in the work of teaching Physical Sciences in their schools. Muzah (2011:109) states that statements were collected covering aspects such as recognition, job satisfaction, opportunities for professional growth, positive support etc from the respondents.

P7 said: "I cannot be satisfied as of now we are still performing at 50%; you see in 2013 we got 52%, in 2014 we got 54%; and so it is not good enough but we are trying our best to make a point that we increase that kind of performance (for Libode District)." P6 responded as follows: "I don't know how to answer that; satisfied, but there is a lot of frustration because you are given learners who have not been well taught in the lower grades."

However P1 said: "Yes, somehow...I can say I am satisfied; I am satisfied because the job is challenging; being a science teacher is not easy. I always like challenges you know. For me I think I am okay." P5 had a similar opinion: "I am satisfied but there are some few problems that

I think need to be addressed namely separating Physics from Chemistry. We discussed this at the District Office and you can see that 90% of the teachers accept that this is a problem.” P4 said: “Yes, very much I like it; there is nothing that I think of, except that of being a science teacher” and P3 agreed: “I am satisfied because I’m compassionate about being a science teacher; I love the subject. I’m so compassionate about it; so I love my work very much” but P2 related satisfaction with learner success: “I cannot say I am satisfied until I get a 100% pass rate.”

Most of the teachers are satisfied with their work despite the challenges in their work and this is encouraging. Satisfaction in ones work breeds commitment, which goes a long way in motivating both the teachers and the learners in the work they do. The Department of Education should thus grasp on this positive sentiment of the participants and introduce even more incentives for the teachers so that they can improve further in their work by assisting learners do better in Physical Sciences.

4.2.10 CONCLUSION

This chapter presented the findings of this research, analysed them and discussed them. The participants in the interviews had an in-depth knowledge of the situation because they work in the schools applicable to this research. They have been teaching Physical Sciences in these schools for a period ranging from 5 years to 34 years. The participants have relevant professional and academic qualifications to teach the subject in the FET band. Aspects such as biographical profile of the participants, the Physical Sciences learners, methods that could be used to deal with the problems the participants met in doing their work, the assistance that the participants acquired from the SMTs and the District Office and the satisfaction of the participants with the work they are doing were dealt with.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter gives a summary and conclusions of the research findings as well as the recommendations that this research would want to see implemented in the schools in which the research was done. Four schools of the Ngcobobo District in Education of the Eastern Cape were purposively selected to participate in this research so as to constitute a case study that this research focused on. This research evaluated the pros and cons of the CAPS Physical Sciences implementation in the FET schools that participated in this research. To get to that an interview schedule was used by the researcher to elicit information from the teachers about the sought after answers pertaining to the questions in the schedule. The teachers and the subject advisor participated voluntarily and agreed to be interviewed by the researcher and accepted that their responses would be recorded on an audio-recorder. To solve the research question namely “The lived experiences of selected Physical Sciences teachers concerning the implementation of CAPS”. A summary of the research and findings is provided.

5.2 SUMMARY OF THE RESEARCH

5.2.1 Biographical profile of participants

Six teachers agreed to participate in this research and were willing to be interviewed by the researcher. These participants have been teaching Physical Sciences in the FET phase with the number of years of service ranging from 5 to 34 years. The participants have all the necessary academic and professional qualifications to teach learners Physical Sciences in the FET phase effectively because they are knowledgeable about the subject as is seen below.

5.2.1.1 What are your qualifications for teaching Physical Sciences? (Question 3)

The participants were requested to indicate their academic and professional qualifications to determine whether they are qualified to teach Physical Sciences.

- P1 said: “. I have got a diploma in education in which I majored in science teaching, then I am also doing B. Sc, that is Physics and Chemistry at Unisa and I am in my second year now”.
- P2 said: “I did a Bachelor of Science with the University of Fort Hare, where I was majoring in Chemistry and Microbiology; then I did a national diploma, a professional diploma in education with the Walter Sisulu University; this year I finished my post graduate certificate in education with the University of South Africa”.
- P3 said: “I am holding a B.Sc degree in Chemistry; I also did Higher Diploma in Education specialising in Physical Sciences”.
- P4 said: “ I am having Physics 1 and Chemistry 1 but I also attended training programmes that are designed by the Province for Physical Sciences resulting in me being one of the teachers of Physical Sciences in the Province”
- P5 said: “I did engineering, mechanical per se; I did Physical Science and teaching Mechanical Engineering”.
- P6 said: “I have a Bachelor of Science degree in Mathematics and Physics”.
- P7 said: “I have my junior degree which is B.Sc in education and I also have B.Ed honours and majored in natural science”.

Muzah (2011:83) states that a teacher cannot be a teacher if she does not know her content. It is important for a teacher to have content knowledge, curriculum knowledge and pedagogical knowledge as they all influence a learner’s performance. The six educators are thus duly qualified as they meet these criteria except possibly for the one who is qualified in Mechanical Engineering. But at least he did Physical Sciences.

5.2.1.2 In which grade/s are you teaching Physical Sciences? (Question 2)

The participants mostly teach grades 10 to 12 learners.

- Participants 1, 2, 3 and 4 (P1, P2, P3 and P4) teach Physical Sciences to grade 10 to 12 learners.

- Participant 5 (P5) is currently teaching Physical Sciences to learners in grades 10 to 11.
- Participant 6 (P6) teaches Physical Sciences to grades 10 to 12 and is also a member the School Management Team (SMT).
- Participant 7 (P7) is a subject advisor but had taught Physical Sciences to grades 10 to 12.

5.2.1.3 How long have you been teaching Physical Sciences? (Question 1)

Most of the participants have been teaching Physical Sciences in FET for a number of years.

- P1 has been teaching Physical Sciences for approximately nine years.
- P5 and P2 have been teaching Physical Sciences for five and six years respectively.
- Participants 3 and 4 have been teaching Physical Sciences for 16 and 18 years respectively.
- P6 has the most experience and has been teaching Physical Sciences for almost 34 years. This participant also serves as a member of the SMT.
- P7 taught Physical Sciences for 15 years and is currently the subject advisor for the District.

5.2.2 HOW WELL DO YOUR PHYSICAL SCIENCES LEARNERS PERFORM? (Question 4)

The general fitness of the learners taking Physical Sciences in the schools has been examined and it has been found to be mixed in terms of their performance in the subject. Positive performance has been noted in learners that obtained levels 4, 5, 6 and 7 in the final examinations; and one learner that achieved 92%. Negative performance has been evidenced by the learners that could not even manage to get level 2.

5.2.3 TEACHING THEIRY IN PHYSICAL SCIENCES

**5.2.3.1 What problems do you encounter when teaching theory in Physical Sciences?
(Question 8)**

The participants appeal that the numbers of learners in the science classes should not exceed 30 to allow for individual attention. Teachers should be encouraged to foster assistance to learners in terms of subject choice at the high school level. Congestion in science classrooms is problematic. The lack of concentration of some learners in class leads to poor performance. The restructuring of schools to commence at Grade 8 may help in the desire to improve the performance of the Physical Sciences learners.

**5.2.3.2 What equipment does your school have which enables you to do your work?
(Question 7)**

The following items are identified by the participants as being essential for them to carry out their work of teaching Physical Sciences as well as for the learners to utilise them to learn Physical Sciences at school successfully: The classroom, desks, chairs, chalk, chalkboards, dusters, textbooks, charts, printing materials, data projectors, writing books, revision books, computers, laptops and access to the Internet, overhead projectors, tables etc.

5.2.3.3 How do you solve these problems? (Question 10)

The participants were asked about how they solved the problems that they encountered as they were teaching theory in class and this was one of the responses: P1 said: "The problem I am facing especially this year is the numbers – they are too many. These are some of the challenges that we have – the numbers of the kids." During classroom teaching no special arrangement is accorded to this problem but just to teach them all in a class".

In my opinion the problem of the large classes in the school appears to have no solution even though it could affect adversely the performance of the learners.

5.2.4 EXPERIMENTAL ISSUES

5.2.4.1 (I) Do you perform experiments in your school? (Question 5)

All the participants indicated that they perform experiments in their schools: P6 said: “We do experiments so that the learners understand the theory; question learners on what we have taught so that they get the concepts, the laws and so on and by the time they experiment they know what is expected, so that when it does not happen – that is the outcome is not what is expected so that they can give reasons why it did not happen and so on.

This is in line with one of the requirements of CAPS that experiments be performed at school to enhance learning. NCS (2011:145) states that in grades 10 and 11 it is recommended that learners do four experiments for informal assessment and in grade 12 learners will do three prescribed experiments for formal assessment,

5.2.4.2 (ii) Is your laboratory well equipped for you to do your work well? (Question 6)

Furnishing of the laboratories seemingly is not that problematic as the following response so indicates: P1 said: “We have a lot of equipment especially when you have to look at the syllabus that we have.” P3 said: “Ja, it (the laboratory) is well-resourced; it is well-equipped. A divergent view, however is as follows: “basically there were no science kits and it was very difficult to perform all the experiments that would assist the learners”.

The issue of equipping school laboratories therefore needs some revisiting by the Department so as to make a balance in terms of providing kits to the schools.

5.2.4.3 What problems do you encounter when you teach practical work in Physical Sciences? (Question 9)

The following clearly shows that there are not many problems experienced during practical work in his school. P5 said: “We normally don’t have many problems when we are teaching the practicals but at times chemicals we think we have are expired; and learners sometimes are breaking some of the equipment. Those are the problems we used to have”. Another though from a participant contradicts him: P6 pointed out that the learners “...start carrying out an experiment without imagining the outcome. Usually with our experiments you know what you are expecting to get. They embark on an experiment without knowing what the outcome would be”.

Experimental issues of the schools need more examination so that the requirements of CAPS concerning them are met.

5.2.4.4 How do you solve these problems? (Question 10)

Currently practical work is done on Saturdays to make up for the time that is not available during the week to do school work to accommodate learners that don’t benefit due to the congestion experienced during these occasions. Learners are given questions to answer during practical sessions to guide learners to concentrate on the work at hand. Some laboratories are used as classrooms making it difficult for the science teachers to prepare practical demonstrations in advance.

The District performs joint experimental work for its schools to mitigate the disadvantages experienced by schools that are not as well-resourced as others. The schools purchase the science kits that are needed. The neighbouring schools assist one another in terms of borrowing and lending science kits.

5.2.5 DO YOU GET ANY ASSISTANCE FROM THE SCHOOL MANAGERS IN YOUR SCHOOL? (Question 11)

The SMTs of the schools are helpful as the participants indicate; .” P6 said: “We try – yes because like printing materials, like acquiring revision books, like getting equipment, we do get them and for me I am part of the management and so in one way or another it helps me to get what I need within our budgetary restrictions.” P1 said: “I always approach the admin, that is the clerk – via the clerk; they always purchase those things for me.” P4 said: “Whatever we need, we request it from the Principal of the school.” P5 said: “Yes, we get a lot of assistance; they are always helping us because Physical Sciences is a critical subject.

Laursen et al (2010:39-40) state that It is important to use equipment, materials and resources to enhance learning and provide a challenging learning environment. Resources, equipment and materials that will be needed for effective teaching should be considered as well as management strategies and safety issues.

5.2.6 What assistance does your District Office offer you through the subject advisor? (Question 12)

The District affords quarterly workshops for the participants in the District. During these workshops challenging topics are dealt with by the participants and the subject advisor. Upgrading courses are offered to the teachers to improve their performance.

The Department of Education does not supply the same science equipment to the rural schools as it does to the urban schools. Science classes have too many learners per teacher due to the shortage of teachers. A learner can choose to take Physical Sciences in the FET phase irrespective of his performance if he so wishes. According to the Department of Education every learner has a right to do so. The attendance in the upgrading courses does not benefit all the participants as sometimes only one teacher per school attends the sessions. The training given to the subject advisors by the Department of Education is not deemed adequate.

The Department of Education should try by all means to attend to the content of Physical Sciences so that all the teachers are taken on board. Participants would like the workshops and upgrading courses to continue yet the participants raised their concerns about the instruction from the Department of Education that learners should not be in a phase for more than 4 years. This has severe implications for performance in grade 12. Career guidance lessons should be conducted for the learners at school to assist learners with their subject choice.

5.2.7 Is the assistance you acquire from the school managers and the subject advisor adequate? (Question 13)

Pertaining to adequacy of the assistance offered the participants expressed their views as follows: " P2 said: "It's not enough yet because like for our school we are a huge number and the training usually will be for one teacher for instance; I think there is still more to be done." P4 referred to class size: "It is not that adequate because there are certain things that are beyond our control, just for an example there is the class size problem with us and the load that the teachers are having because of the numbers that are in the school; that is, the number of the teachers that is associated with the number of the learners.

Gultig et al (2002: 71) states that if teachers are to pursue understanding, develop and refine their criteria of judgement and their range in their subject, they must be able and they must have time and opportunity for professional development. The conditions of teaching at present too often make survival a more urgent concern than scholarship. More research is needed to forge teaching procedures which embody survival techniques compatible with the personal and intellectual development of both pupils and teachers. Large classes also need to be addressed.

5.2.8 What more could be done to assist you improve your work? (Question 15)

More assistance should be rendered to the participants as they request: " P7: "I think basically it is to encourage teachers to assist learners in terms of subject choice when they come to the

high school level; and also try by all means that the content that is dealt with in our curriculum is such that teachers are taken on board, because it is unfortunately so that some of the topics that we are having in the curriculum as of now are the topics that our teachers never met before. So it is important that we take all teachers on board so that they can have a clear understanding of what these topics are all about; and now that will also assist them to be confident enough to assist these learners.”

Assisting the participants would go a long way in alleviating some of their problems.

5.2.9 Are you satisfied with your work as a science teacher? (Question 14)

The participants are generally satisfied with the work they do but there are challenges that need to be addressed such as the large numbers of the learners per teacher and insufficient teacher training.

5.3 RECOMMENDATIONS

The researcher set out to investigate the implementation of CAPS Physical Sciences in the four schools that participated in the research using the following sub-questions as the basis of the investigation:

- What difficulties do teachers encounter with regard to teaching and learning of Physical Sciences?
- How are classrooms equipped for practical work?
- How do subject advisors and school management teams (SMTs) support teachers and their initiatives?
- What recommendations can be made to address the challenges experienced by Physical Sciences teachers in the implementation of CAPS?

The researcher having evaluated the programme of implementing CAPS for Physical Sciences in the four participating schools has decided to make the following recommendations based on the findings of the research that are hoped would improve the performance of the learners in these schools.

5.3.1 Department of Education

It is recommended that:

- The Department of Education should furnish rural schools with science equipment in the same manner that it does the urban schools (Section 4.2.6).
- The Department should alleviate the unsatisfactory teacher learner ratio by employing more teachers (Section 4.2.3.1).
- The training of the teachers should be accessible to all the participants in every school so that all can benefit instead of just one teacher per school (Section 4.2.6),
- Career guidance lessons should receive priority in the schools to enable learners to choose subjects that meet their needs and abilities (Section 4.2.2) .
- The Department of Education should allow for flexibility when it comes to the admission of learners in Physical Sciences classes. Teachers should be consulted when deciding which learner should be admitted on merit (Section 4.2.2).
- The policy that learners should not be in a phase for more than 4 years in a phase is counter-productive as these learners fail in grade 12; thus the policy should be discontinued (Section 4.2.2).
- Learners that perform exceptionally well (such as the one who achieved a 92%) at the end of the year should be granted scholarships to attend tertiary institutions (Section 4.2.2).
- There should be thorough monitoring in the lower grade schools at the end of the year so that they do not automatically promote their learners to high school in keeping with the promotion requirements of the Department of Education (Section 4.2.2).

- Intense training should be afforded to both the participants and the subject advisor so that they can do their work well (Sections 4.2.6 & 4.2.8).
- More classrooms should be built in the schools to avoid laboratories being used as ordinary classrooms (Section 4.2.4.3).

5.3.2 The participating schools

It is recommended that:

- Each school requests the Department of Education to employ more teachers for teaching Physical Sciences when the need for such manifests itself (Section 4.2.3.1).
- The school time table should indicate periods for doing practical work during the course of the week (from Monday to Friday) to avoid working on Saturdays (Section 4.2.4.3).
- Regular monitoring of the furnishing of the laboratory should be done under the auspices of the SMT in conjunction with the science teacher to avoid the shortages, chemicals expiring and being contaminated (Section 4.2.4.3).
- Regular updating of the laboratory inventory should be undertaken to replace used items and also replace those that have been broken and have become unusable (Section 4.2.4.3).
- The use of the common tasks from the District should be maintained as this helps learners to meet other teachers' styles of setting examination papers and assures that syllabus pacing is the same for all the schools (Section 4.2.4.4).

5.4 REFLECTION ON THE STUDY

In this section an explanation is given regarding the experiences of the research. The participants that responded to the interview schedule did that voluntarily and with delight perhaps hoping that this research will assist them to address the tribulations they have been

experiencing. Others however declined to take part in this research. Thus it has not been easy to do this research.

The participants gave as much as they could in the interview sessions making the researcher believe that this effort was worth the undertaking. The researcher can only hope that whatever comes out of this research does have a positive impact on the Physical Sciences results of the learners of the participating schools if the recommendations are implemented.

5.5 LIMITATIONS

De Vos et al (2002:121) state that potential limitations are often numerous even in the most carefully planned research study. Moll (1999:41) states that it is important to indicate the boundaries and limits of the study in order to explain the aim of the research. One limitation that this research therefore has had is that of the 22 FET schools of the Ngcobo District only four schools participated even though all the schools according to the results have the same problem of poor performance by learners in Physical Sciences. Another limitation of the research was the unavailability of the subject advisor of the Ngcobo District who is directly involved in monitoring the four schools to participate. The researcher requested the subject advisor of the neighbouring Libode District which is as rural as the Ngcobo District, and therefore has a similar setting, to participate so as to have another dimension of view pertaining to the issues under investigation. McMillan and Schumacher (1993:21) state that in evaluation research collaboration occurs between an educational research and a developmental centre and may involve other agencies such as state departments of education or regional education centres. Thus the participation of the subject advisor was in line with the above provision. The researcher felt the need for someone stationed at the District Office to add another dimension to the responses of the teachers so as to enrich the opinions of the participants

5.6 REFLECTION ON THE RESEARCH RESULTS

This research has been done in four schools that agreed to participate in this research. This represents a fraction of the number of FET schools in the Eastern Cape but because all the schools of the Province have somehow similar problems (because most of them are in rural areas) the findings and recommendations may be of value to their schools. This research may not yield the best results but it is hoped that it will serve as an inspiration to others concerning the science education issues of the Ngcobo District and the larger community as it embarks on the new curriculum of CAPS.

5.7 FURTHER RESEARCH

There is still room for other educationists and researchers to follow suite and undertake research in our schools that will lead to the establishment of an environment conducive to learning and achievement. All issues related to the teaching of Physical Sciences that can contribute to improved learner results, need to be researched. These include inadequate parental involvement, poor socio-economic background of learners and supervision of teachers, to name a few.

5.8 CONCLUSION

The education system of the Eastern Cape Province has some problems as is evident from the findings of this evaluation research that was conducted in the four selected schools of the Ngcobo District that participated in this case study investigation. These problems can however, be resolved if the Department of Education and the schools in the research can work together to implement the findings of this research.

The Department could for instance address the unsatisfactory situation of the shortage of Physical Sciences teachers in the schools by employing more teachers so as to enable the teachers to focus more on individual learners and improve their performance. Muzah (2011:88)

states that one study indicated science classes were characterised by insufficient individual interactions and rapport, lack of motivation, lack of individual attention by the educators during science lessons and inability to ensure adequate provision of learning experiences such as handling of apparatus, observation and recording of results by each learner. The Department should adopt a more equitable approach in its supply of science equipment with respect to the rural and urban schools. The Ngcobo District is largely rural in nature and this would go a long way in resolving this impasse. Thorough monitoring of examinations proceedings at the end of the year in lower grades needs special attention so that learners who deserve to be promoted in terms of their academic performance are promoted to the following grade.

REFERENCES

- Akerson, V.L., Cullen, T.A, & Hanson, D.L. 2009. Fostering a community of practice through a professional development program to improve teachers' views of nature of science and teaching practice. *Journal of Research in Science Teaching*. 46(10):1090–1113.
- Arms, K. & Camp, P.S. 1979. *Biology*. New York: Holt, Rinehart and Winston.
- Assessment and Examinations Directorate. 2010. *NSC Mathematics and Physical Science. Question by Question Project Analysis*. Bundy Park Building. Schornville. King William's Town. (0436047709).
- Assessment and Examinations Directorate. 2013 National Senior Certificate Results. 7 January 2014. Office of the premier: Province of the Eastern Cape
- Beckmann, J.L., Klopper, J.C, Maree, Prinsloo, J.G & Roos, C.M. 1995. *The Chalkface Series. Schools and the Constitution*. Cape Town: Via Africa
- Brookes, D, Gibbon, D. & Patrick, M. 2007. *Physical Sciences Grade 12 (OBE for FET). (Learner's Book)*. Cape Town: Nasou Via Africa.
- Carl, A. 2012. *Teacher empowerment through curriculum development*. Claremont: Juta.
- Creswell, J.W. 2012. *Qualitative enquiry and research design: Choosing among the five traditions*. Thousand oaks: Sage.
- Curriculum News. May 2011. *Improving the quality of learning and teaching: Strengthening curriculum implementation from 2010 and beyond*. Pretoria: Department of Basic Education.
- De Vos, A.S., Strydom, H., Fouche, C.B. & Delpont, C.S.L. 2002. *Research at grassroots for the social sciences and human service professions*. Pretoria: Van Schaik Academic.
- Driver, R. 1983. *The pupil as scientist?* Bristol: The Open University Press.

Educare. 1998. Volume 27 (1 & 2). Pretoria: University of South Africa.

Education White Paper 4. August 1998. A Programme for the transformation of Further Education and Training (Preparing for the twenty – first century through education, training and work). Pretoria: Department of Education

Farenga, S.J, & Joyce, B.A. 1997. What children bring to the classroom: Learning science from experience. *School Science and Mathematics* 97(5):248-252.

Fisher, R. 1995. *Teaching Children to Learn*. Trowbridge, Wiltshire: Stanley Thornes Publishers.

Gultig, J., Hoadley, U. & Jansen, J. 2002. *Curriculum: From plans to practices: A reader*. Cape Town: Oxford University Press Southern Africa.

Halloun, I.A. 2006. *Modeling theory in science education*. Dordrecht: Springer.

Hamerman, E. 2006. *Becoming a better science teacher: 8 steps to high quality instruction and student achievement*. Thousand Oaks, California: Sage.

Hamm, M. & Adams, D. 1998. *Collaborative inquiry in science, math, and technology*. Portsmouth: Heineman.

Howie, S.J. 2004. Renewal of Secondary Curricula and Assessment in South Africa. (p41 – 53).
[www postino.up.ac.za](http://www.postino.up.ac.za)

Jansen, J. 1999. A very noisy OBE: The implementation of OBE in Grade 1 classrooms. In J. Jansen & P. Christie (eds). *Changing curriculum: Studies on outcomes-based education in South Africa*. Cape Town: Juta.

Kelder, K.H. 2005. *Physical Sciences: Teacher Guide: NCS. Grade10*. Cape Town: Cambridge University Press.

Kelder, K.H. CAPS. Study and Master Physical Sciences Grade 11. Promotion Copy. Teacher's Guide. Cape Town: Cambridge University Press.

- Laursen, S., Hunter, A., Seymour, E., Thiry, H. & Melton, G. 2010. *Underground Research in the Sciences (Engaging Students in Real Science)*. San Francisco: Jossey-Bass.
- McMillan, J.H. & Schumacher, S. 1993. *Research in Education. A conceptual introduction* (3rd Ed) New York: Harpen Collins College Publishers.
- Moll, A. 1999. Unpublished paper presented at Research Seminar for M.Ed students. University of South Africa: Pretoria.
- Mouton, J. 2001. *How to succeed in your masters and doctoral studies*. Pretoria: Van Schaik Publishers.
- Muzah, P. 2011. An exploration into the school related factors that cause high matriculation failure rates in Physical Science in public high schools of Alexandra Township (Submitted in accordance with the requirements for the degree of Master of Education with specialisation in Natural Science Education). Pretoria: University of South Africa.
- Ndawi, O & Maravanyika, O. 2011. *Curriculum and its building blocks: Concepts and processes*. Gweru: Mambo Press.
- National Curriculum Statement. 2003. *Physical Sciences General Grade 10-12*. Pretoria: Department of Education.
- National Curriculum Statement. 2011. *Curriculum and Assessment Policy Statement Further Education and Training Phase Grades 10-12*. Pretoria: Department of Education.
- National Curriculum Statement. 2011. *National Protocol for Assessment Grades R-12 (NPA)*. Pretoria: Department of Education.
- National Curriculum Statement. 2011. *National Policy pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R-12 (PPR)*. Pretoria: Department of Education
- National Education Policy Act 27 of 1996. Policy Handbook for Educators. The Education Labour Relations Council (ELRC). Printed by Universal Print Group 2003.

- O'Brien. 2011. *Even more brain-powered science: Teaching and learning with discrepant events*.
Arlington: National Science Teachers Association.
- Oxford Advanced Learner's Dictionary of Current English. 2000. Sixth edition. New York:
Oxford University Press.
- Palmer, D. 2007. Teaching science. *Journal of the Australian Science Teachers' Association*
53(1):38-42.
- Ramnarain, U.D. & Modiba, M. 2013. Critical friendship, collaboration and trust as a basis for
self-determined professional development: A case of science teaching. *International
Journal of Science Education*. 35(1):65-85.
- Ratcliffe, M. 1998. Discussing socio-scientific issues in science lessons – pupils' actions and the
teacher's role. *School Science Review*, 79:288.
- Salloum, S. & Abd-El-Khalid, F. 2010. A study of practical-moral knowledge in science teaching.
Case Studies in Physical Science Classrooms. 47(8):929-951.
- Setati, M.C. 2011. English as a Language of Learning and Teaching Science in Rural Secondary
Schools: A study of the Vlakfontein Circuit in Limpopo (Submitted in accordance with the
requirements for the Degree of Doctor of Education in the subject Didactics). Pretoria :
university of South Africa.
- South African Schools Act (SASA) Act 84 of 1996. Province of the Eastern Cape Education:(ECE):
Bhisho.
- Stavy, R. & Tirosh, D. 2000. *How students (mis-)understand science and mathematics*. New York:
Teachers College Press.
- Stone, R. 2007. *Best practices for teaching science*. Thousand Oaks: Corwin Press.
- Teacher Toolkit. 2012. *FET Physical Sciences*. Cape Town: Oxford University Press.

The Education Support Services Trust (ESST) Matriculation Programme. Pasport to Physical Science. 1995. Cape Town: Harrington House, 37 Barrack Street

Thijs, A. & Van den Akker, J. 2009. *Leerplan in ontwikkeling*. Enschede: Stichting leerplanontwikkeling.



Research Ethics Clearance Certificate

This is to certify that the application for ethical clearance submitted by

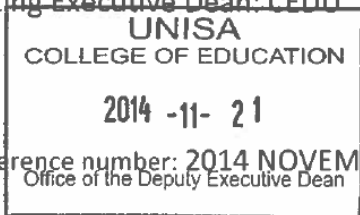
M Koti [06915205]

for a MEd study entitled

**Challenges with implementing the Physical Science Curriculum and Assessment
Policy Statement in selected Eastern Cape schools**

has met the ethical requirements as specified by the University of South Africa
College of Education Research Ethics Committee. This certificate is valid for two
years from the date of issue.

Prof VI McKay
Acting Executive Dean: CEDU



Reference number: 2014 NOVEMBER /06915205/MC

Dr M Claassens
CEDU REC (Chairperson)
mcdtc@netactive.co.za

17 NOVEMBER 2014

Interview Schedule for teachers

M.Ed (Specialising in Curriculum Studies) (97292)

You are cordially requested to respond to the following questions voluntarily (and if you choose not to you will not suffer any penalty) and to the best of your ability so that this research can yield the best result in terms of the findings that it will make. You have been selected to take part in this research because you can provide information that will make it possible for the researcher to prepare a report on the findings of this study that will assist in addressing the questions that this research seeks to answer. Thanking you in advance for your invaluable contribution.

1. How long have you been teaching Physical Sciences?
2. In which grade/s are you teaching Physical Sciences?
3. What are your qualifications for teaching Physical Sciences?
4. How do you perform in terms of producing good results for the learners? What makes you produce good results?
5. If you are not producing good results what causes this? How do you try to mitigate the causes that lead to this poor performance?
6. Do you perform experiments in your school?
7. Is your laboratory well-equipped for you to do your work well? In case of shortages who helps you to purchase the needed equipment?
8. What equipment do you possess in the school which enables you to do your work?
9. Could you please enumerate the problems that you encounter when teaching theory as well as those that you encounter when you teach practical work in Physical Sciences?

10. How do you solve these problems in the theory part of the work as well as those of the practical work?
11. Do you access any assistance from the school managers in your work?
12. What assistance does your District office offer you through the subject advisors?
13. Is the assistance you acquire from the school managers and the subject advisors adequate? If not what do you do about it?
14. Are you satisfied with your work as a science teacher?
15. What more could be done to assist you improve your work?

Thank you for participating in this interview.

Interview Schedule for subject advisors

M.Ed (Specialising in Curriculum Studies) (97292)

You are cordially requested to respond to the following questions voluntarily (and if you choose not to you will not suffer any penalty) and to the best of your ability so that this research can yield the best result in terms of the findings that it will make. You have been selected to take part in this research because you can provide information that will make it possible for the researcher to prepare a report on the findings of this study that will assist in addressing the questions that this research seeks to answer. Thanking you in advance for your invaluable contribution.

1. How long did you teach Physical Sciences in your school?
2. In which grade/s were you teaching Physical Sciences?
3. What are your qualifications for teaching Physical Sciences?
4. How did you perform in terms of producing good results for the learners?
5. If you were not producing good results what caused this? How did you try to mitigate the causes that led to this poor performance?
6. Did you perform experiments for your learners? If not, why? How did you deal with this shortfall?
7. What impact did they have in assisting you to make the learners understand the subject matter?
8. As a subject advisor what are your duties?
9. What challenges have you encountered in your work of assisting teachers?
10. Are you satisfied with the Physical Sciences results of your District?
11. What assistance does the Department of Education give you to improve your work?
12. What do you think should be done more to assist the teachers in their work?

Thanking you for participating in this interview.